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Learning Design and Learning Analytics: Snapshot 2020

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"Learning design" belongs to that interesting class of concepts that appear on the surface to be simple and self-explanatory, but which are actually definitionally vague and contested in practice. Like "learning analytics," the field of learning design aspires to improve teaching practice, the learning experience, and learning outcomes. And like learning analytics, this interdisciplinary field also lacks a shared language, common vocabulary, or agreement over its definition and purpose, resulting in uncertainty even about who its practitioners are — Educators? Designers? Researchers? All of these? (Law, Li, Farias Herrera, Chan & Pong, 2017). Almost a decade ago, however, learning analytics researchers pointed to the rich potential for synergies between learning analytics and learning design (Lockyer & Dawson, 2011). These authors (and others since, as cited below) argued that effective alignment of learning analytics and learning design would benefit both fields, and would offer educators and investigators the evidence they need that their efforts and innovations in learning design are "worth it" in terms of improving teaching practice and learning:

> *The integration of research related to both learning design and learning analytics provides the necessary contextual overlay to better understand observed student behavior and provide the necessary pedagogical recommendations where learning behavior deviates from pedagogical intention* (Lockyer & Dawson, 2011, p. 155).

Learning Design: Noun or Verb?

Confusingly, learning design is sometimes presented as a product, and at other times as a practice or process, with the origins of each mode traced to different drivers. One narrative asserts that the notion of "learning design" (as a noun) emerged in the early 2000s, in response to increasing pressure on educational institutions to develop shareable, scalable documentations of "best educational practice." Such shareable documentations, it was theorized, would help institutions meet the needs of increasing numbers of increasingly diverse learners, improve institutional teaching quality and meet national demands for institutional accountability (Lockyer & Dawson, 2011). This perspective presents learning designs (sometimes referred to as *learning patterns*, *pedagogical patterns*, or *design for learning*) as "representations of teaching practice" — "the documented design and sequencing of teaching practice, and how together these may serve to improve understanding and evaluation of teaching intent and learner activity" (Lockyer, Heathcote, & Dawson, 2013, p. 1). As Persico and Pozzi (2015) have extensively documented, tools and systems designed to help educators *create* learning designs (that is, representational frameworks of outcomes, activities, and assessment) have by this time proliferated, as have repositories of shareable learning designs (see also Law et al., 2017; Rienties, Nguyen, Holmes, & Reedy, 2017).

The emergence of learning design as a *practice,* on the other hand, is often connected by learning theorists to increasing interest in and commitment to socio-constructivist pedagogy (often mediated by technology; Mangaroska & Giannakos, 2019). These scholars present the *practice* of learning design as a divergence from the older, established practice of "instructional design" (Persico & Pozzi, 2015). While instructional design tended to focus (it is argued) on development of systematic educator-centric approaches to teaching towards achievement learning goals (Reiser & Dempsey, 2007; Schott & Seel, 2015; Seel, Lehmann, Blumschein, & Podolskiy, 2017), proponents of learning design argue that it is by contrast learner-centred (Gagnon & Collay, 2005), and focuses on "what the *learners* do" (Mor, Craft, & Maina, 2015; Seel et al., 2017). From this perspective, learning design is viewed as wholistic and process-oriented: "a grounded rigorous creative process of perpetual educational innovation: grounded in a well-defined concrete context of practice, rigorous in its attention to scientific evidence and pedagogical theory, and creative in its approach to generating new solutions to educational challenges" (Mor & Craft, 2012, p. 93).

These twin origin stories that appear to have brought different notions of learning design into existence muddy the definitional waters. Happily, Mangaroska and Giannakos (2019) go some way towards resolving this confusion by embracing

Koper's (2006) definition of learning design, which can encompass both product and practice: "the description of the teaching–learning process that takes place in a unit of learning (e.g., a course, a lesson or any other designed learning event)" (p. 14).

Other challenges to realizing the potential benefits of learning design nonetheless persist. Recent commentators note that, thus far, the field of learning design has struggled to develop models, frameworks, or guidance that are sensitive to and relevant for diverse disciplines and learning contexts (Corrin et al., 2016). Limited work has been undertaken to evaluate the effectiveness of various learning designs (Hernández-Leo, Martinez-Maldonado, Pardo, Muñoz-Cristóbal, & Rodríguez-Triana, 2019), and there is limited published research offering evidence of impact of learning design on learner outcomes or satisfaction (Schmitz, Van Limbeek, Greller, Sloep, & Drachsler, 2017). While learning design repositories have multiplied, they are often not well used (Persico & Pozzi, 2015). For all these reasons, there is a pressing need to involve and support educators, as core learning design practitioners, more firmly in the community responsible for developing, testing, and interpreting impacts of learning designs (Bakharia et al., 2016; Schmitz et al., 2017). It is recognized, however, that our empirical understanding of educator design practice is still in its infancy, and further research will go some way towards establishing learning design and, more specifically, the concept of educator as designer, as a platform for effective, sustainable, technology-enhanced learning in higher education (Bennett, Lockyer, & Agostinho, 2018).

