UNLEASHING LEARNING ANALYTICS

Through Instructional Design

Author:
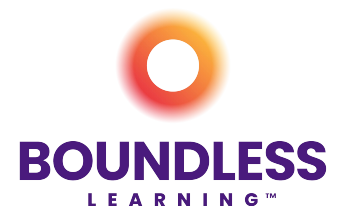**Jay K. Sloan-Lynch**
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Through Instructional Design

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The use of learning analytics dashboards (LADs) has proliferated in recent years; however, studies consistently report persistent and significant challenges with educators' ability to turn the information presented in these dashboards into learning theory-informed action. This white paper describes our team's approach to making learning analytics dashboards more effective and useful by tapping an underutilized resource; instructional designers. The aims of this paper are twofold: (a) share the steps, challenges, and lessons learned from an ongoing design-based research collaboration between educational data scientists, faculty, and instructional designers to develop a Course Revision Dashboard, and (b) reflect on the early feedback from instructional designers and faculty on the impact this project has had on their course design process. Our experience suggests that empowering instructional designers as learning analytics liaisons can be an effective strategy for optimizing learning analytics tools, supporting faculty adoption of LADs, and driving learning theory-informed changes to course design.

INTRODUCTION

Widespread adoption of educational software and the rapid growth of online learning has generated rich and expansive datasets of learner activity and performance. In response to this increasing data availability, higher education institutions have increasingly sought opportunities to utilize this data to improve the quality of teaching and learning. Baker has suggested that perhaps the biggest challenge facing education today is how to effectively access, analyze, and translate large reservoirs of educational data into actions that demonstrably support administrators, faculty, and learners.[1] The field of Learning Analytics (LA) has grown in response to this demand, and it focuses on developing tools and processes to effectively measure, collect, analyze, and report on educational data to better understand and optimize student learning and the environments in which it occurs.[2]

Perhaps the most ubiquitous example of learning analytics tools within higher education is the increasing use of learning analytics dashboards (LADs). Many authors have extolled the potential benefits of LADs in education[3], highlighting their ability to provide educators with insights into student behavior and performance that can drive data-informed changes intended to improve student outcomes and course design.[4] However, studies reviewing the impact of LADs in education have found that instructors and administrators consistently struggle to make productive use of learning analytics dashboards.

Commonly cited reasons for this struggle include the steep learning curve of adopting data-informed decision making, the challenge of integrating LADs into existing instructor workflows, concerns with instructor role expansion and training, lack of instructor backgrounds in the learning sciences, and the failure to consider instructor perspectives and needs during the dashboard development process.[5,6] Failure to address these challenges with LADS often results in low levels of faculty adoption and poor decision making.[7]

In this paper, we describe the **Learning Design Solutions (LDS)** team's efforts to design learning analytics dashboards that address these frequently reported challenges with LAD adoption and use. Specifically, we share the LDS team's novel approach to making learning analytics more effective by tapping an underutilized resource—instructional designers. The LDS team has found that enlisting instructional designers as learning analytics liaisons, who are able to bridge the gap between educational data scientists and faculty during the learning analytics design and implementation process, is a powerful strategy for realizing the potential of learning analytics tools and driving learning theory-informed changes. By sharing our experience designing learning analytics dashboards with our educational partners, and highlighting the lessons we've learned, we hope that others may replicate our success and there is a growing appreciation for the important role instructional designers can play in realizing the promise of learning analytics in higher education.

Enlisting instructional designers as learning analytics liaisons is a powerful strategy for realizing the potential of learning analytics tools and driving learning theory-informed change.

1 Baker, R. S. (2015). *Big data and education* (2nd ed.). Teachers College, Columbia University.

2 Lang, C., Siemens, G., Wise, A., & Gasevic, D. (2017). *Handbook of learning analytics*. SOLAR, Society for Learning Analytics and Research.

3 Park, Y., & Jo, I.-H. (2015). Development of the learning analytics dashboard to support students' learning performance. *J. UCS*, 21, 110–133.

