Excerpt

An Analytics Handbook

Moving From Evidence to Impact

Linda L. Baer and Colleen Carmean

SCUP Society for College and University Planning

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An Analytics Handbook: Moving From Evidence to Impact

Edited by Linda L. Baer and Colleen Carmean

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About the Society for College and University Planning (SCUP)

The Society for College and University Planning is a community of higher education planning professionals that provides its members with the knowledge and resources to establish and achieve institutional planning goals within the context of best practices and emerging trends. For more information, visit **www.scup.org**.

What is Integrated Planning?

Integrated planning is a sustainable approach to planning that builds relationships, aligns the organization, and emphasizes preparedness for change.

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Preface

Dancing With Data

by Mark David Milliron

Most leaders in higher education came of age in a day when dancing with data had different steps. Their dance with data was important, make no mistake. Getting solid data for boards, state regulators, federal agencies, and accreditors was at best required and at worst existentially threatening. Institutional Research (IR) departments took their work seriously; so much so, they were typically overwhelmed with requirements and particularly protective of their products and processes. Progressive data-centric colleges collected Key Performance Indicators (KPIs) and followed emerging Continuous Quality Improvement (CQI) traditions. For example, the Continuous Quality Improvement Network (CQIN, 2015), an early and effective data-dancing organization, had colleges that won the Baldridge Award (e.g., Richland College, see Schaefer, 2016), were featured in key publications (e.g., Community College of Denver, see Garmon, 2007), and who were shining examples of the courage to learn and guide organizational change with data.

As you'll see in the chapters that follow, this type of data dance is no less important today; indeed, reporting requirements are not only still there, they are expanding. However, as leaders across higher education are seeing, the embrace of digital tools for student information systems (SIS), learning management systems (LMS), customer relationship management systems (CRM, recruitment and advising tools), digital curricula, and student apps brings a flood of new and deeper data that holds far more potential than the production of accurate and useful reports for planning and monitoring. Bringing together modern data science (e.g., predictive modeling, machine learning, and sentiment analysis) and strategic design thinking means that we can bring data to life not only to tell us stories about students today and past, but about the likely trajectories our students are heading toward on their learning and completion paths and how we might improve those trajectories.

Let's think of this new dance as a Data Waltz. As you might know, a traditional waltz is a dance in triple meter that consists of three key steps that cycle into an array of different forms. Dance innovators have taken the basic waltz and created untold innovations, including the Viennese Waltz, Slow Waltz, Scandinavian Waltz, and the Contemporary Western Waltz. As with any waltz, the Data Waltz consists of three basic steps that allow leaders to bring new energy and insight to their work and afford the ability to create their own innovations on the base. Here we go.

Step One: Move away from a primary focus on reporting

While your traditional IR work is vital, it should not be the sole data driver. Indeed, you need to take a bold step out and away from a primary focus on reporting and into the world of real-time and predictive data, which involves broader teams. This means building out your infrastructure to turn your own data lights on (not rely on best practice data from other places) and starting to share the data with larger groups who are more focused on guiding operations rather than precise reporting. This is a bold move that includes honoring your past as you move to your future. Moreover, it's a courageous step, because sometimes sharing the data broadly, especially data that aren't flattering, means working hard to keep a culture of wonder at the core, as opposed to an easy and often damaging culture of blame (e.g., "Whose fault is that?").

Step Two: Put these new data tools to purpose, and quickly

Sometimes the bold first step stalls the dance as teams look in wonder at their new data and get trapped in "analysis paralysis." You must push to thoughtfully—but assuredly—make the second step. Second-step work means using your real-time and predictive data about your students to reach out, make contact, and act—typically focusing on improving persistence and completion outcomes. However, future innovations in this dance will hopefully include more inclusive, interesting, and expansive targets—like optimizing the student learning

experience, linking to career outcomes, and long-term personal welfare/agency. This second step can include more complicated movements, like adopting an app for faculty, advisors, or students; redesigning pathways; or simple steps like assembling care teams to guide triage and outreach (Office of Academic Outreach, 2018) or launching nudge campaigns (Community College Daily, 2017) to reach out to students at the right time with the right message to keep them on the right track. Regardless of the complexity, this second step has to be taken with care, as the misuse or unethical use of these data can be problematic.

Step Three: Bring it together and learn!

While steps one and two are the boldest and most obvious, it's step three that is the most neglected. And as any good waltz pro will tell you, the third step sets you up for keeping the cycle going and really innovating. Indeed, taking the time to test what is working in your student-success data dance using solid analysis matters. Using impact studies on outcomes (Milliron, Kil, Malcolm, & Gee)—particularly unpacking equity gaps in student outcomes—is a must. So too is challenging yourself to hold this learning to the highest standard (Kil & Malcolm, 2018). Good leaders never neglect the third step in this dance. Indeed, it's their way of charting the course for the continuing flow of their work.

