UNVEILING THE POTENTIAL OF LEARNING ANALYTICS IN LEARNING DESIGN: THEORETICAL IMPLICATIONS FOR GENERAL EDUCATION

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ABSTRACT
The article seeks to explore the possibilities of learning analytics in the improvement of learning design in general education. Hence, it aims to describe key components of learning analytics and address its advantages and some limitations in education, as well as to depict the most common learning design models. Theoretical analysis helped to reveal how learning analytics can provide teachers with valuable insights into student engagement, progress and learning outcomes. By taking into account students' data on interaction with course materials, teachers can identify areas for improvement, and make data-informed decisions on pedagogical strategies. The implications of the article highlight the most common practices on how learning analytics can be used to evaluate the effectiveness of the learning design, address weaknesses in teaching-learning process, predict course completion rates by identifying student profiles, etc. The theoretical implications allow for presupposing that the synergy of learning analytics and learning design could serve the improvement of the quality of general education.
KEY WORDS: *learning analytics, learning design, general education.*

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Introduction

The significant advancements in information and communication technology during this century have had a profound influence on general education. To ensure the effectiveness of teaching and learning, educators across the world utilise various technological tools to enhance the quality of educational experiences for their students (Kouser, Majid, 2021; Mian et al., 2022). Engagement with learning management systems and involvement in massive open online courses have resulted in the generation of digital data traces by both students and teachers throughout the duration of learning programmes. Digital trace data are assuming an increasingly central role in both informal and formal educational settings (Hakimi et al., 2021). Data are being produced, stored, manipulated and disseminated on an unprecedented scale, and is seen as a mean to improve the quality and efficiency of educational systems. As stated by Kew and Tasir (2022), learning analytics has the potential to be utilised across various research studies in the field of technology, as the data it collects have the capacity to reveal significant insights into student behaviour in online learning environments. A widely used definition of learning analytics in the scientific literature is: 'The collection, analysis, and reporting of data about students and their contexts to understand and optimise learning and the environment in which it occurs' (Siemens, Long, 2011). This is an official definition from the Society for Learning Analytics Research (SoLAR), and emphasises learning analytics' pursuit of using data to comprehensively understand

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and improve educational systems. Generally speaking, learning analytics involves collecting, analysing and interpreting data related to learners and their contexts to optimise learning and the environments in which it occurs. Learning analytics often leverages technology and data-driven approaches to understand various aspects of the learning process, such as student performance, behaviour, engagement levels, preferences and interaction with instructional resources. By applying statistical techniques and data mining algorithms to educational data, educators and institutions can gain insights into the effectiveness of teaching strategies, curriculum design, and learning resources (Aldowah et al., 2019). Learning analytics can also help in identifying at-risk students, personalising instruction, and improving overall learning outcomes (Foster, Siddle, 2020).

However, by providing a summary of data, learning analytics does not provide overall information about the learning process, for example, how the curriculum or content should change (Volungevičienė et al., 2019). Learning analytics is a field that quantifies, assesses and presents data concerning students and their learning environments, aiming to comprehend and enhance the overall learning process (Menéndez et al., 2022). By embracing a data-driven approach, learning analytics contradicts the essence of designing for learning that requires a thoughtful, deliberate and careful process in order to prioritise the needs of learners over commercial considerations (Phillips et al., 2021). Despite the potential of learning analytics, teachers should personally analyse and contemplate learning data, determining how to utilise this information for the purpose of overseeing and enhancing teaching and learning processes, as well as curriculum development. According to Lim and Heggart (2023), to fully exploit the potential of learning analytics and improve its adoption in education, teachers need to develop their understanding of data that can inform about students' learning in learning design. In other words, in order to successfully design teaching and learning, educators need to be informed, but not driven by learning data. This entails the integration of learning analytics into learning design. This integration underscores the role of human decision-making, involving the interpretation of information, making decisions based on the data gathered, and implementing specific actions or interventions accordingly (Dyckhoff et al., 2013).

According to Battou et al. (2016), learning design involves creating learning experiences which make the process of acquiring knowledge and skills more efficient, effective and attractive. In most cases, instructional designers employ and integrate technology and multimedia as tools to improve the efficiency of instruction. In education, instructional design is seen as a framework for developing courses or lessons that increase the engagement and involvement of learners, so that they learn faster and gain a deeper understanding of the course materials.