4 Ginda, M., Richey, M. C., Cousino, M., & Börner, K. (2019). Visualizing learner engagement, performance, and trajectories to evaluate and optimize online course design. PloS One, 14(5).
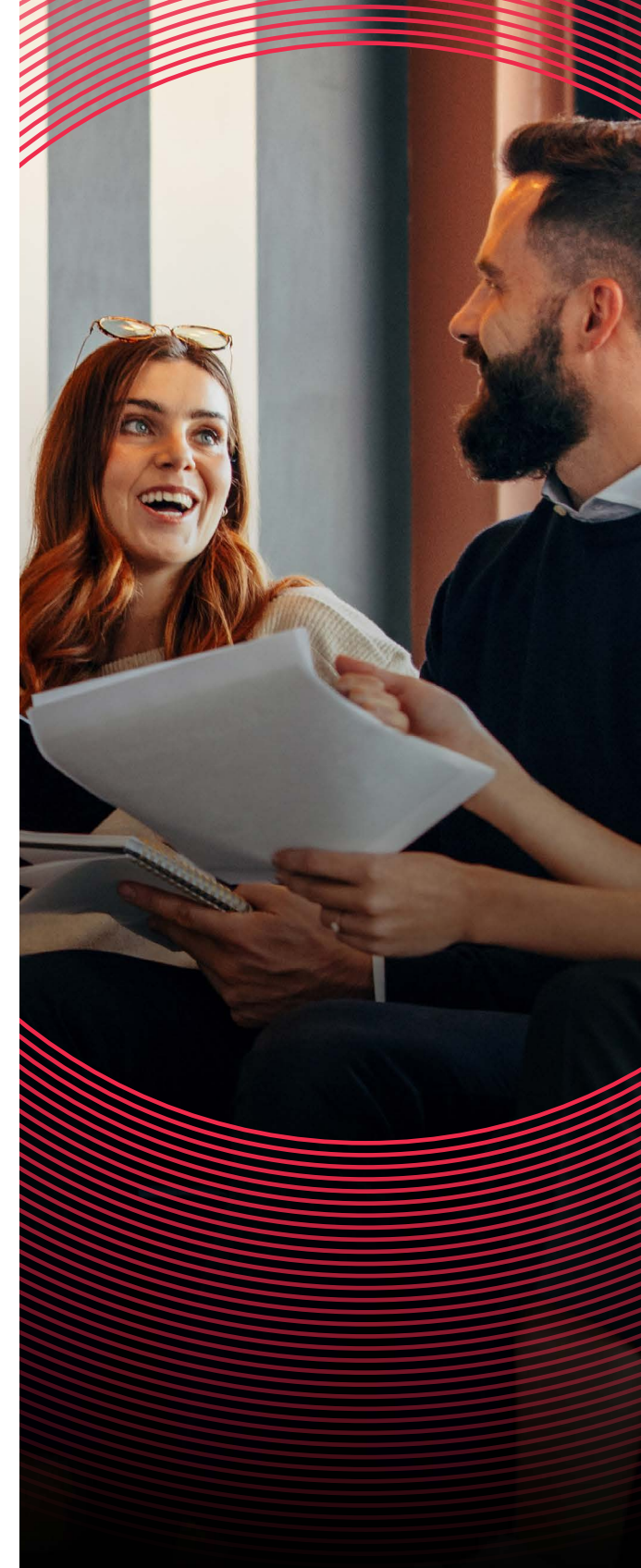
5 Wise, A. F., & Jung, Y. (2019). Teaching with analytics: Towards a situated model of instructional decision-making. *Journal of Learning Analytics*, 6(2), 53–69.

6 Wardrip, P. S., & Shapiro, R. B. (2016). Digital media and data: Using and designing technologies to support learning in practice. *Learning, Media and Technology*, 41(2), 187–192. https://doi.org/10.1080/17439884.2016.1160929

7 Arthars, N., & Liu, D. Y.-T. 2020. How and why faculty adopt learning analytics. In D. Ifenthaler & D. Gibson (Eds.), *Adoption of data analytics in higher education learning and teaching* (pp. 201-220). Springer International Publishing.