Learning Design and Learning Analytics

Lockyer and Dawson (2011) presciently proposed that learning analytics literally take up where learning design leaves off. Learning analytics, it is argued, can help learning design research move beyond its current heavy focus on design principles, and begin to evaluate "what happens next," lending greater rigour and credibility to the field (Persico & Pozzi, 2015): Which learning design decisions actually stimulate productive learning experiences? Which learning analytics actually generate actionable insights for educators? (Mangaroska & Giannakos, 2019). Others have noted that learning analytics offer the necessary on-demand indicators for evidence-based learning design decisions (including learning design interventions during "course run time"), offer the potential to increase learning outcomes and learner satisfaction, and may offer new and meaningful ways of sharing learning design knowledge and involving learners in learning (re)design (Schmitz et al., 2017).

In return, learning design offers the field of learning analytics a domain vocabulary and a more thorough and much-needed theoretical grounding (Hernández-Leo et al., 2019). Law et al. (2017) and others have argued that, to date, insufficient attention to learning theory and learning design in the development and implementation of learning analytics has hampered effective and successful application (Gašević, Dawson, Rogers, & Gasevic, 2016; Gašević, Dawson, & Siemens, 2015; Knight, Buckingham Shum, & Littleton, 2013; Koh, Shibani, Tan, & Hong, 2016; Stewart, 2017; Wise, 2014). Learning design, it is proposed, offers educators and designers an interpretive pedagogical framework to guide learning analytics application and data gathering, and ensure that learning analytics are appropriate and relevant in a given learning context.

Progress at the Interface

Where are we now? What progress has been made in discovering whether and how learning analytics might usefully inform learning design decisions? Have we reached a better understanding of how learning design could or should influence learning analytics integration and use? Are there frameworks or principles that best illuminate connections between learning analytics and learning design?

While evidence of how learners respond to different learning designs is still limited, several recent studies have offered the first large-scale confirmation that learning design significantly influences learner engagement and academic outcomes. Rienties and Toetenel (2016) examined the activity of 111,256 students in 151 courses at The Open University in the United Kingdom using multiple regression models, and found that learning design choices strongly predicted virtual learning environment (VLE) behaviour, satisfaction, and performance of students. In particular, learning activities coded as "communication" (i.e., student to student, educator to student, student to educator) significantly predicted VLE engagement and academic retention over time. Follow-up fine-grained analyses of weekly engagement within 38 courses found that 69% of engagement by students was primarily predicted by *how* educators were designing their respective courses (Nguyen, Rienties, Toetenel, Ferguson, & Whitelock, 2017). In a US study, Fritz (2016) similarly identified strong correlations between implementation of a learning management system (LMS)-based course design elements and learner engagement and outcomes.

In their 2019 systematic review, Mangaroska and Giannakos nonetheless identify a range of persistent gaps in the research on learning design and learning analytics. Few published studies offer course- or learning-design metadata that would allow clear mapping of learning analytics to learning design. Rigorous evidence for effective learning designs is lacking, and there is an urgent need to consider context and theory to avoid misinterpretation of analytics. Many learning analytics implementations are trammelled by use of data from a single system or platform, and implementation of multimodal learning analytics is not widespread. There remains a critical need to involve educators in learning analytics and learning design research

and practice, and the learning analytics provided are often misaligned with real educator concerns; at the same time, educators need guidance in how to make best use of learning analytics for learning design. Importantly, Mangaroska and Giannakos (2019) emphasize that longitudinal and comparative studies in a wide range of educational contexts are needed for further maturation of the fields of learning analytics and learning design.

In recent studies, a number of researchers have proposed frameworks designed to connect learning analytics and learning design and guide educator practice (Bakharia et al., 2016; Donald, Blumenstein, McDonald, Milne, & Gunn, 2016; Hernández-Leo et al., 2019; Schmitz et al., 2017; Wise & Vytasek, 2017). While these frameworks emphasize the potentially valuable connections between learning analytics and learning design, Corrin, Law, Ringtved, and Milligan (2018) note that they are generally described at such a high descriptive level that meaningful operationalization is difficult. Mangaroska and Giannakos (2019) reinforce Law et al.'s (2017) proposition that a shared language and framework for learning design (and, arguably, learning analytics) could more effectively guide operationalization, and stress that:

> *future research should consider developing a framework on how to capture and systematize learning design data grounded in learning analytics and learning theory* (p. 531).