It involves the strategic planning, development and implementation of teaching-learning materials and activities to facilitate learning (Paniagua, Istance, 2018). Learning design takes into account various factors, such as learning objectives, audience characteristics, teaching-learning methods, assessment strategies and learning technologies. It aims to align these elements coherently to support the desired learning outcomes. Effective learning design considers principles of pedagogy, cognitive science and educational psychology, to engage learners, foster a deeper understanding, and promote knowledge retention (Laurillard, 2013).

Recent research has emphasised the possible relationship between learning analytics and learning design, which lies in their complementary roles in enhancing educational practices (Mangaroska, Giannakos, 2018). Learning analytics can provide valuable insights into learner behaviours, preferences and performance patterns. These insights can inform the design of learning experiences, by enabling educators to tailor instruction to individual needs, adjust curricula to address areas of difficulty, and create adaptive learning pathways that optimise engagement and learning outcomes. After implementing learning design, analytics can be used to evaluate its effectiveness. By analysing data on student performance, interaction with learning materials and other relevant metrics, educators can assess whether the design is achieving its intended objectives. This evaluation can help identify areas for improvement, and inform iterative refinements to the learning design process. However, as stated by the researchers (Mangaroska, Giannakos, 2018), the present landscape at the intersection between learning analytics and learning design is rather theoretical in its nature. Future research should consider developing a framework on how to capture and systematise learning data,

and follow what learning design choices could be made by educators in order to influence subsequent learning activities and performances over time (Mangaroska, Giannakos, 2018). Moreover, the convergence of learning analytics and learning design has not been analysed specifically in the context of general education (Dawson et al., 2019).

Hence, the aim of this article is to unveil the potential of learning analytics within the context of general education, emphasising the identification of synergies that enable the meaningful application of learning analytics across diverse learning scenarios. The primary focus is on extending the theory of learning analytics beyond the analysis of learning process data to incorporate the relevance of learning design models.

Objectives of the article are:

- To explore theoretically the potential of learning analytics in enhancing teaching and learning processes in general education.
- To examine learning design models by scrutinising existing learning design models to better understand their implications for the integration of learning analytics.
- To reveal synergies that enable the meaningful application of learning analytics in learning design in general education.

Methods used: the article employs a theoretical analysis of research resources, aiming to synthesise and critically examine existing literature to contribute valuable insights to the discourse on learning analytics and its potential in enhancing educational practices.

1. The potential of learning analytics in general education

The field of learning analytics as an academic discipline is dedicated to enhancing learning and education through the collection and analysis of educational data gathered from teachers and students. Learning analytics employs predictive models to offer practical insights. Learning analytics encompasses educational data analysis that leads to meaningful insights for teachers and students, and a visualisation of the collected learning data (Gedrimiene et al., 2020). The objective of learning analytics is to customise educational experiences according to each learner's requirements and capabilities, by taking actions such as assisting students at risk or delivering feedback and teaching-learning materials.

The main field of study of learning analytics is learning management systems prepared to perform distance education (Ylimaz, Çakır, 2021). A learning management system is software designed for facilitating distance education, encompassing elements like student profiles, course materials and communication tools (for example, chat environments). Students access these systems through their individual user accounts, allowing for the convenient tracking of each student's activities within the system. A learning management system collects various data points, such as log-in times, assessment scores, resource access, and communication interactions between students and instructors. According to Cao et al. (2020), learning management systems not only ensure the integrity of online learning, but also allow objective assessment and statistical analysis, and the interpretation of the learning process findings.

Learning analytics utilises this data to identify patterns, trends and correlations. It can provide information on which students may be struggling, which content is most effective, and which teaching strategies are working best.

The process of assembling learning analytics consists of four steps (Mougiakou et al., 2022):

- Collecting data: gathering information from the learning process, such as user engagement (number of interactions with a particular learning management system), assessments, activity outcomes, and other feedback gathered from student satisfaction and graduate surveys.
- Analysing data: looking for patterns in the data (for example, student behaviour), examining trends, and identifying correlations between different measurements. This can be done through various data analysis techniques, such as correlation analysis, statistical analysis and machine learning algorithms.

- Reporting data: encompassing a series of procedures aimed at structuring and displaying the outcomes derived from the analysis of learners' data, and learning data through graphic representations (charts, tables). By reporting on learners' and learning data, valuable insights regarding learners' progress throughout the learning process can be achieved. Interpreting these insights facilitates data-driven decision-making, informing subsequent actions.
- Taking action: undertaking informed decisions and the practical interventions based on the analysis of collected data. Follow-up actions determine the success or failure of the analytical process.

These four steps employ learning process data that broadens the horizons of retention tactics, planning the teaching-learning process, and achievement, thus moving from standardised curriculum or levelling by the average to meet the needs of each student in a personalised and data-oriented way.