The Rise of
INSTRUCTIONAL DESIGN

In recent years, higher education institutions have increasingly relied on instructional designers (IDs) to partner with faculty to design and build their online courses. In fact, demand for instructional design services has increased more than 20% in the United States during the last decade.[8] While faculty are subject matter experts in their course's content, instructional designers are experts in how to design effective learning experiences and optimize the teaching of course material. Instructional designers typically possess strong backgrounds in learning theory and instructional design models (for example, ADDIE and backward design), and assist faculty in writing learning objectives, presenting course material to learners in research-informed ways, designing valid assessments, and creating engaging assignments aligned to course objectives.[9] Because instructional designers collaborate closely with faculty when designing courses, they also have a deep knowledge of course context and pedagogical goals—giving them a level of familiarity that is often only shared by the faculty who teach the course.

While there has been substantial discussion in the learning analytics community around various ways that learning analytics can support the field of learning design— for example, providing data needed to evaluate learning design principles or validate learning design patterns—there has been little discussion about instructional designers as critical stakeholders in the learning analytics development and implementation process. Yet given the increasing importance of instructional designers in the creation of effective online learning experiences, as well as their valuable backgrounds in learning theory and intimate knowledge of course pedagogical goals, we believe instructional designers are well suited to helping educators bridge the gap between learning analytics tools and learning theory-informed course improvement.
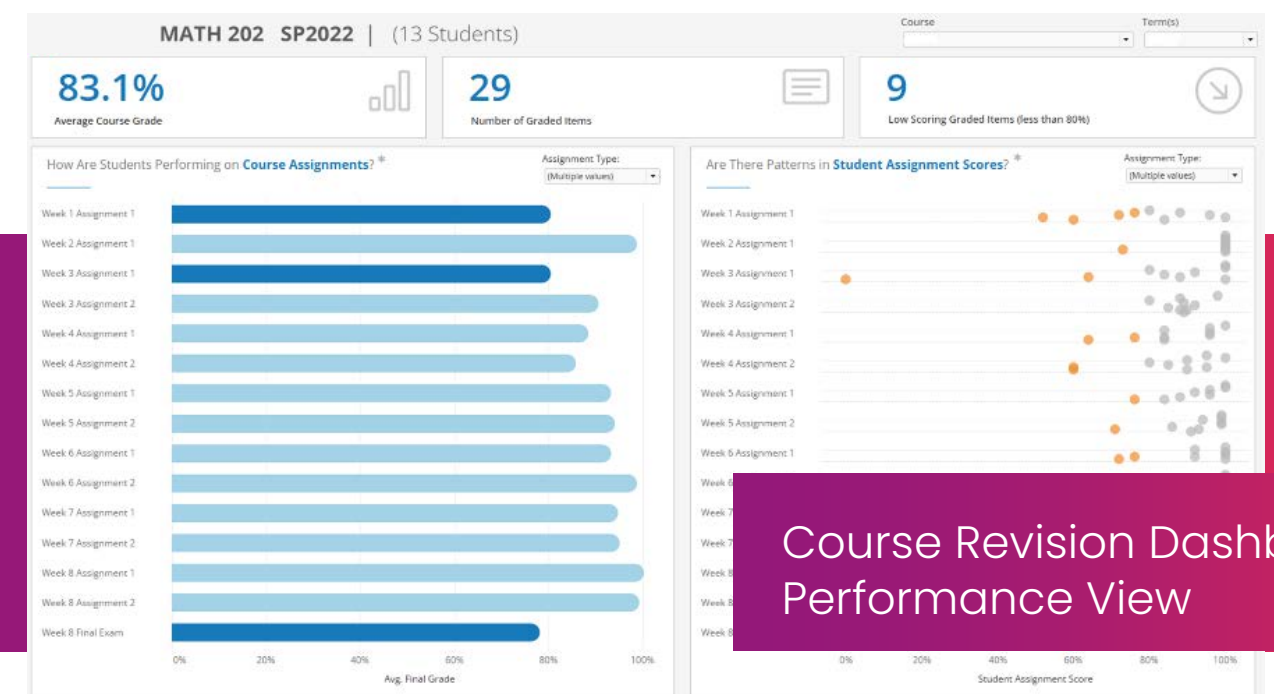
Course Revision Dashboard—
A CASE STUDY

To illustrate the value instructional designers bring to the learning analytics process, we describe a collaborative effort between the Learning Design Solutions team and several graduate programs at a large private university to create a Course Revision Dashboard (CRD). The CRD was designed to be used by university faculty and LDS instructional designers during their regular course revision process, where they jointly review course outcomes and make decisions about how to improve course delivery and design.