Snapshot 2020

Building on Mangaroska and Giannakos' (2019) recommendations, and to keep our finger on the pulse of developments at the intersection of learning analytics and learning design, we invited submissions to this special section that might:

- Offer conceptual frameworks that connect learning design and learning analytics, bridge the gap between theory and practice, and/or offer guidance in use, interpretation of and reflection on learning analytics for refinement and redesign of learning activities.
- Detail examples or use cases in which learning design changes (design of learning environments, choice of pedagogical approach, just-in-time adaptation of design while teaching) driven or informed by learning analytics are positively (or negatively) influencing learning or the learner experience.
- Explore how educators plan, implement, and evaluate learning designs, and how they might take greater advantage of learning analytics to do so (and vice versa).
- Trace how progress and insights in the field of learning analytics is contributing to learning design decisions and experiences.
- Investigate effective interpretations of learning analytics to offer insights into learning processes that can be theoretically grounded in ways that inform theory and learning design.
- Explore ways in which educators may effectively share learning design decisions with learners, or collaborate with learners in learning design.
- Consider whether and how learning analytics might contribute to personalization and flexibility vs. scalability and standardization of learning design.
- Track the impact of learning analytics-informed learning design over time.

Reflecting increased activity in this area of work, we received 22 submissions, of which six (one review and five research papers) completed peer review. Together, they provide a rich, albeit incomplete, snapshot of ongoing work in this arena.

In **"Synergies of Learning Analytics and Learning Design: A Systematic Review of Student Outcomes,"** author Marion Blumenstein responds to the call for greater "evidence of impact on learning" (both of learning analytics and of learning design). Her systematic review and meta-analysis gather and illuminate a set of 38 studies published between 2011 and 2019 that employed learning analytics to measure learning gain and enhance learning design. Blumenstein reports large positive effects on learning outcomes in learning designs that foster socio-collaborative and independent learning skills, and proposes a new Learning Analytics Learning Gain Design (LALGD) model that could support educators, learning designers, and curriculum managers in making sense of the complex relationships that exist between data and learning design.

Lockyer et al. (2013) were the first (to our knowledge) to propose a coherent framework that might help educators and designers align learning analytics with learning design, but few examples exist in the literature to date to demonstrate the use of this framework in practice. Rogers Kaliisa, Anders Kluge, and Anders I. Mørch help to fill that gap with their paper **"Combining Checkpoint and Process Learning Analytics to Support Learning Design Decisions in Blended Learning Environments."** Their paper offers a detailed use case of the Lockyer et al. (2013) framework of checkpoint and process analytics applied here to support learning design decisions made by educators in a blended learning context. They conclude, first, that their case study confirms the value and utility of this framework. Second, and perhaps more importantly, their study emphasizes the critical importance — already flagged by others (see, for example, Bakharia et al., 2016) — of centring and collaborating with educators in such undertakings. Teachers in this study, for example, requested clearer visualizations of learner data that "hide unnecessary complexity" but that still allow them to lead the interpretation of data about their learners.

Authors Alia Lancaster, Scott Moses, Martyn Clark, and Megan Masters kick the tires of another "learning analytics for learning design" framework put forward in the literature to facilitate intentional and systematic use of learning-related, system-level data in design for learning. In **"The Positive Impact of Deliberate Writing Course Design on Student Learning Experience and Performance,"** these authors describe how they embraced principles (comparison, coordination) drawn from Wise and Vytasek's (2017) "learning analytics implementation" (LAI) framework to investigate how and whether learning design influenced learner behaviour patterns and learning outcomes in an LMS-hosted course. They analyzed and visualized LMS metrics and learner outcomes from five sections of the same online course, taught by five different instructors, and identified key learner activity metrics that correlated with learning outcomes. Since each instructor was free to make their own learning design decisions in relation to course content, this study offers an example of instructor-led design choices that led directly to different learning outcomes, and raises questions for instructors and for administrators. If we can observe data that clearly connects design with learning outcomes, how can we use that evidence to guide design and ensure that the learner experience is consistent across instructors and courses within a program?

Given the growing evidence that learning design decisions impact both learner behaviours and achievement, what do we know about the factors influencing how educators actually "do" learning design? What do they *think* they are doing? In **"A Mixed-Method Study into How Instructors Design for Learning in Online and Distance Education"** authors Quan Nguyen, Bart Rienties, and Denise Whitelock shine a bright light on the ongoing complexities and confusions of learning design as an educator-led practice within educational institutions. These authors carried out semi-structured interviews with instructors to investigate their learning design choices, and also used network analysis and taxonomical analysis (using a learning design taxonomy; Conole, 2012) to investigate instructors' actual learning designs. Methodologically, this study extends and confirms the utility of network analysis as a tool for comparative analysis of learning designs. Moreover, this study revealed some significant discrepancies between educators' pedagogical beliefs and intentions, and their actual implementations of learning design in practice. Most of their learning designs were dominated by assimilative, productive, and assessment activities, while communication and experiential learning activities were limited. The authors also report that an array of factors "beyond instructor intentions" influenced learning design choices, including institutional policy, and learner and educator pushback relating to workload. Such qualitative exploration of real institutional contexts and pressures offer valuable insights in relation to efforts to consolidate and develop learning design practice and community, and again emphasizes the need to actively gather educator "voices," and engage them in the development of learning analytics for learning design.