There are many reasons why learning analytics is used in the education process. Mian et al. (2022, 3) state that learning analytics could be used as a tool to assess teaching quality. The author mentions that with the help of learning analytics, all information related to students could be analysed in order to forecast or monitor the learning process. Learning analytics also operates by offering educational opportunities tailored to students' needs and abilities (Nunn et al., 2016). Mian et al. (2022) also highlight the fact that learning analytics could assist teachers in identifying students at risk. The system of early warnings, derived from online learning settings, enables teachers to identify students at risk of academic failure, and offers assistance to plan, structure and provide actions and initiatives in order to help these students make improvements. Quadri and Shukor (2019), who analysed the benefits of learning analytics, mention that one significant application of learning analytics involves forecasting and monitoring students' academic performance. This offers timely identification of potential problem areas, allowing for immediate corrective measures and interventions to prevent academic failure. Banihashem et al. (2022) suggest that feedback provided from learning analytics enhances students' progress throughout the learning journey. This feedback involves various aspects, such as self-regulation, goal setting, encouragement, techniques and strategies. Commonly defined as the necessity to communicate a student's learning status to various educational stakeholders (including instructors, students and school administrators), feedback in learning analytics serves as a means of improvement and support. All the advantages of learning analytics mentioned basically revolve around personalised learning, early interventions and data informed decision-making in an education context.

Ahmad et al. (2022) point out that widespread interest in learning analytics has made the field very heterogenous. Learning analytics involves a wide range of data sources, analysis techniques and applications, and stakeholders in the educational context. Learning analytics draws data from learning management systems, external bases or online interactions. The data collected may vary in format, structure and granularity. Learning analytics also employs a range of analytical methods (statistical analysis, machine learning, data mining, text mining, and social network analysis) that require specifically strong analytical skills from educators. What is more, the capacity of institutions to access, integrate, analyse and visualise data is always limited by access to qualified staff. As is mentioned by Ahdam et al. (2022), who conducted a detailed analysis of the possible synergies between learning analytics and learning design, one of the biggest issues in the field of learning analytics lies in its lack of alignment with pedagogical and learning models. According to the researchers (Ahmad et al., 2022), a lot of data about the learning process are tracked; however, it remains unclear how to use the resulting datasets to identify relevant indicators that can be used to support the learning process. There is uncertainty among teachers regarding which data to gather and how to utilise it effectively to gain insightful markers of students' advancement in the specific subject area. Authors strongly emphasise the need for well-defined directives on the meaningful implementation of learning analytics across various learning contexts.

Therefore, as proposed by researchers, it is important to analyse the possibilities of learning analytics with respect to teaching and learning processes. One of the possibilities to unveil the potential of learning analytics for teaching and learning lies in the integration of learning analytics and learning design. This integration could offer a strategic approach to address the challenges identified, ensuring a more purposeful and aligned use of data in educational settings.

2. Learning design and learning design models

Learning design refers to the pedagogical approach applied in the process of teaching and learning. According to Battou et al. (2016), learning design has evolved from instructional design, emphasising learning activities as the primary focus of the design process. Learning design takes a broad perspective, and sees learning and teaching design as a dynamic, inclusive and ongoing process that takes into account all stakeholders. It involves organising and structuring learning activities, setting up the learning environment, and engaging stakeholders in activities aimed at achieving specific learning objectives, ultimately resulting in desired learning outcomes (Beetham, Sharpe, 2013; Conole, Fill, 2005; Mor et al., 2013, as cited in Ahmad et al., 2022). Learning design basically refers to deliberate choices about 'what, when, where and how to teach'. Teachers have to make decisions concerning the content, structure, timing, pedagogical strategies, sequence of learning activities and assessment, and the nature of technology used in teaching and learning. The key elements of the learning design involve:

- Learning objectives that identify what a learner should be able to do after single or multiple learning events (Ahmad et al., 2022). A learning objective aims to answer the question: What is it that your students should be able to do at the end of the course/class session that they were not able to do before?
- Learning events that include creation, exploration, practice, imitation, reception, debate, meta-learning or self-reflection, and experimentation (Leclercq, Poumay, 2005 as cited by Ahdam et al., 2022). According to Pappas (2014), creation includes the concept of utilising recently acquired knowledge or skills to generate something new. Exploration centres around students' characteristics. It is important to offer students the chance to explore the topic on their own, and in this way be in control of the learning process. Practice refers to some sort of routine that is accompanied by regular feedback. Specifically in an eLearning course, activities should offer a step-by-step look at a specific process. Imitation involves observation and modelling. Reception refers to the transmission of information through different contexts. Debate focuses primarily on justifying one's opinions or views, along with the capacity to substantiate them with factual information or evidence. Meta-learning or self-reflection pertains to learners' self-reflection and understanding of the concepts taught. Experimentation is connected with the application of knowledge.
- Learning support that is crucial in providing pertinent resources and the fulfilment of learning tasks (Lockyer et al., 2013, as cited in Ahmad et al., 2022). In order to achieve an effective outcome and enhance learning process, it is essential to have an instructor who provides relevant resources, and a set of tools, techniques, and necessary support that includes web links, files, videos, literature, etc (Kwakman, 2003, as cited in Ahmad et al., 2022).
- A learning task is a specific activity or assignment designed to facilitate the acquisition of knowledge, skills or understanding in an educational context. After receiving the necessary assistance, learners are expected to undertake their assigned learning tasks (Conole, Fill, 2005; Lockyer et al., 2013, as cited in Ahmad et al., 2022). The components of a learning task encompass the methodologies employed, associated tools and materials, and the actions specified in the learning activities (Conole, Fill, 2005, as cited in Ahmad et al., 2022).
- Learning outcomes identify knowledge, skills and abilities that individual students should possess and can demonstrate after single or multiple learning experiences. Learning outcomes are realised through a variety of learning activities facilitated by the necessary tools, resources and support (Conole, Fill, 2005, as cited in Ahmad et al., 2022). Consequently, this outcome provides feedback to learners, ultimately enhancing the learning process (Brown et al., 2016, as cited in Ahmad et al., 2022).

Another key element of learning design is learning design models that provide a systematic and efficient approach to learning/instructional design, and ensure alignment with learning objectives (Evanick, 2023). Various learning design models have been developed in the theory of learning/instructional design, namely TPACK (Mishra, Koehler, 2006), ADDIE (Valverde-Berrocoso et al., 2022), 4C/ID (van Merriënboer,

Kirschner, 2018), CAFE (Borup, Archambault, 2022), ELED (Czerkawski, 2016), etc. These and other models are widely analysed in the scientific literature. Here we provide a short overview of some models.

To start with, ADDIE stands out as the most widely acknowledged name among professional learning designers. The elements made by following the ADDIE model stand for Analysis, Design, Development, Implementation and Evaluation (Evanick, 2023). Each phase in the ADDIE model is interconnected and influences each other. According to Aldoobie (2015), in order to carry out the analysis phase, we have to start with learners' analysis (their skills and needs, where they are), which is followed by the developing of instructions analysis (to provide the necessary steps and present opportunities to learn and use new information in an instruction), creating instructional goals (aimed at specifying the desired end result), and analysing learning objectives (how to measure the attainment of goals). This means that an instructor has to be clear about his goals and where he wants his learners to be. The designing phase is about applying the instructions. This evolves and focuses on designing an assessment for (his/her) topic, selecting a form for the course, and creating their personal instructional strategies (Aldoobie, 2015, 69). The development phase, which depends on analysis and design, focuses on the integration of technology with the educational setting and process. This involves visually organising the content and constructing the course within the eLearning tool. It encompasses all aspects of producing the final educational material for the learners (DeBell, 2020). The implementation phase relies on transforming the instructor's plan into action. In order to go through this phase, three major steps, training the instructors, preparing the learners, and organising the learning environment, should be considered. With these steps a course could be displayed in a very active and authentic way (Aldoobie, 2015). Evaluation is the final phase of the ADDIE model. Evaluating each stage of teaching-learning is crucial, to ensure that the learning objectives are effectively achieved and the learning materials are tailored to meet individual learner needs. Evaluation encompasses formative and summative assessment (Aldoobie, 2015).

Bloom's taxonomy is also a widely recognised model of learning design. Bloom's Taxonomy provides teachers with a useful tool for designing learning objectives and assessments that focus on specific cognitive skills. Bloom's taxonomy consists of six phases that align with the desired level of cognitive skill development (Adams, 2015). It serves as a valuable framework to create impactful learning aligned with the desired learning outcomes (Jha, 2023). It achieves this by defining the learning objectives, directing the development of instructional activities and assessments, and fostering cognitive growth in learners. Ultimately, it contributes to meaningful and successful learning outcomes.