The project was carried out consistent with design-based intervention research, which emphasizes "multiple iterations of testing and re(design) in partnership with practitioners to support on-the-ground use and impact."[10] Accordingly, the dashboard's visualizations, core features, and delivery strategy were updated and modified during each iteration, informed by extensive feedback from both LDS instructional designers and university faculty.

Course Revision Dashboard: Performance View

8 Decherney, P. & Levander, C. (2020, April 24). The hottest job in higher education: Instructional designer. Inside Higher Education. https://www.insidehighered.com/digital-learning/blogs/education-time-corona/hottest-job-higher-education-instructional-designer

9 Ritzhaupt, A. D., & Kumar, S. (2015). Knowledge and skills needed by instructional designers in higher education. *Performance Improvement Quarterly*, 28(3), 51-69.

10 Penuel, W. R., Fishman, B. J., Haugan Cheng, B., & Sabelli, N. (2011). Organizing research and development at the intersection of learning, implementation, and design. *Educational Researcher*, 40(7), 331-337.

The Course Revision Dashboard itself consists of five distinct views, each containing a collection of related visualizations and metrics. The first view (Performance) displays student performance and grade information on course assignments, both in aggregate and broken down individually by student. The second view (Behavior) shows student course activity, including when students post most frequently and broader activity trends across the term. The third view (Engagement) displays information on student discussion interactions and various posting-related metrics. The fourth view (Advanced Engagement) highlights some experimental analyses, including discussions where students are frequently using words related to frustration and confusion. Finally, view five (Impact) displays historical course performance data and enables instructional designers and faculty to explore changes in assignment-level performance across terms.
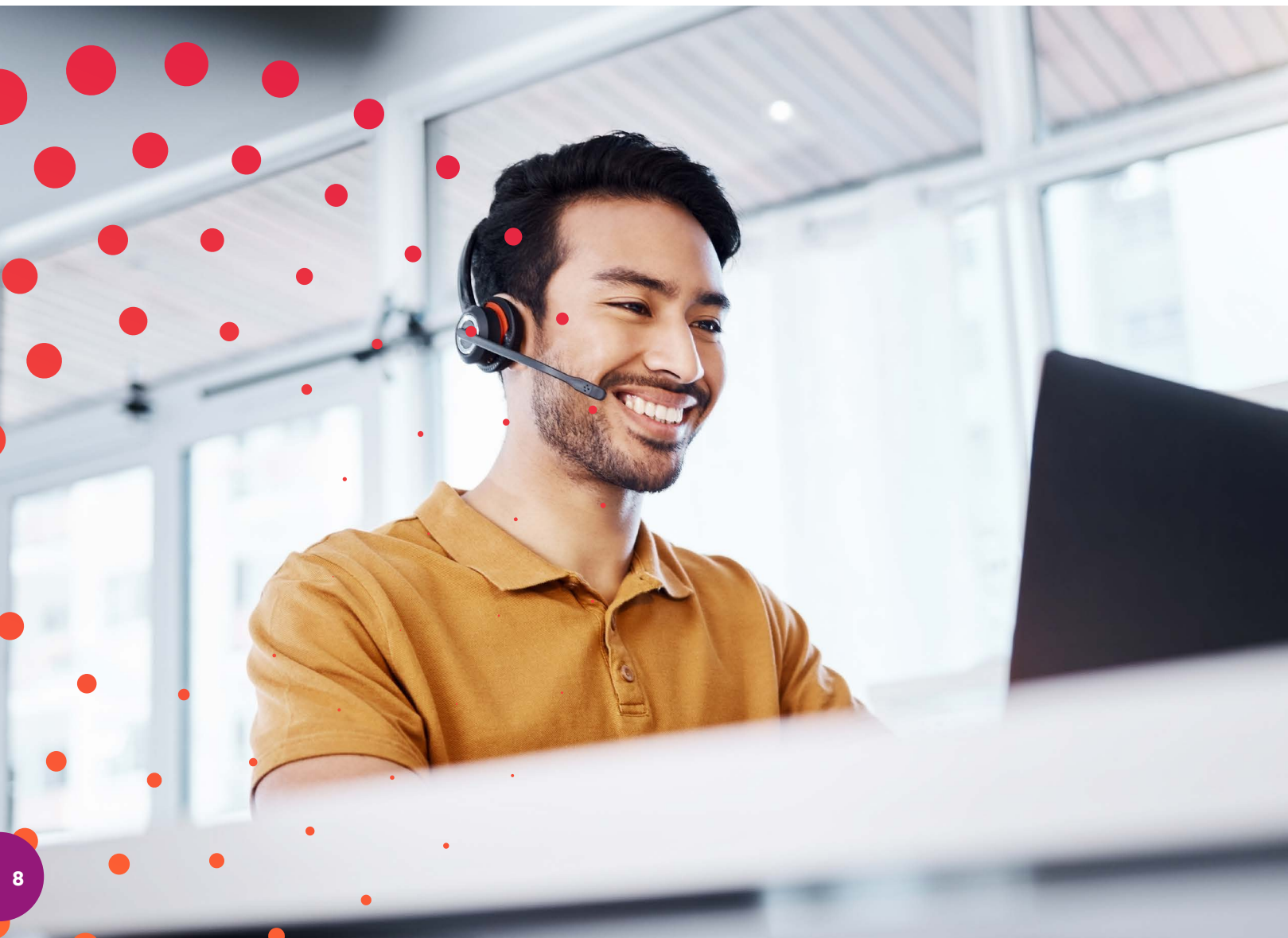
In the following paragraphs, we share five important steps the teams took to address prior challenges hindering the effective use and adoption of LADs, emphasizing the critical role instructional designers played alongside faculty and educational data scientists.