In the chapters that follow, the music is cued and the dance instructors are at the ready. And as any seasoned dance teachers will tell you, the next move is yours. Dancing takes courage and practice; but most of all, it takes a willingness to learn, try, and explore. Data dancing is much the same. And the wisdom, insight, and practical strategies outlined here will get you on your way.

An earlier version of this preface first appeared as an article in Ferris State University's *Perspectives: Community College Leadership for the 21st Century* (May 2018).

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About the Author

Mark Milliron, PhD, is co-founder and Chief Learning Officer of Civitas Learning, an organization committed to helping education bring together the best of emerging technology, data science, and design thinking to help students learn well and finish strong on education pathways. In previous roles, Mark served as the Deputy Director for Postsecondary Improvement with the Bill & Melinda Gates Foundation; founding Chancellor of WGU Texas; Endowed Fellow and Director of the National Institute of Staff and Organizational Development at The University of Texas at Austin; Vice President for Education and Medical Practice with SAS; and President and CEO of the League for Innovation in the Community College.

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PART I | EVIDENCE

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Chapter 1

The Rise of Analytics in Higher Education

by Linda L. Baer

The growth, importance, and use of analytics have expanded exponentially in the last decade. Analytics enables us to engage in a process of data assessment and measurement and is aimed at improving the performance of individuals and institutions. This chapter will explore how higher education has responded to the increased pressure for accountability and the use of analytics.

The importance and use of analytics has expanded exponentially in the last decade. But as the field of analytics has continued its steady growth across all sectors of the economy, moving beyond the collecting and storing of information and toward the utilization of data analysis to improve competitive advantage, its benefits are still not shared equally. To paraphrase William Gibson, analytics is here—it's just not evenly distributed.

Analytics generally refers to "a set of software tools, machine-learning techniques and algorithms used for capturing, processing, indexing, storing, analyzing and visualizing data" (Daniel, 2014, p. 3). Analytics enables us to engage in a process of data assessment and measurement and is aimed at improving the performance of individuals and institutions.

Data analytics is already shaking up many industries. In *Big data: The Next Frontier for Innovation, Competition, and Productivity*, management consulting firm McKinsey discusses data sweeping into every industry and business as a critical factor of production, determining that the use of big data will become the basis of competition and growth for individual firms and companies (Manyika et al., 2011). McKinsey describes five ways big data create value: creating transparency; enabling experimentation to discover needs and improve performance; segmenting populations to customize actions; replacing and supporting human decision making with automated algorithms; and innovating new business models, products, and services (p. 5).

In this report, McKinsey determined that big data will matter across all sectors, but some sectors are poised for greater gains. This sector analysis is based on an index of five metrics that were designed to serve as proxies to indicate 1) the amount of data available to use and analyze; 2) variability in performance; 3) number of stakeholders (customers and suppliers); 4) transaction intensity; and 5) turbulence inherent in the sector (Manyika et al., 2011, p. 8). The industries most ready for gains included computers, electronic products and the information sector, manufacturing, finance, insurance, and government. The researchers noted that some sectors, including education—with its "lack of data-driven mind-set and available data"—had to overcome more barriers to capture value from the use of big data (Manyika et al., 2011, p. 9). Key to the success of the use of big data and analytics in education is the development of the necessary talent—with deep expertise in statistics and machine learning—and its ability to capture insights and use them to improve. The skill sets this analytics workforce must possess include the ability to build a bridge from content expertise in academic programs to student services, and the intentional translation of data into metrics, interventions, action, and assessment.

Much in the world of data analytics has changed since McKinsey issued its report in 2011. Increased demand for global competitiveness and increased political and social change are driving higher education to adopt more sophisticated analytics frameworks. Still, "[i]n spite of the growing changes happening in the environment of higher education, the role of data in helping address contemporary challenges is often overlooked" (Daniel, 2014, p. 3). While more data are available than ever before, they still remain too siloed, isolated, and fragmented for use by decision makers.

