

University of Missouri- St. Louis: Data-Driven Online Course Design and Effective Practices

Mary Rose Grant

UNIVERSITY OF MISSOURI-ST. LOUIS

IMPACT OF DATA ANALYTICS

The most dramatic factor reshaping the future of organizations and business is data analytics, which offers a new model for decision making and understanding the world around us. Basing decisions on data seems an obvious way for organizations to improve output and productivity, but for higher education, experience and gut instinct continue to dominate policy and decision making, often causing barriers to educational reform.

Outside of higher education, the range of data-driven practices is extensive. In *Moneyball*, Michael Lewis chronicled how Billy Beane, the manager of the low-budget Oakland Athletics, massaged data and arcane baseball statistics to spot undervalued players. Retailers like Wal-Mart, Kohl's, and Target analyze sales, pricing, and demographics to tailor product selections in stores and determine the timing of markdowns. The shipping company UPS mines data on truck delivery times and traffic patterns to fine-tune routing. Online dating services like Match.com use client personal characteristics to improve algorithms for matching men and women. Police departments use computerized mapping and analysis of variables like arrest patterns,

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paydays, sporting events, rainfall and holidays to predict crime “hot spots.” Data-based decision making is transforming other fields. Medicine is using data analytics and computational modeling to predict who will get sick and insurance companies use it to determine high-risk clients.

Research suggests that data-guided management is working for corporate America. An MIT study of 179 companies found that those adopting data-driven decision making achieved productivity gains that were 5 to 6 percent higher than other factors could explain (Brynjolfsson, Hitt, & Kim, 2011).

Using analytics, organizations are making intelligent decisions to better educate and serve society. Why is education so slow to respond to data-based decision making? In an arena that typically gathers an astonishing amount of data about its students, higher education has historically been inefficient in analyzing and using data for instructional and curricular development, allocating resources, or planning. However, now more than ever, the efficiency of educational institutions and the quality of academic programs are being challenged, and as a framework for making policy decisions and effecting organizational change, analytics could have a tremendous impact on higher education.

DATA ANALYTICS IN HIGHER EDUCATION

Data analytics is transformative, promoting not only organizational efficiency and systemic change but also providing a model for educators to improve teaching and learning (Siemens & Long, 2011). We are in an era of data explosion. Because of the ubiquity of the Internet, mobile devices, and social networks, we have transitioned from ephemeral to captured, explicit data. Every online encounter, every Tweet or Facebook update, leaves a digital footprint, a personal data trail. Learning management systems (LMS), online courses, digital student records, and mobile devices capture streams of data about students that can be processed and analyzed. Data analytics has the potential to predict existing and upcoming challenges for institutions and students, drive decisions about financial resources and pedagogical systems, and offer a structure for improving academic outcomes, but it requires a different way of thinking about data and their value.

ACADEMIC ANALYTICS VS LEARNING ANALYTICS

Academic analytics is the application of business intelligence in higher education. The focus of academic analytics is to improve decision making at the institutional level by producing actionable intelligence. As in business, it is the point where value is generated (Campbell, DeBlois, & Oblinger, 2007).

Learning analytics differs from academic analytics in that it analyzes data about learners to understand and optimize learning and the learning environment. The focus is on the learning process, how students access and use content, and how they interact with instructors to create the learning space (Siemens & Long, 2011). It is an important tool for modifying and revising existing curricula and for planning courses and programs. From the intersection of technical, pedagogical, and social networks, including formal and informal education and work-life domains, learning analytics opens portals to new ways of teaching and learning.

By analyzing student-performance behaviors, learning patterns, and interactions, institutions can make timely adjustments in course content, management, and support. In contrast to traditional evaluation methods, learning analytics provides information that can be used to make improvements in the same semester in which the data are collected (Siemens, 2011). The mechanism for learning analytics integrates technology, learning theory, and people in the organization to collect, process, and analyze data for applying and sharing knowledge. Analytics is more than evaluating what learners have done or predicting what they will do, it is about restructuring teaching and learning strategies to repurpose pedagogical paradigms and academic systems. Learning analytics is only as effective as the institutional capacity to accept and encourage a data-driven model of assessment. Administrative support and faculty buy-in are pre-requisites to creating an evidence-based and action-oriented culture (Norris et al., 2008).

USING LEARNING ANALYTICS

Many institutions across the country are applying learning analytics to predict student success in terms of learning outcomes and to increase student retention and institutional accountability. Purdue University's SIGNALS and the University of California, Santa Barbara's Moondog projects are good examples of programs applying learning analytics to assess the chances

of students' success in a course, identify at-risk students and provide opportunities for students to modify their academic behaviors and improve learning (Arnold, 2010; Zhang et al., 2008).