Identify Your Key Learning Questions

1

Given prior findings that LADs often include visualizations and analyses lacking actionable information[11], the first step in the dashboard design process was to understand the key questions that instructional designers and faculty had about their courses. Following principles of human-centered learning analytics, the goal was to move away from "providing users with data to interpret, and toward providing them with answers to the questions they are asking."[12]

Consequently, instructional designers and faculty were asked to work together to compose lists of key questions they wanted the dashboard to help answer about their courses, along with the relevant actions they imagined taking in response to the data insights.

The goal was to ensure each visualization was linked to a relevant learning design question and that each question was then tied to an evidence-informed action. Once these lists of questions were compiled, the team investigated what data was available to effectively answer them. The questions were then divided into three categories: 1) questions that could be directly answered, 2) questions that could be answered with various proxies, and 3) questions that could not be fruitfully answered with the data available. After another round of discussions with faculty and IDs, the list of questions was further narrowed based on data availability. The educational data science team produced a collection of prototype visualizations using actual course data that was used to make final selections about which visualizations to include in the dashboard.

11 Li, Q., Jung, Y., & Wise, A. F. (2021). Beyond first encounters with analytics: Questions, techniques and challenges in instructors' sensemaking. LAK21: International Learning Analytics and Knowledge Conference (LAK21). ACM.

12 Buckingham Shum, S., Ferguson, R., & Martinez-Maldonado, R. (2019). Human-centered learning analytics. *Journal of Learning Analytics*, 6(2), 1-9.

2 Design with Your Audience in Mind

Given that the CRD was intended to be used by instructional designers and faculty during their course revision discussions, it was important that the visualizations and analyses be easily understood and interpreted. This meant taking time to understand the data literacy of both the IDs and faculty, as well as their comfort with various analytic outputs. It was ultimately decided by the team that visualizations and analyses that could not be quickly explained by instructional designers were unlikely to be useful during the course revision process, regardless of how visually compelling or informative they were. For these reasons, several complex visualizations initially created by the data science team were rejected and most visualizations on the dashboard utilized more familiar bar and line charts.