Still, the benefits of data analytics are well known, even in popular culture. Society has seen a tremendous increase in the use of analytics across sectors. Michael Lewis' *Moneyball* (2003) famously chronicled the use of advanced statistics to improve both the records and bottom lines of small-market Major League Baseball teams. Jeff Luhnow (2018) has since updated the progress of baseball's data analytics revolution since 2003, and indeed, that revolution has spread to other professional sports and leagues. Basketball is now "smarter" with analytics. From the beginning of the sport, teams relied on the gut feelings of coaches and scouts, but that time has "been replaced by an era in which coaches and their back-room staff pore over formulas and figures...to predict the most effective methods for winning" (Ross, 2018, para. 2). Player tracking systems are now being used, analyzing every action and weighing the impact of those actions on team scores (Ross, 2018). Yet, even with the increased reliance on data in sports, many owners, managers, coaches, and players face difficult transitions from success models in use long before big data to the insight gained from analytical models today.

Although not the subject of any blockbuster books or Hollywood movies to date, data analytics is being liberally applied in other economic sectors, as well. Analytics has had major implications in the health care industry. With improved data collection, data sharing, and diagnosis, providers can offer improved health care outcomes, with better matching of products and services to patient needs (Manyika et al., 2011, p. 7). At the first level for improving patient care through data, Electronic Health Records (EHR) provide ready access to patient information. IBM Watson Health has been on the forefront working with cancer diagnoses and treatments. With cognitive computing, providers can see and analyze more data, ostensibly leading to improved diagnoses and patient care (IBM Watson Health, 2018). Yet IBM, while still advancing the accuracy of the modeling, has had trouble turning the Artificial Intelligence Platform into a profitable business (Strickland, 2018). The use of analytics is still in its early stages and data analysts are still testing the models. A tremendous amount of data is not accessible, and much that is available is not fully used due to lack of data integration, shortages of talent, data-sharing challenges, and regulations.

IBM Watson Education is also bringing education into the cognitive era by integrating cognitive tutoring capabilities in which teachers can use the insights provided by Watson to respond to each student on a personalized level in a bid to transform the learning experience. "Cognitive solutions that understand, reason, and learn help educators gain insights into the learning styles, preferences, and aptitude of every student. The goal is holistic learning paths, for every learner, through their lifelong learning journey" (IBM Watson Education, 2018).

How Is the Field of Analytics Changing?

In *Analytics 3.0*, Thomas Davenport (2013) describes the progression of analytics as a competitive differentiator in three stages. Analytics 1.0 is marked by enterprises assembling business intelligence systems and expertise to drive reporting and descriptive analytics. For higher education, this means building the infrastructure capacity to support increased data analysis; thus far, this has been the focus of many institutions' efforts at modernizing their approach to analytics. The next stage in the progression, Analytics 2.0, capitalizes on the emergence of large, fast moving, external, and unstructured data from various new and interesting sources. In higher education, this has meant developing expanded data warehouses and data lakes to gather and provide access to the wide variety of information on students that can contribute to improved student success. This process can include data gathered by admissions, learning management systems (LMS), and academic and support services monitoring. As more activities become digitized, additional activities can be assessed.

But with Analytics 1.0 and 2.0, the business impact has not always been clear. That is now changing. Analytics 3.0 marks the stage of maturity where leading organizations realize measurable business impact from the combination of traditional analytics and big data (Davenport, 2013, p. 66-67). Higher education institutions are beginning to specifically understand what factors contribute to student success, what interventions work the best for which students at which time in the learning cycle, and which policies and practices can avoid barriers and roadblocks to contribute to student success.

The Rise of Analytics in Higher Education

A number of scholars have indicated that the big data framework is well-positioned to address many of the key challenges currently facing higher education (Daniel, 2014). With advances in technology, increased demand for accountability, and the development of data analysts in higher education, several higher education institutions have begun to pioneer and expand the use of data, data mining, data analytics, and predictive analytics. As with data analytics in sports, educators are primed to use the tools at their disposal, analyzing student actions with the goals of persistence and completion in mind.

Gagliardi and Wilkinson (2017) observe that "[w]e are smackdab in the middle of a data revolution" (p. 1). Amidst this revolution, some institutions have employed data analytics to create more personalized approaches to advising. Others have leveraged predictive analytics to estimate the likelihood of student progress through courses and majors. Still others have used such analytics to combine data with teaching and advising to help improve student outcomes, particularly among underserved students.

The use of analytics in higher education promises no less than a complete transformation of how we realize and even think about student outcomes. "Bringing together modern data science—e.g., predictive modeling, machine learning, and sentiment analysis—and strategic design thinking means that we can bring data to life not only to tell us stories about students today and past, but about the likely trajectories our students are heading toward on their learning and completion paths and how we might improve those trajectories" (Milliron, 2018, para. 2).