One of the most commonly used learning design models is the SAM model (Pappas, 2021). SAM challenges the idea of progressing through a linear process (such as ADDIE), starting from Analysis and ending at Evaluation, as an optimal approach for designing learning events aimed at enhancing performance (Martinez, 2016). The SAM model revolves around an iterative approach, fast swift prototyping, and testing. It proves especially effective scenarios, where course content evolves rapidly, or there is a demand for prompt delivery (Evanick, 2023). SAM is a cyclical process that consists of preparation (gathering all the information and background knowledge relevant to the project), and iterative design (prototyping and evaluating) (Ali et al., 2021). After presenting and testing the prototype, an alpha version is released, and then evolves to a beta version, before finally rolling out the gold version (Jung et al., 2019). This model is particularly suitable for online education, prioritising collaboration among learning designers and learners (Evanick, 2023).

In comparison with well-known learning design models that require extensive knowledge and professional skills of instructional design, the CAFÉ model is recognised as a particularly simple learning design model created to assist K-12 teachers with transforming classroom-based classes into 'emergency remote teaching' (Wang, 2021). The CAFÉ model consists of four elements, including Content, Activities, Facilitation and Evaluation. Content refers to organising instructional content in a systematic way: course level → module level → lesson level → activity level (Wang, 2021). Activities refer to a wide range of learning efforts to help students achieve the desired learning objectives/outcomes. Some commonly used online activities include reflective, productive, synchronous and asynchronous activities. Facilitation revolves around three types of interaction for learning: learner-content interaction, (2) learner-teacher interaction, and (3) learner-

learner interaction. Providing appropriate scaffolding and clear guidance, offering support and resources, and motivating students to engage in these three types of interaction, help students to achieve pre-established learning objectives. Evaluation involves assessing the effectiveness and impact of the learning design and implementation (Wang, 2021). The CAFÉ model was developed to meet the immediate requirements of general educators, operating under the assumption that these educators possess a clear understanding of their students, their learning requirements, the technology and resources available for distance learning, and its instructional content (Wang, 2021).

According to Trif-Boia (2022), in pursuit of enhancing the efficiency of training activities, learning design emerges as one of the viable approaches to address the challenges of modern education. Due to its distinct principles and models, learning design provides ways to tailor training activities to learners' characteristics, making learning more engaging and responsive to the requirements of students/learners. There is no need to strive to devise a single model that accommodates all requirements. It is more important to conscientiously select a model that aligns with the epistemology and learning theories relevant to the context, embracing diversity among learners, and adhering to suggested guidelines. In order to effectively implement any of the learning design models, the teacher must plan his/her piece of design carefully.

3. Searching for synergies between learning analytics and learning design

In general, learning analytics refers to the application of data analytics in learning and teaching process. According to Nguyen et al. (2020), the widely adopted definition of learning analytics refers to the process of using learners' data to optimise learning by offering meaningful information related to learner profiles, learning materials and learning contexts. However, as was stated by Mangaroska and Giannakos (2018), without a contextual interpretation of the data collected with e-learning tools, the capabilities of learning analytics are limited. From this perspective, learning design is important, as it offers a structure for analysing and comprehending learner behaviour and data. It defines educational goals and the pedagogical methods that educators can deliberate on, enabling decisions and enhancements. Additionally, learning design entails documenting the sequence of learning tasks, resources and teaching methods, serving as foundational elements for the reusability and transferability of effective practices across diverse educational settings.

Learning analytics can support learning design in different ways. First of all, learning analytics can evaluate the effectiveness of the learning design, i.e. determine the appropriateness of learning design in teaching (Mian et al., 2022). During the learning design process, teachers strive to grasp their students' needs. Learning analytics can provide evidence to guide educators on the effectiveness of their learning design efforts, including aspects such as student engagement with learning materials, the timing of learning activities, and the pathways followed by students in their learning journey (Iftenhaler, Yau, 2020). For example, students' engagement with course material can be measured by collecting analytics on a number of views. Philips et al. (2021), who analysed learning analytics as a tool for improvement and reflection on instructional design practices, revealed that a type of content students frequently viewed can aid teachers in recognising the most popular content formats. Knowing which struggling students are most active helps teachers seek an insight as to the type of content that captures students' interest more effectively and seek student feedback on the content (Philips et al., 2021).

An effective online course should facilitate both student-student and student-teacher interactions (Johar et al., 2022). Consequently, features such as online discussion boards and chatting are becoming essential components of any online course. Learning analytics, particularly metrics related to the number of comments, can provide instructors with valuable insights into the level of student interaction within the course. Shukor and Abdullah (2019) revealed that the inclusion of online discussion features significantly impacts students' satisfaction with the course.