A second important consideration during the design process was the aesthetic properties of the CRD visualizations. Substantial research on the elements of effective visualization design exists, and many excellent summaries are available.[13,14] In our case, all dashboard visualizations were created following several key tenets of data visualization design to best support instructional designers and faculty in their sensemaking process. Specifically, CRD visualizations employed the following techniques:

- Using descriptive and engaging titles that foreshadow the visualization's purpose
- Using a high data-to-ink ratio that deemphasizes unnecessary graphical features
- Visually highlighting the most relevant or important data in a visualization (for example, outlier scores)
- Using simple number summaries to describe insights not requiring entire visualizations
- Deemphasizing data intended to provide only contextual information or included as a point of comparison (for example, liberal use of low opacity and grey scales)
- Incorporating context-relevant reference points to direct user attention to both positive and concerning outcomes (for example, incorporating program grade standards and relative measures of discussion participation)

13 Sosulski, K. (2018). *Data visualization made simple: insights into becoming visual.* Routledge.

14 Knaflic, C. N. (2015). *Storytelling with data: A data visualization guide for business professionals.* John Wiley & Sons.

3 Provide Embedded Supports

Prior research has found LADs rarely include supporting information to aid user interpretation.[15] However, instructional designers and faculty decided early in the project that embedded informational supports were critical inclusions in the CRD. Instructional designers noted that interpretative guidance increased their comfort when presenting the analyses on the dashboard and when fielding faculty questions, two factors likely to increase faculty uptake.[16] Thus, each visualization on the dashboard is associated with a tooltip providing a brief summary of the visualization's purpose, as well as the underlying data used to create it. Embedding this information directly into the dashboard lessened the cognitive load on IDs tasked with explaining the visualizations and provided a quick reference if they forgot any details about a particular visualization.

Also included in the dashboard tooltips are lists of learning theory-informed questions to guide IDs and faculty through the often-challenging process of moving from data insights to action.[17] In particular, the questions included within the tooltips prompt instructional designers and faculty to think about how student performance and behavioral patterns revealed in each visualization might be translated into practical course changes. In this way, the dashboard aids IDs and faculty in moving from data insights to evidence-informed course changes.

What does this visualization show?

How each student scored on course assignments/quizzes as recorded in the gradebook. Highlighted students scored less than 80% and hovering over a student will display her exact score.

What Learning Design questions can I explore?

- Do students score similarly on an assignment or are they spread out (i.e., lots of variation in performance)?
- Do some assignments reveal different performance groups within clusters of students scoring higher or lower)?
- Are there patterns in which assignments students don't turn in
- Do students struggle on assignments tied to particular course topics or units?

Example
Dashboard Tooltip

15 Bodily, R., & Verbert, K. (2017). Review of research on student-facing learning analytics dashboards and educational recommender systems. IEEE Transactions on Learning Technologies.

16 Wise, A. F., & Vytasek, J. (2017). Learning analytics implementation design. In Lang, Charles, et al., (Eds.), *Handbook of Learning Analytics* (pp. 151-160). SOLAR, Society for Learning Analytics and Research.

17 Molenaar, I., & Knoop-van Campen, C. A. (2018). How teachers make dashboard information actionable. *IEEE Transactions on Learning Technologies, 12*(3), 347-355.

4 ## Include Tools to Measure Impact

Prior reviews have found LADs rarely include the ability for users to evaluate the impact of actions made in response to data-derived insights.[18,19] But as Sedrakyan and colleagues argue, dashboards should include "built-in mechanisms to allow tracking effects from such interventions."[20] In the case of the CRD, instructional designers and faculty were both motivated to monitor the impact of the changes they made to their courses, which resulted in the inclusion of several evaluative tools within the dashboard.

First, a visualization showing individual and overall student course performance across multiple semesters was added so that IDs and faculty could assess the macro-level impact of course revisions and monitor course outcomes across time, an important point of comparison noted by previous authors.[21] Second, a tool enabling users to compare student discussion activity and performance on course assignments across multiple terms was also included. This feature allows instructional designers and faculty to assess whether changes to an assignment in one term (for example, including an assessment exemplar alongside assignment instructions) is associated with positive student performance changes in subsequent terms. Although these tools are relatively simple—and a conscious decision was made to avoid complex statistical analyses (for example, hypothesis tests)—feedback suggests they have already encouraged instructional designers and faculty to be more empirical and systematic in their design.