Practical applications include using data to support smart machines such as chat bots at Georgia Tech, where "Jill Watson," the first chat box teaching assistant, is fielding student questions. Other emerging uses include smart machines that answer questions about admissions, course enrollment, and financial aid. The ability to answer student questions in a timely manner has improved the ratio of students admitted to students who enter (Oblinger, 2018).

Taking Action

Better understanding of the types and levels of analytics can assist decision makers in improving student success. Based on this knowledge, institutions have reinvented processes, practices, and business models based on evidence-based knowledge. There are several levels of analytics in higher education, with an advance from one level to the next indicating increased data specificity, increased value of the data usage, and progress towards maximizing student success through the improved understanding of student progress.

Level 1: The descriptive model

"Institutions of higher learning have always gathered copious amounts of information about their students, from how many of them complete certain courses to how accurately a grade in one course predicts their success in harder classes down the line" (Zinshteyn, pp. 3–4). Until recently, much of that information had been collected merely for accountability purposes. But what about using data to look ahead? Today, predictive analytics systems assist colleges in making better decisions that lead to more successful learning experiences.

Descriptive level measurements include the standard measures of student success. In the first level of data analytics at higher education institutions, these measures have included persistence, completion, and placement rates. Learning outcomes in a descriptive model are implied by test scores, grades, and assessment of portfolios—lagging data that measures only what has happened after the fact and after students have moved on.

Level 2: Assessment of student learning behavior

With the advent of Learning and Course Management Systems (LMS and CMS), more detail is now known about student learning behavior. Indicators include attendance, use of the LMS, login behavior online, grades on multiple activities, assignment turn-in behaviors, adequate academic progress, posting behaviors with associated insights, social network analytics, responses to adverse events, and course engagement. LMS systems can provide a comprehensive profile of learner performance and growth (Phillipo & Krongard, 2012, p. 5). These measures can be timelier and thus inform when a student is at risk or in an accelerated mode. Personalized

interventions can be administered in time to better support successful student behavior and nudge the student toward a better trajectory.

While LMS tools are available across campuses, there is a gap in use of the tools for classroom management (by both faculty and students), assessment, and ready intervention. Institutions can expand the use and value of LMS systems by moving beyond the administrative functions of storing and managing assignments, filing grades, and offering supplemental materials. Far more value is available with more advanced LMS features which include analytics tools that encourage communication between students outside the classroom (Lang & Pirani, 2017, p. 3).

Level 3: Predictive and prescriptive insights on persistence

Powerful insights are now possible using multifaceted, data science-based predictive analytics platforms. Data can be refined to reflect the likelihood of persistence across student segments and time within the student learning cycle. At-risk factors can also be assessed and monitored. Data science research includes examples where D Grades, F Grades and Withdrawal (DFW) grades for students are a strong signal of non-persistence (Kil, 2017). Grades matter, and while students may persist with a C grade, they are less likely to graduate, since they are lacking fundamental skills required in upper-level courses. In some courses, grades lower than an A or B reflect an important tipping point for subsequent persistence and graduation (Kil, 2017). This level of predictive analytics can inform decision makers about student behavior that more likely leads to persistence and completion so the overall student learning ecosystem can be strengthened.

Level 4: Action Analytics Intelligence (AAI)

AAI is the next level of evidence-based student success knowledge. Analytics intelligence is a machine learning algorithm that makes it easier to drill down, respond to questions, and get to insights. This technology is what is behind Siri or Alexa and Echo machines, and in much the same way at the university level, student inquiries like "When is the registration deadline?" or "What do I need to do to apply for financial aid?" allow institutions to gather more information about student behavior, leading to additional questions and answers like "What is the first course in the sequence for my major?"

Level 5: Impact prediction and forecasting

The move to impact prediction creates a powerful link between data and predictive analytics-informed action to impact. Impact prediction supports the capacity to build micro-interventions, inspiration, and nudges for each individual student based on their needs. Thus the actual impact of interventions and actions can be determined, improving the overall efficiency and efficacy of decision-making. Matching can occur for the right students at the right time, thereby allowing intervention before the student moves beyond help (Kil & Milliron, 2016).

Level 6: Development of campus-based research frameworks

There has not been enough attention placed on the rigorous experimental designs required to ascertain whether students and instructors can use the predictive modeling tools to increase learning (Dede, 2016). In order to sustain an analytics agenda, the institution must develop a research-based template to understand the data, insights, and predictions and establish systematic and progressive improvements that maximize student success. "Rigorously evaluating the impact of innovative student success initiatives is key in meeting institutional goals for student outcomes, resource allocation, and return on investment" (Milliron, Kil, Malcolm, & Gee, 2017, p. 1).