Another known use of learning analytics addresses student profiling (Barthakur et al., 2023). The purpose of user profiling is to provide individuals or student groups with tailored and personalised learning experiences in order to optimise learning. In education, learning analytics techniques, such as classification and

clustering, are frequently used to classify (or profile) students based on their interaction with various learning management systems. This interaction includes the most highlighted passages in written texts, browsing history for predicting likely-to-visit websites, completing assignments or quizzes, submitting projects or essays, engaging with multimedia content (e.g. videos, simulations), communicating with peers or instructors through messaging or video conferencing tools, and approaching supplementary resources or readings. According to Bienkowski et al. (2012), this data could be employed to categorise new learners, aiming basically to offer adaptive interaction assistance on identifying behaviours that hinder learning, or to understand methods for supporting engaged behaviour. Classification can also assemble students into small learning communities or other collaborative learning experiences.

Learning analytics parameters are also used to predict students' completion rate at the end of the course (Shukor, Abdullah, 2019). In research conducted by Murray et al. (2012), data on the frequency of students accessing online learning materials revealed a significant correlation between academic achievement and students' interaction with course materials. Specifically, students who used a variety of resources had a higher chance of achieving success in the course (Murray et al., 2012).

Learning analytics can also help teachers to identify and address weaknesses in learning design and implementation. Learning analytics provides real-time insights into the learner activity and experience, assisting an instructor in making suggestions to students that will help them succeed (Mougiakou et al., 2022). By monitoring student activity and performance over a course, learning analytics can guide instructors to identify students who are at risk and offer interventions, facilitate moderations in teaching methods, and enable students to have an awareness of their own learning.

Fig. 1 provides a theoretical approach to the integration of learning analytics and learning design models. We use the CAFÉ model as an example to show the synergies that enable the meaningful application of learning analytics in learning design.

The CAFÉ learning design model

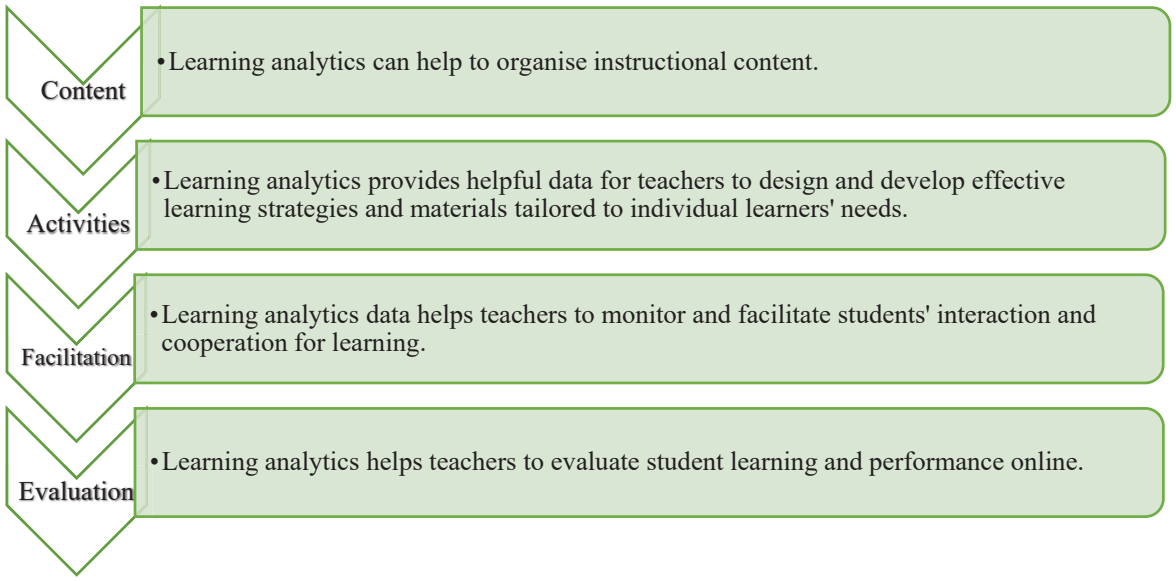

Figure 1. Synergies that enable the meaningful application of learning analytics in learning design within general education according to the example of the CAFÉ model

Source: The authors.

The CAFÉ model supports iterative content design processes, where teaching-learning activities are continuously refined based on ongoing evaluation and feedback. Learning analytics facilitates continuous improvement, by providing data-driven insights into the effectiveness of teaching-learning interventions. Teachers can use learning analytics to monitor trends over time, assess the impact of changes on teaching-learning design, and identify opportunities for further refinement. By leveraging analytics to inform iterative design cycles, teachers can continuously enhance the quality and effectiveness of their teaching-learning materials and strategies.