LMS data allow faculty to evaluate the effectiveness of specific learning resources as correlated with student success. Research has shown that LMS student-tracking variables are pedagogically meaningful and statistically valid as predictors of final grades (Finnegan et al, 2010; Fritz, 2010; MacFayden & Dawson, 2010). Other studies have reported that time on task and frequency of participation was statistically significant and therefore critical for online learning (Finnegan et al., 2010; Morris et al., 2001).

Although many colleges and universities use analytics and LMS data to monitor student performance, faculty rarely use or understand learning analytics when making decisions about their own courses, student learning and retention, or instructional effectiveness.

THE CASE STUDY

Based on recommendations from the Higher Learning Commission, the provost and academic deans at a mid-size public Midwest university established an office for e-learning in fall 2010 to centralize online programming. A charter for distance learning, written and approved by the academic council, provided the framework for this new office. An associate dean and two full-time instructional designers were hired to develop institutional policies and protocols for implementing online courses and programs. The office, housed in the Division of Continuing Education, reported to the dean of the division. The success of the new enterprise was heavily dependent on showing that quality and rigor in course design and development could improve teaching effectiveness and increase student retention and course completion. It was also hoped that academic units and faculty would be encouraged to offer more online courses.

Before the e-learning office was established, there was no formal process for designing or developing courses or reviewing courses for quality assurance before they were offered. Faculty put together online courses, of which there were approximately 400 using video lecture, without guidelines. According to the university charter on distance learning, no new online course from this point on could be developed outside of the auspices of this office.

The design-development process begins when the academic dean approves a course, after which faculty and designers flesh out learning

activities and assessments in line with learning objectives. A template for syllabus construction provides a guide for developing content, implementing teaching strategies, and articulating expectations for course completion. Appropriate technology and design elements are reviewed throughout the process. Course design, development, and implementation take five months from start to finish.

By fall 2011, 13 new online courses were in place following these procedures. Instructional designers from the e-learning office had met individually with faculty from Arts and Sciences, Social Work, and Education to design 10 undergraduate courses, including four in criminal justice, two in gender studies, two in history, one in Spanish, and one in social work. There were also three graduate courses, one in social work and two in education. Only one of the instructors had any online teaching experience. The courses would apply best practices and quality measures to sustain learning outcomes consistent with those in face-to-face classes and would be remarkably different from existing courses in terms of quality and rigor. Also, the services, support, and training that faculty received would be unmatched by former mechanisms.

Feedback from faculty and students about their teaching and learning experiences would provide an understanding of what influences and motivates learning in a virtual learning environment. In addition, LMS tracking data would be used to assess elements of course design, navigation and management, delivery strategies, and learner participation. Based on critical analysis of real-time information extracted from the LMS and student mid-course surveys, areas of improvement and implications for instructional designers and course facilitators of the current as well as future virtual learning environments would be identified.

Student mid-course survey

Collecting the right information for the right reasons for the right persons at the right time was critical to the credibility of the efforts of the e-office. Instructors in the new courses distributed a 21-item mid-course student survey, which included open-ended questions, to gather data on student demographics, motivation, and satisfaction. Students completed and submitted the survey within one week of distribution.

Of the 36 percent of the students (N=186) who responded, three-quarters were female, 60 percent were 22 to 33 years of age, 68 percent were juniors or seniors, and 21 percent were graduate students. Forty-one percent held

full-time jobs; 29 percent worked half time or more, consistent for adult learners and what was expected for distance learners (Grant & Thornton, 2007).

The survey data were electronically processed on all courses collectively and for individual courses within a day of the submission deadline. One collective report and one individual report were sent to each instructor along with guidelines to help respond to student feedback. Instructors met with designers within a week of receiving results to review LMS data and to discuss implementing learning interventions, and make design changes and content revisions before the course ended. Learning interventions usually included web links to additional resources and adding or eliminating assignments. Design changes consisted of developing strategies to foster more discussion, providing easier access to assessments, and adding voiceover to PowerPoint presentations. Content revisions usually called for more clarity in presentation. The meeting also presented an opportunity to strengthen the instructor-designer relationship while learning how to apply information extracted from the LMS.

Faculty mid-course survey

At the same time that students were surveyed, instructors were also surveyed for feedback about their online teaching experience and competencies, i.e., engaging, motivating, and assessing students; creating and facilitating group activities and discussions; and using technology. They were also asked about services and support. Finally, instructors were asked to evaluate whether course design and development were conducive to learning and if implementation and delivery posed any barriers to student access or teaching effectiveness.

Survey results

More than 70 percent of students reported spending 3-6 hours per week in the course, that it was meeting academic needs, and that they would take another online course. In terms of course design, 94 percent were satisfied with the syllabus and learning objectives, and 91 percent found course navigation user-friendly and class policies clearly articulated. Over 84 percent found discussions valuable and instructor feedback prompt. Comparing online with face-to-face courses, 76 percent reported the online experience more effective and 65 percent felt connected to classmates. Open-ended questions confirmed that the majority of students were satisfied with their online learning experience, found it convenient and accessible, and learned that they had to manage their time to become effective online learners.