Next Steps

We still have more progress to make in higher education. Yet in the American President Study 2017 only 12 percent of presidents ranked the use of institutional research and evidence among the top five areas of growing importance for presidents in the future. Presidential leadership is critical and a key requirement for moving analytics forward. Many issues must be addressed including quality of data, data connections across the institution, fears of misuse of data and costs for modernizing data functions. (Gagliardi & Turk, pp. 1–2.)

Overall, business intelligence is still in its infancy, with many of the latest concepts and technology gains still out of reach

at universities across the U.S. As the technology advances, higher education has started to move the needle in the use and application of data. Many university systems are at the stage of small-scale analytics projects that develop recommender systems, predictive models, and profiles of successful students. Yet there is still a lack of enterprise-wide models, which hinders the full broad-scale impact that analytics could make. Figuring out how to make analytics work pervasively in the higher education system is the prodigious task that awaits skilled thinkers and dedicated professionals.

More institutions will need to create their own knowledge base of student success through experimentation via the use of connected analytics. Connected analytics allows institutions to take advantage of the best of machine learning, behavioral science, design thinking, causal inference, and resource allocation optimization. The most difficult connection is between risk prediction and impact prediction. As business intelligence continues to get smarter, it will also become easier to use and provide more data power than ever for decision making. Leaders in the field who are using advanced analytics tools to expand their capacity are finding the following:

- Tools have evolved to a metadata capacity that allows users to see how and when data sets are collected. This makes accessing reports much easier and provides a self-service access to data.
- Tools have moved from data warehousing to the capacity for data visualization, dashboards, and action.
- Data precision and predictive analytics is improving accuracy, insights, and designated actions to improve student success.
- Technological tools are enabling the embedding of analytical descriptions and recommendations into Learning Management Systems that can lead to more timely and improved interventions and impacts.
- Communications with students are targeted and customized, which improves advising and aids in retention and completion (Powers, 2011).

It will be important to link the levels of analytics with overall integrated planning for student success. The power of analytics in higher education lies in building the "last mile in data science"—connecting what we learn from analysis, data impact predictions, and intervention science to optimizing and matching resources needed to design and sustain this data-informed environment. The future is bringing machine learning, behavioral science, design thinking, and statistical inferences together to maximize the learning environment. Campuses will need to assess skill sets, tools, practices, and policies required to support a more focused and intentional approach to student science.

Conclusion

Analytics tools will continue to become more user friendly, with improved visualization to support the deep analytics behind dashboards, intervention strategies, and return on investment indicators. Institutions will need to develop culture blueprints with a clear focus on understanding and planning around the deep power represented by this change from existing to future culture. The future cannot reside in the present, but by developing a "culture blueprint," institutions can anticipate gaps between the knowledge that data can inform decision making and improve student success and the actual creation of the environment that embraces necessary cultural changes in order to act on the high-impact student success opportunities (Richman, 2015). Realizing the transformative power of analytics in higher education will require leadership that can articulate, communicate, and manage the rapidly changing environment.

As this new culture is established, developing the talent needed across the institution is critical. The next generation workforce will require new skills in the AAI realm (Sharma, 2018). Organizational structure will need to be adaptable, flexible, and responsive in order to support innovation and change, while leadership will be critical to support and sustain the integration of analytics, building and supporting the infrastructure and championing the culture of inquiry that is possible with its expansion. This process requires faculty and staff to work together to understand the implications, insights, and investments needed to transform data-informed decision making into predictive insight.

Creative partnerships will be required across institutional divisions and the educational ecosystem, from K-12 to colleges and universities as well as with key tool and service providers. We must continue to develop evidence-based intervention opportunities, providing students with the optimal learning environment to increase their success. The emerging set of analytic tools can help move higher education toward the goal of concerted and intentional actions to optimize student success.

As is the case with companies that are successfully competing using analytics, so higher education can move beyond data collection to more strategic analysis and action. The field of learning analytics is assisting faculty and students in understanding the links between teaching and learning. Those institutions that move toward data-informed planning, decision making, and enhanced teaching and learning will hold a significant competitive and quality advantage (Arnold, 2014). The following chapters tell the story about the application and impact of analytics in higher education.

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About the Author

Linda L. Baer, PhD, has served in higher education leadership roles for more than 35 years. Her focus has been on the future of higher education, planning for change and transformation, building organizational capacity for analytics, and next generation leadership development. She has served as a faculty member, Senior Vice President, Interim President, Senior Vice Chancellor at the system level, senior project manager at the Bill & Melinda Gates Foundation, Senior Fellow at Civitas Learning, and now is a senior consultant in higher education. Her focus is to inspire leaders to improve student success and transform institutions for the future.