CAFÉ emphasises the importance of tailoring learning experiences to individual learners' needs and preferences. It promotes flexible learning pathways that accommodate diverse learning styles and paces. Learning analytics provides insights into learners' behaviours, preferences and performance. By analysing this data, educators can personalise learning paths for each student, ensuring that teaching-learning activities are aligned with their specific needs and abilities. For example, analytics can inform adaptive learning systems to deliver content tailored to each learner's proficiency level and learning style.

The CAFÉ model allows teachers to identify areas where learners may be struggling or experiencing difficulty. Learning analytics can help pinpoint specific learning gaps or challenges that students are facing. By analysing data on student performance and interactions, teachers can identify intervention points and provide targeted support to help students overcome obstacles and achieve their learning goals. For example, learning analytics can highlight common misconceptions or areas of weakness, prompting instructors to provide remediation or additional practice opportunities.

The CAFÉ model allows for ongoing evaluation and the refinement of teaching-learning activities, based on feedback from learners and teachers. Learning analytics enables real-time monitoring of learners' progress and engagement. Teachers can use this data to provide timely feedback to students, adapt teaching-learning strategies, and address learning gaps as they emerge. For instance, if learning analytics reveals that a significant number of students are struggling with a particular concept, teachers can modify their teaching approach or provide additional resources to support comprehension.

The CAFÉ model encourages teachers to base their teaching-learning design decisions on pedagogical principles and empirical evidence. Learning analytics provides empirical evidence about the effectiveness of different teaching-learning approaches. Teachers can use analytics to evaluate the impact of various teaching methods, technologies and resources on student learning outcomes. This data-driven approach enables teachers to make informed decisions about which strategies are most effective, and how to optimise their teaching-learning design.

The synergy between learning analytics and learning/instructional design revolves around the collaborative relationship between the analysis of learning data and the process of designing effective learning experiences. As stated by Macfadyen et al. (2020), learning analytics could improve learning design by switching the focus from design principles to begin evaluating 'what happens next' in learning. In return, learning design offers educators a pedagogical framework that helps ensuring learning data are appropriate and relevant in a contemporary context. Learning analytics provides educators with valuable insights into learners' behaviour, illustrates their progress or engagement and interaction with course materials and activities, and identifies areas for improvement. These insights can inform the design of learning experiences by assisting educators in identifying areas for improvement, personalising instruction, and curating the content of the curriculum. Otherwise, learning design principles guide the collection and interpretation of learning analytics data, ensuring that insights are used effectively to enhance the design and delivery of educational experiences. Moreover, as is stated by Macfadyen et al. (2020), learning design enriches the field of learning analytics with a domain vocabulary and a more thorough theoretical grounding (Hernández-Leo et al., 2019).

Implications

The purpose of this article was to describe the synergy between learning analytics and learning design. To do so, it was important to reveal features of the analysis of learners' data, and the main principles, practices and models of learning design.

The analysis of scientific literature revealed that learning data mining and analytics are rapidly becoming a common notion in education, and play a crucial role in enhancing the effectiveness and efficiency of e-learning platforms. Learning analytics focuses on data related to learners' interactions with course content, other students, and teachers; however, learning analytics alone is not sufficient to predict or modify learning.

Learning design is the framework that supports learning experiences. Learning design refers to deliberate choices about 'what, when, where and how to teach'. It is frequently employed in technology-enhanced classes, since it helps educators organise and structure content in a way that maximises online learning efficiency. Learning design models can vary in their specific processes and approaches; however, they typically share several common elements, such as gathering information about learners and their needs, developing a plan for achieving instructional goals, creating teaching-learning materials and resources, and assessing the effectiveness of the instruction in achieving its goals.

Learning analytics can support instructional design by providing educators with data-driven insights into student learning behaviour and performance, informing decisions about course content selection, instructional strategies and assessment practices, and enabling the continuous improvement of learning experiences. The research has indicated the importance of developing a framework for capturing and systematising learning design data, as well as understanding how teachers' choices in learning design influence subsequent learning activities and outcomes over time. In the case of general education, the integration of learning analytics into the CAFÉ learning design model could serve as an illustration of such synergies.

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MOKYMOSI ANALITIKOS GALIMYBIŲ ATSKLEIDIMAS PLANUOJANT MOKYMOSI PROCESĄ: TEORINĖS PRIELAIDOS BENDROJO UGDYMO KONSTEKSTE

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Santrauka

Straipsnyje siekiama aptarti *mokymosi analitikos* sampratą ir apibūdinti pagrindinius jos komponentus, jų pranašumus bei kai kuriuos apribojimus ugdymo procese. Straipsnyje aprašyti dažniausiai pasitaikantys mokymosi projektavimo modeliai.