Seventy-four percent of the faculty considered themselves competent in motivating student participation, five percent said they were experts, and 21 percent described themselves as novices. Faculty (63 percent) felt competent in assessing students, with 21 percent claiming to be experts and 16 percent novice. With regard to group projects, 37 percent reported novice status, 29 percent said they were competent, and 26 percent of faculty never created groups. Over half said they were competent using technology and facilitating discussions, with about 25 percent claiming either novice or expert skills in both areas. Sixty-three percent of faculty said they used student tracking, 19 percent claimed expert status. However, only 50 percent considered themselves competent in using analytics, 32 percent reported being novices, 8 percent claimed expertise, and 10 percent admitted no competency.

Other than the increased amount of time dedicated to online course development, most faculty (55 percent) found no differences in teaching online compared to the traditional format. Over 83 percent were satisfied with online course design and development services and ongoing support for implementation and delivery. Open-ended questions revealed that faculty missed the face-to-face interaction and that student time management and participation in discussions were crucial for successful course completion. Some faculty reported that they would re-think course design and re-do supporting materials for the next course offering.

Applying learning analytics

Overall, faculty perceptions of their online teaching skills were consistent with student feedback. However, their sense of competency with learning analytics and student tracking was not consistent with the perception of the e-learning office. We discovered that most faculty were unfamiliar with extracting LMS tracking data to assess student progress or identifying and offering learning interventions to struggling students. Faculty were also not making LMS data available to students to modify their academic behaviors, seek learning resources, or ask for academic support.

Of the faculty who voluntarily met with instructional designers to discuss their course and options for enhancing the student learning experience, all modified or revised elements in their current course rather than wait until the next course. One criminal-justice instructor completely revised content and changed formats by adding case studies and interactive simulations to the course.

We found that real-time information allowed faculty to intervene in ways that resulted in fewer student withdrawals or failing grades and more student retention (2.8 percent drop rate) compared to equivalent online courses that did not participate in the mid-course review and revision process (3.0 percent drop rate) and to the face-to-face counterpart (4.7 percent drop rate).

RECOMMENDATIONS

Over the long term, using analytics can be more efficient than traditional assessment or support measures for actionable improvements in teaching and learning because it provides a richer picture of student immediate practice. Faculty buy-in is imperative in creating assessment based on what students are learning. Faculty training and practice in tracking learning outcomes with an emphasis on results provide a measure of instructional effectiveness that is dynamic and invigorating. Our experience allows us to make the following recommendations:

- Develop and provide guidelines to define clearly the data-driven process for course design and delivery using linked data, e-learning theory, and best practices.
- Establish mechanisms to collect, process, and analyze data on student performance during course delivery to identify students needing learning interventions for retention and success.
- Establish a process for re-designing the online learning environments in real time by integrating learning analytics, LMS data, and student/faculty feedback.
- Provide ongoing services and support to instructors developing courses and teaching online.
- Implement specific training in extracting and applying LMS student tracking data to improve teaching effectiveness and increase student learning.
- Institutionalize online data-driven processes to provide continuing resources and support for program management and enhancement.

These recommendations can become the foundation for policies and procedures related to offering and delivering online education and are also generalizable for broader use in other distance-learning environments.


TIPS FOR IMPLEMENTING LEARNING ANALYTICS

- Implementing learning analytics is not hard, but it can be messy when the control, distribution of results, and purpose are not properly communicated or supported from top administration. Implementation must take a value-layered approach.
- Demonstrate analytics' uses and positive impact on organizational productivity and reputation.
- Articulate the impact of analytics in higher education by communicating how institutions use data to make decisions about economic and pedagogical systems and to allocate resources for future planning.
- Identify what is already being measured and determine what still needs to be measured and when.
- Strengthen faculty and instructional designer relationships.
- Use student-tracking data to assess instructional effectiveness.
- Create a community of practice to communicate and share analytics approaches and results openly across the institution to get buy-in from faculty and other stakeholders.

CONCLUSION

Analytics has a significant place in the future of higher education by guiding reform and system change. As this case study has shown, analytics can do more than evaluate what students have done and predict what they will do. Learning analytics can be transformative, altering existing pedagogical processes, research, data management, and policy-making. We were able to actualize real-time insight into student performance with targeted interventions, design changes, and content adjustments even as courses were taking place. Learners received feedback about their learning behaviors so that they could make in-course corrections for self-improvement. The increased collaborations among instructors, designers, and administrators improved the quality and value of the learning experience.

This was new territory for us, but it is also new territory for education at a time when the way we teach and learn online is constantly evolving. Repurposing data collection and analysis to accommodate new modes of

teaching and learning and to make decisions about designing and delivering online courses will be critical to student success and institutional productivity. 

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