5 ## Prioritize Training & Data Literacy

A final key element in the CRD development process was providing instructional designers with sufficient training to effectively support faculty in the interpretation and use of the CRD. Tasking instructional designers with the responsibility of presenting the CRD to faculty and guiding them through the analytic sensemaking process was a notable expansion of their role, and there was understandable anxiety among IDs about leading a more data-informed course revision process. Thus, it was important to equip instructional designers with the skills necessary to comfortably engage in productive and positive conversations with faculty around the learning analytics displayed by CRD.

To that end, a first step was providing team-wide training sessions on the dashboard, where instructional designers were walked through a demo version of the dashboard. A major goal of the training was to improve the IDs' pedagogical literacy, which Ellen Mandinach describes as "the ability to transform information into actionable instructional knowledge and practices."[22] This training stressed the strategic learning questions behind each visualization as well as the data and analytic techniques used to create it. The team also discussed important data patterns to look out for in each visualization and engaged in dialogue about possible learning design changes that could be made in response to the patterns revealed.

One important area of emphasis during trainings to embrace "interpretive flexibility"[23] and to avoid presenting the dashboard as providing clear answers to complex learning questions or treating data as inherently objective.[24] It was also stressed that IDs should avoid presenting the analytic outputs as immutable "facts" and openly acknowledge the many decisions made in the dashboard design process and the different, but equally valid, ways of interpreting visualization outputs.[25] Initially, many instructional designers found this ambiguity unsettling, but they eventually came to embrace going into course revisions prepared to have richer conversations and not feeling as though they needed to push a list of course changes "based on the data."

18 Macfadyen, L. P., Lockyer, L., & Rienties, B. (2020). Learning design and learning analytics: Snapshot 2020. *Journal of Learning Analytics*, 7(3), 6-12.

19 Ferguson, R., Brasher, A., Clow, D., Cooper, A., Hillaire, G., Mittelmeier, J., Rienties, B., Ullmann, T., & Vuorikari, R., (2016). *Research evidence on the use of learning analytics: Implications for education policy*. European Union, Centre for Research in Education and Educational Technology.

20 Sedrakyan, G., Malmberg, J., Verbert, K., Järvelä, S., & Kirschner, P. A. (2020). Linking learning behavior analytics and learning science concepts: Designing a learning analytics dashboard for feedback to support learning regulation. Computers in Human Behavior, 107, 105512.

21 Wise, A. F., & Jung, Y. (2019). Teaching with analytics: Towards a situated model of instructional decision-making. *Journal of Learning Analytics*, 6(2), 53-69.

22 Mandinach, E.B. (2013). Data literacy vs. assessment literacy. Blog entry on Michael & Susan Dell Foundation. Retrieved from http://www.msdf.org/blog/2013/09/ellen-mandinach-data-literacy-vs-assessment-literacy/

23 Selwyn, N. (2019). What's the problem with learning analytics? *Journal of Learning Analytics*, 6(3), 11-19.

24 Wise, A., Sarmiento, J. P., & Boothe Jr., M. (2021). Subversive learning analytics. In LAK21: 11th International Learning Analytics and Knowledge Conference (LAK21), April 12–16, 2021, ACM.

25 Kitto, K., Buckingham Shum, S., & Gibson, A. (2018). Embracing imperfection in learning analytics. In Proceedings of the 8th International Conference on Learning Analytics and Knowledge (LAK '18), 5–9 March 2018 (pp. 451–460). ACM.

Instead, IDs were encouraged to present the dashboard as simply "another tool in the course revision toolbox" and emphasize that the goal was not to use data to evaluate faculty, but, as Wasson & Kirschner note, to empower them with data to generate deeper questions and monitor the impact of their efforts.[26]

In addition to these initial training opportunities, the team continues to hold regular meetings with the lead instructional designers and ID managers after the initial dashboard rollout to address questions and collect feedback on the experience. An important outcome of these check-ins was the realization of the need to further support IDs with guidance on how to engage with different types of faculty. While some faculty were excited to view their course data and spent several meetings going through every visualization, other faculty were initially defensive or not interested in the dashboard. Thus, it was critical to support the IDs on how to tactfully engage cautious faculty without harming their relationship.

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26 Wasson, B., & Kirschner, P. A. (2020). Learning design: European approaches. *TechTrends*, 64(6), 815-827.