In **"Multimodal Learning Analytics to Inform Learning Design: Lessons Learned from Computing Education,"** authors Katerina Mangaroska, Kshitij Sharma, Dragan Gašević, and Michalis Giannakos remind us that in our ongoing work in this arena we must nonetheless continue to pursue learning analytics that are "consequential for learning," rather than those that are "easy and convenient to collect." In their contribution to this special section, these authors describe their efforts to make use of multimodal learning analytics (MMLA) to investigate both learner cognitive processes and learner affective states, in a selected set of programming activities in a face-to-face computer science class. They made use of eye-tracking data, physiological (arousal) data from a wristband sensor, video data capturing facial expressions, and log data from the online design environment, and argue that their findings suggest that learner behaviour captured by multimodal data provides additional understanding of performance. "To optimize learning and make accurate changes in the learning design," they remind us, "we need to understand how and when students learn best." This is not yet settled science.

Finally, authors Nancy Law and Leming Liang also address the call by Mangaroska and Giannakos (2019) and others for usable frameworks that meaningfully integrate learning theory and learning analytics with learning design. In **"A Multilevel Framework and Method for Learning Analytics Integrated Learning Design,"** these authors again emphasize the need for partnership with educators, and outline and apply a new framework for "learning analytics integrated learning design" that extends Law et al.'s (2017) pattern language-inspired learning design taxonomy and design tool. This new framework, they explain, is multilevel, to match the multilevel nature of learning design; it offers explicit connections and guidance for decisions at the different levels of learning design; it integrates a learning analytics taxonomy into the learning design framework; it offers a means of documenting design decisions that can be shared and customized; and it stands as procedural guide to help educators focus on core pedagogical decisions. While they illustrate the potential of this new framework by applying it to a previously documented learning design from an authentic STEM curriculum unit, they also note that their framework is complex and will not be easily adopted by educators until it is meaningfully realized on a user-friendly technology platform. This appears to be valuable work in progress.

Conclusion

In the past ten years, tremendous progress has been made in the conceptualization, theorization, and empirical embedding of

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learning design and learning analytics. The aim of this special section is to contribute to and help extend this work. While the six contributions substantially push the boundaries of our understandings of the complex interactions between learning design and learning analytics, we feel that several important areas of investigation require greater attention in the coming years.

First, we need more in-depth and sophisticated studies that demonstrate which learning design decisions, informed by appropriate learning analytics approaches, positively influence both learning behaviours and the learning experience. Being able to map and identify how educators are making learning design decisions, and how students are reacting to these decisions, is important. We see a continuing need, however, for evidence-based studies that can illuminate just how intervening in those learning design decisions can positively or negatively influence learners. Studies of this kind will allow the research community to make a stronger case that mapping learning design activities really matters to our learners.

Second, an inherent assumption of many learning design and learning analytics approaches assume that we can talk about "the" learner and "the" educator. This seems overly simplistic in today's diverse and increasingly mixed learning contexts, where designing effective learning experiences for "the average learner" will probably not work for most. Given the potential power of learning design supported by learning analytics, there is an urgent need for researchers to explore how personalization and flexibility of learning design might help to support our diverse learners and diverse educators. This may mean that we have to ask some challenging questions that recognize the complexity of who is learning, who is teaching, and how those interactions unfold. For whom am I designing this learning activity? Who will be teaching or facilitating this activity? For which learners might this learning activity be more/less suited? How could learning analytics tools provide a flexible learning path for all learners and allow differences in how educators approach teaching?

Third, we need further research on educator design practices, particularly as they engage with learning analytics and other kinds of teaching and learning evidence. Understanding how educators make design decisions will help us develop better ways to support them in their design work, create an integrated environment of learning and teaching design, delivery and analytic systems, and foster institutional design climates.

Finally, while many studies of learning design and learning analytics, including some in this special issue, recognize the importance of time, few provide appropriate theoretical, conceptual, and empirical solutions to the challenge of designing the "right" learning activity at the right time for our diverse learners. Preliminary work by Nguyen, Huptych, and Rienties (2018) has highlighted that while most learners tend to follow the schedule of learning activities designed by educators, many do not, and often revisit learning activities at different points in time. Such findings suggest, we believe, that there is a need to fine-tune not only our methodological approaches to collection and analysis of learning design and learning analytics data, but to also consider how we can make sense of "timing" decisions in the learning experience in a theoretically meaningful manner.

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