Predictive and Prescriptive Analytics in Higher Education

4 STEPS TO REALIZE THE PROMISE OF
It is undeniable that big data analytics provide a real opportunity to academic institutions. In an extended sense, one of the core value propositions of machine learning (ML) and artificial intelligence (AI) is the potential to analyze large sets of data for focusing more intently on the individual learner. In a larger sense, organizations can parse student data through predictive churn to focus on finding, retaining, and supporting the next generation of student freshmen.

From adaptive learning to targeted student advising, the value proposition behind big data analytics in higher education is practically limitless. But as you will read in this eBook, education has the lowest adoption of predictive and prescriptive methodology.¹ Though worrisome, institutions can close this gap through thoughtful analysis of their technology ecosystems and a use case-driven approach to implementation that will bring interactive value to students, educators, and academic administrators.

¹ McKinsey
Targeted Student Advising

A recent National Academic Advising Association (NACADA) survey found that the “median caseload of advisees per full-time professional academic advisor nationally was 296:1.”² This figure jumps to 441:1 for community colleges.

Embracing analytics for student advising requires commitment in moving from a model of advising – focused on information provisioning or course registration – to a sustained, strategic, integrated, proactive, and personalized (SSIPP) advising model.

Data-driven advising technologies offer efficient delivery of information, freeing up time for advisors to provide more sustained, holistic support.

Strategic outreach technologies entail proactively communicating with students via email, phone, or text message (CCRC). As part of institutions’ enhanced advising, and per the SSIPP model, outreach takes place at several points during the semester, and advisors often differentiate their approaches according to student needs.

Providing students with virtual assistants via student-facing mobile applications will offer greater understanding of their current academic status in relation to their career goals with predictive elements that prescribe strategies to course-correct and overcome academic and nonacademic challenges.

Institutions should establish data-driven advising sessions with AI-driven insights to help advisors engage students in a data-informed discussion about their successes.

Early-alert systems use predictive models that identify at-risk students. Predictive models can include factors like “demographic data, standardized test scores, high school and college GPA, class attendance, student behavior (i.e., whether or not students take advantage of tutoring services), and course taking patterns in college and high school."

Configuration of multiple alerts is necessary per student action. Early-alert systems should use different types and combinations of student data updated at different intervals. Some data is updated in real time, such as Georgia State’s GPS, which has identified more than 800 kinds of alerts. Others may only identify at-risk students once per semester.

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RECOMMENDER SYSTEMS

Course and major recommender systems use predictive analytics to identify how students are likely to perform in courses and majors based on their previous academic performance.

Leverage your integrated environment. As an example, most recommender systems develop predictive models using enrollment and demographic data, academic performance data of current and past students, and learning analytics. Leverage the ecosystem you have invested in for advising gains.
Adaptive Learning

ADAPTING TO A DATA-DRIVEN APPROACH

Adaptive Learning solutions take a sophisticated, data-driven, nonlinear approach to instruction and remediation, adjusting to each learner’s interactions and demonstrated performance level, and “subsequently anticipating what types of content and resources meet the learner’s needs at a specific point in time.”

Adaptive learning tools also provide information to instructors they may not have previously had. Instructor dashboards, for example, enable faculty to closely monitor whether students are progressing, and identify areas where they are struggling.

While the value of adaptive learning technologies is obvious in online courses, adaptive learning technologies can be used in all modalities, including online, blended, or face-to-face classes.
PREDICTIVE ADVANTAGE

There are three opportunities within an ed-tech ecosystem for adaptive learning: consumable course content, demonstrable assessment criteria, and lesson sequencing.\(^5\)

Use predictive analytics to develop adaptive learning courseware, which modifies a student’s learning route based on the interactions of the student with the technology.

For online courses, leverage past outcomes with current student data to help mimic decisions an instructor would normally make to determine the type of content, assessment, and the sequence of content and assessments that will optimize learning.

OPPORTUNITIES TO ADAPT

Leveraging advanced analytics and integration within an ed-tech ecosystem can provide three opportunities for adaptive learning: consumable course content, demonstrable assessment criteria, and lesson sequencing.\(^6\)

Use content-driven heuristics to automate lesson plans and presentations to unique student learners. Specifically, align lesson sequencing based on a student’s unique understanding and response to current course content. This process will allow instructors to automate the order in which material is presented to a student.

Personalize outcomes assessment based on student data. A data point and normalization algorithm can be applied to present a student and instructor with options on how to measure and demonstrate what a student has learned. Different students, responding to different learning methodologies, can now be afforded different ways to demonstrate content mastery.

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\(^5\) Michigan State University, Diverse Learners.
\(^6\) Michigan State University, Diverse Learners.
Guide online learners down a path that provides optional content. Additional content allows for the expansion of curriculum growth for active learners so that they continue to find value and can contribute to the overall course dialogue. Some examples of additional content are:

- Sidebars: Additional information contained in a floating panel next to the main text
- Tool tips: Pop-ups with information that appears when things are rolled over
- “More”: buttons that allow people to get more information about something being described

Algorithmically supplement additional material to address the knowledge or skill gap for remote content assimilation for students who have some difficulty mastering content. This allows educators to address lagging learners bringing all participants to a common baseline of understanding.