Sparti informacinių technologijų pažanga labiausiai paveikė švietimo sektorių. Siekdami užtikrinti ugdymo proceso efektyvumą pedagogai visame pasaulyje naudoja įvairias skaitmenines platformas ar programas, kurios gali praturtinti ugdytinių mokymosi patirtį ir atliepti šiuolaikinio ugdymo, pagrįsto technologijomis, tikslus. Sąveikaudami su įvairiomis skaitmeninėmis platformomis ir elektroninėmis mokymosi valdymo sistemomis tiek pedagogai, tiek ugdytiniai sukuria didžiulį skaitmeninių duomenų srautą. Šie duomenys, kurių kiekis įgauna beprecedentį mastą, laikomi viena pagrindinių švietimo sistemos kokybę ir efektyvumą užtikrinančių priemonių. Šiame kontekste ypač svarbia tampa mokymosi analitika, nes surinkti duomenys atskleidžia reikšmingas įžvalgas apie ugdytinių mokymąsi virtualiose ugdymo aplinkose.

Mokslinėje literatūroje mokymosi analitika apibrėžiama, kaip duomenų apie mokinius rinkimas, jų analizė ir jos grafinis atvaizdavimas, siekiant suprasti bei optimizuoti mokymąsi ir aplinką, kurioje jis vyksta. Analizuojant mokymosi analitiką pabrėžiamas siekis tikslingai naudoti ugdymo proceso duomenis, orientuojantis į švietimo sistemos tobulinimą. Pateikdama duomenų sąvadą mokymosi analitika nesuteikia informacijos apie patį mokymosi procesą ar tai, kaip jis turėtų keistis. Ji kiekybiškai įvertina ir pateikia duomenis apie ugdytinių mokymąsi, o pedagogai patys turi nuspręsti, kur ir kaip šiuos duomenis naudos. Čia ir atsiskleidžia poreikis mokymosi analitiką integruoti į mokymosi projektavimo procesą. Ši integracija pabrėžia žmogiškąjį veiksnį, tai apima informacijos interpretavimą, objektyvius ugdymo proceso duomenis, pagrįstus į ugdymo proceso kūrimą ir tobulinimą nukreiptus sprendimus.

Mokymosi projektavimas apima mokymosi veiklos organizavimą ir struktūravimą, mokymosi aplinkos kūrimą ir ugdymo proceso dalyvių įtraukimą į veiklą, kuria siekiama konkrečių mokymosi tikslų. Mokymosi dizainas iš esmės reiškia sąmoningą pasirinkimą, ką, kada, kur ir kaip mokyti. Mokytojai turi priimti sprendimus dėl ugdymo turinio, struktūros, laiko, pedagoginių strategijų, mokymosi veiklų ir vertinimo sekos bei mokymo ir mokymosi technologijų pobūdžio. Taikomi principai ir įvairūs modeliai (pvz. ADDIE modelis, SAM modelis, Bloom'o taksonomija, CAFÉ modelis) leidžia mokymą projektuojantiems pedagogams pritaikyti mokymo veiklą besimokančiojo poreikiams, taip siekiant mokymosi patrauklumo ir atitikimo besimokančiųjų poreikiams.

Mokymosi analitikos ir mokymosi projektavimo sinergija apima mokymosi duomenų analizę ir veiksmingos mokymosi patirties kūrimo procesą. Mokymosi analizė suteikia pedagogams vertingų įžvalgų apie besimokančiųjų elgesį, iliustruoja jų pažangą arba įsitraukimą ir sąveiką su mokymosi proceso medžiaga bei nustato tobulintinas pasirinktų pedagoginių strategijų sritis. Šios įžvalgos gali padėti pedagogams kaupti efektyvias mokymosi patirtis, individualizuoti mokymą ir tikslingai koreguoti ugdymo programų turinį. Mokymosi projektavimo principai siejasi su mokymosi analizės duomenų interpretavimu. Tai leidžia užtikrinti, kad ugdymo procese surinkti duomenys bus veiksmingai naudojami tobulinant mokymosi patirties perteikimą besimokantiesiems. Be to, mokymosi analitikos ir mokymosi projektavimo integracija leidžia pedagogams kurti efektyvesnes ugdymo proceso aplinkas, kurios užtikrina sėkmingą ugdytinių mokymąsi.

PAGRINDINIAI ŽODŽIAI: *mokymosi analitika, mokymosi projektavimas, bendrasis ugdymas.*

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