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PROJECT OUTCOMES

Interviews with instructional designers and faculty after four terms of using the CRD suggest the dashboard has enriched course revision conversations, increased faculty engagement in the revision process, and generated important insights leading to learning theory-informed course changes. A common theme shared by instructional designers asked to reflect on their experience using the CRD was how it elicited deeper conversations around the student experience and learning design. This outcome is particularly encouraging because it suggests the CRD is supporting a more dialogic pedagogy focused on "conversations, dialogue, and context" rather than being used to drive "objective" solutions in isolation.[27]

Instructional designers and faculty also reported that the introduction of the CRD into the course revision process led to valuable conversations about what additional data could be collected to reveal further insights into the student learning experience. After viewing the CRD, faculty also expressed increased interest in assessment validity and excitement about monitoring the impact of course changes term over term. This suggests a positive shift in the ID and faculty relationship toward the use of inquiry, evidence, and innovation in learning design and less reliance on educator anecdotes and course surveys.[28]

In addition to richer course design conversations, instructional designers and faculty also provided several examples of how the insights surfaced by the CRD led to learning-theory–informed course changes. For instance, a frequently cited area for course improvement by faculty was course discussions that were performing poorly and failing to generate expected levels of student interaction. Using the dashboard to identify these discussions led to conversations about pedagogical intent and research-informed changes to better support their intended learning outcomes. Several instructional designers also noted that using the dashboard to examine student performance in course quizzes and exams helped identify concepts that students were struggling to grasp and highlighted common misunderstandings. This led to conversations about how to adjust the presentation of this material earlier in the course and anticipating student misconceptions in the design of course activities.

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27 Perrotta, C., & Williamson, B. C. (2018). The social life of learning analytics: Cluster analysis and the 'performance' of algorithmic education, learning. *Media and Technology*, 43(1), 3–16. https://doi. org/10.1080/17439884.2016.1182927.

28 Rehrey, G., Shepard, L., Hostetter, C., Reynolds, A. M., & Groth, D. (2019). Engaging faculty in learning analytics: Agents of institutional culture change. *Journal of Learning Analytics*, 6(2), 86-94.

Before we had data insights, we talked about instructor experiences and teaching highlights at a surface level. With the data provided, we were able to reach into deeper issues in the course and engage in deeper conversations about how we can design and deliver course content differently, or what kind of issues [the instructor] faced in the course.

– Instructional Designer

Data on discussion forums helped us identify that some courses are doing an excellent job vs. courses that are only touching on a superficial level of engagement — and faculty were then able to share with us how the particular forum is looking at fact-finding answers, which led to the discussion that a forum might not be the best delivery method.

– Instructional Designer

CONCLUSION

For too long, higher education professionals have taken a largely unsystematic approach to the design and evaluation of the learning experiences they create, relying primarily on end-of-year surveys, faculty anecdotes, and learning design "best practices." This is unfortunate. Whether an institution's goal is to evaluate the impact of course design changes on student learning, uncover inequities in the outcomes of underrepresented minorities, or support student self-regulated learning, it is impossible to improve what is not measured. While the field of learning analytics promises to provide educators with the data and tools needed to adopt a more data-informed approach, it is unrealistic to expect educators, who are already overworked and focused on effectively teaching their courses, to become experts in learning design, data analysis, and educational research. In short, we must do more to support educators if we are to realize the promise of learning analytics in practice.

The **Learning Design Solutions** team's success designing and implementing learning analytics dashboards with our institutional partners, however, suggests a promising new strategy. From the early steps of identifying key learning questions and selecting dashboard visualizations to collaborating with faculty during the dashboard sensemaking process and making learning design changes, we've found instructional designers to be an invaluable resource in helping faculty move from data insights to learning theory-informed action. And although tasking instructional designers with adopting a more data-informed approach is a notable expansion of their traditional role, our experience suggests instructional designers are energized by the opportunity to use data to inform and guide their work with faculty. As a result, the LDS team has made increasing the data literacy and analytic skills of our instructional designers a key point of emphasis as we look to build on our learning analytics successes. And we've committed to expanding our team's learning analytics capabilities so that faculty and instructional designers are further empowered to use data to improve learning and teaching.

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