Online learning allows students to assimilate small independent modules organized around various topics. Through the mastering of student data, students can model their own course content that speaks to specific gaps in their knowledge but gives them the freedom to control their training, so they get what they need most efficiently.
DISCOVERING ENROLLMENT

> **Student Financial Health:** Each year, roughly 30 percent of first-year students at baccalaureate institutions do not return for their second year. Institutions can use predictive and prescriptive enrollment technologies to target retention efforts towards these students to promote student success and ensure financial health.7

> **Performance-based Funding:** According to the National Conference of State Legislatures, a non-profit organization that supports the efforts of state legislators, 32 states reward colleges with more money if they help more students to complete courses and graduate on time.8

> **Maximizing Revenue:** A survey conducted by Noel Levitz found that four-year private colleges spent a median of $2,433 recruiting each new freshman they enrolled. Forty-six four-year public institutions spent $457 per new student and two-year public institutions spent $123 per new student.9

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7 “Predicting Student Churn,” University of Washington
8 National Conference of State Legislatures
9 Noel Levitz
Discovering the unknown relationships is vital in enhancing enrollment scenarios. Given the vast quantity of data available, it is safe to say institutions are data rich, yet insights poor. The use of ML and AI to produce predictive and prescriptive models allows for the discovery of insights that augment an institution’s abilities to draw a correlation and provide prescriptive methods for additional discovery.

Integrating data is essential to lay an advanced analytics foundation that can serve to identify patterns associated with enrollment. It isn’t necessary to completely integrate all data assets before reaping the rewards of data science. Different data sources can be triaged and sequentially brought into an integrated environment. It is also important to do a data assessment by a professional to understand the relevancy and ROI associated with each integration point to legacy systems.

Neural network analysis is suitable for non-linear problems. Neural networks are able to discover complex patterns and provide solutions for non-linear problems in which the nature of the predictor-outcome relationships is unknown.

Predictive student churn allows for two essential data-related tasks: Student churn quantifies the number of enrollees, potential enrollees, and aggregates the number of students who choose to transition by category. After quantification, advanced AI techniques such as machine learning allow institutions to anticipate potential churners and provide modeling for easy analysis and reporting.
ALLOCATE FINANCIAL AID TO BOOST ENROLLMENT TRENDS

Student backgrounds and experiences become increasingly diverse, leaving post-secondary institutions more to chance during the enrollment process than ever before.

Institutions should not rely solely on historical, or point-in-time, data sets to assess the trajectory of this year’s student. Incorporating real-time, survey, and/or potentially social behavioral data into a predictive model can increase visibility into a student’s enrollment decision, enhance the overall accuracy of existing models, and help institutions more efficiently define, target, and sustain students who require financial assistance and asset financial programs find the most students possible.

MODELING STUDENT SUCCESS

Student attrition has become one of the most challenging problems for academic institutions. To combat this problem, historical institutional data, outcomes assessment, and demographics can be modeled and dynamic predictions related to an institution-specific nature of attrition can be queried. Furthermore, prescriptive methodologies can combat attrition and identify at-risk students before they are even enrolled, giving institutional executives the opportunity to constantly stay ahead of enrollment trends and implement measures to boost enrollment while providing quality student-specific feedback.
Overcoming Perceived Limitations

USE CASE-DRIVEN SOLUTIONS

- AI and ML promise important benefits for academic administrators, instructors, and the student body yet “education as the sector has the lowest adoption of predictive and prescriptive methodology.”\(^\text{10}\)

- Having a flexible education data model is key to establishing a long-term predictive/prescriptive solution. A flexible data model should contain use case-driven criteria that supports current academic administrative workload.

- Having an overlapping technology plan that contains a correspondent data strategy and supports proper data classification is key to a good security posture that promotes data sharing across the academic institution.
A CULTURAL SHIFT

An academic institution’s culture drives its ability to accept, leverage, and deploy predictive and prescriptive analytics that can enhance workflow. Factoring culture and methods to outline potential wins and use cases associated with the deployment of advanced analytics should help with guiding the discussion.

Predictive churn or neural networks may seem like nebulous concepts for organizations to embrace. Providing clarity as to which datasets and how they will be leveraged is essential to ensure success.

SECURITY

It is important to choose technology elements that support security frameworks for integration, data storage, visualization, data capture, and much more. Vendors should have an established record of connecting to and providing analytics from Criminal Justice Information Services (CJIS), The Health Insurance Portability and Accountability Act (HIPAA), Family Educational Rights and Privacy Act (FERPA), and Federal Information Security Management Act (FISMA) compliance standards.

Compliance and regulatory frameworks are sets of guidelines and best practices. Organizations follow these guidelines to meet regulatory requirements, improve processes, and strengthen security. Vendors that work on academic systems need the ability to navigate common frameworks, such as National Institute of Standards and Technology (NIST), Payment Card Industry Data Security Standard (PCI DSS), International Organization for Standardization (ISO), and potentially esoteric frameworks such as AT-101 or Statement on Standards for Attestation Engagements No. 16 (SSAE-16).
ADAPTING TO A DATA-DRIVEN ENTERPRISE

It is impossible to redesign students to fit into a data model, but we can redesign a data model to speak to student engagement. Having a flexible, extensible data model and heuristic algorithms that can be updated in an automated fashion would go a long way to establishing a dynamic analytics environment through which hidden insights can be gleaned and retention can be established.

AI and ML promise important benefits for academic administrators, instructors, and the student body. Yet despite this promise, the McKinsey report identified education as the sector with the lowest adoption of predictive and prescriptive methodology. Having a data strategy that can showcase a flexible, data-modeled approach to implementation is key.
Notes
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ibi is a data and analytics company that embeds intelligence into — everything. From the beginning,ibi has known the importance of data and insights to make better decisions. We help organizations get their complex and disconnected data in order, so they can build, embed, and automate intelligence into everything they do. By preparing organizations for the future and turning them into builders – information builders – everyone can use enterprise trusted data at scale to drive their growth. Whether our customers use pre-built applications or build their own solutions for their data and analytics challenges,ibi powers their innovation and reinvention.ibi’s open platform and industry-specific building blocks accelerate speed to market, improve operational efficiency, and enhance their customers’ experience.

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