EDUCAUSE LEARNING INITIATIVE

Degree Compass Course Recommendation System

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SEI Case Study June 2013

Snapshot

Institution:	Austin Peay State University, a four-year public, master's university with more than 10,000 students that offers programs on four campuses and online
Timetable:	April 2011 to present
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As a regional institution at which more than 40% of students are nontraditional learners and over 50% are Pell Grant recipients, Austin Peay State University (APSU), in Clarksville, Tennessee, enrolls many students who are unfamiliar with the subtleties of navigating their way through a degree program. Although every APSU student meets with an advisor each semester, Austin Peay recognized the difficulties that students face in choosing courses and constructing a successful degree pathway.

To address this challenge, the university developed Degree Compass, a course recommendation system. Inspired by recommendation systems implemented by companies such as Netflix, Amazon, and Pandora, Degree Compass matches current students with the courses that best fit their talents and program of study for upcoming semesters. The system uses predictive analytics and data-mining techniques to combine hundreds of thousands of past students' grades with a particular student's current standardized test scores and college transcript grades to make individualized course recommendations for that student. The courses that are the best options for that student are presented in an easy-to-use interface that lists the courses with ratings that indicate how strongly a course is recommended.

Degree Compass was designed to empower students and their advisors to make more-informed choices about student coursework, and to help pair students with courses in which they are more likely to find academic success. The university collects data about grades earned by each student in each class they take. These data are categorized by the demographic information about the student earning the grade. This allows a longitudinal comparison of grades across semesters for the student body as a whole, as well as a variety of student subpopulations.

1. Project Overview

1.1. Project Goals, Context, and Design

The university sought to create a course-selection architecture, powered by predictive analytics, that would empower students to make advantageous and informed choices about their education. In contrast to systems that recommend movies or books, Degree Compass does not sort courses based on student preferences. Rather, it uses predictive analytics techniques based on grade and enrollment data to rank

courses according to factors that measure how well each course might help the student progress through their academic program.

From the courses that apply directly to the student's program of study, the system selects those that fit best with the sequence of courses in the degree and that are the most central to the university curriculum as a whole. That ranking is then overlaid with a model that predicts the courses in which the student is most likely to achieve the best grade. Analysts opted to measure this by using the metric of the percentage of students earning a C or better in a course each semester. By the very nature of the system, only courses that satisfy unmet degree requirements are ever recommended. A significant increase in passing grades (As, Bs, and Cs) would point to significantly more students successfully completing more of the classes they attempted. In this way the system recommends courses that are required for a student to graduate, that are core to the university curriculum and their major, and in which the student is expected to succeed academically.

The system provides information for three audiences:

- A simple student-focused interface presents choices to be made in an appealing and informative way.
- An advisor-focused interface provides information to enable a student's academic counselor to provide more nuanced advice.
- An array of reports available to the institution enables aggregated recommendation data to be used to optimize future class schedules, while also providing early-alert data that enable the institution to target support initiatives to students who are forecast to perform poorly in the courses in which they have enrolled.

1.2. Data-Collection Methods

Data collected as part of Degree Compass falls into three categories:

- **Grade-prediction accuracy.** Because courses are recommended to students based on curricular fit and a prediction of the grade that the student would likely earn if he were to take the class, it is crucial to collect data that establish the accuracy of the grade predictions. To assess the accuracy of these predictions for each student in each class in which they are enrolled, the university collects the grade that Degree Compass predicts the student will earn in a given course based on that student's previous academic record, together with the actual grade that the student earns once the grades are posted. These data are also categorized by course, subject, course level, and the student's grade-level classification.
- **Degree Compass usage data.** Given that advice from Degree Compass is useful only if it is consulted, the system uses click-traffic data to provide information about the system's use. These data track unique users who consult their recommendations, collecting information about when and how often they consult their course suggestions and how long they spend exploring the information provided.
- **Direct user feedback.** Focus groups and surveys also provide feedback about the usability of the interface and other features that users might find useful. The survey data provide information about the users' attitudes about the interface. The survey asks how confident they feel about the information, whether the interface was easy to use, and whether they would recommend that others use Degree Compass. These data are categorized by demographic information about the

users, as well as by information about how frequently they use other recommendation engines and how comfortable they are using computers.

1.3. Data-Analysis Methods

The data were analyzed largely by using a combination of Excel and purpose-written Python code. We analyzed grade predictions to compare predicted grades with actual earned grades. We also calculated the average absolute difference between the predicted and the earned grade, as well as the standard deviation of that absolute difference. These data were compared longitudinally across semesters, across different course subjects, and across the student's academic career to see whether predictions were more or less accurate in developmental, freshman, or senior classes. The analysis included calculation of the proportions of students who were predicted to earn a passing grade (at least an A, B or C) and those who were predicted to earn a D or F, respectively. These proportions were compared across subject areas, course levels, and student class. This measure is a recognition that there are different consequences for mispredicting a student grade: If a student is predicted to earn a C but actually earns a B, that outcome is very different from one in which the grade earned is a D, even though both differ by only one grade from the prediction.

We analyzed usage data to establish how students consult Degree Compass as they make plans for an upcoming semester. That usage was compared longitudinally across the semesters dating from the system's introduction in Spring 2011, as a growing proportion of the student body used the system. We analyzed survey data to identify groups of students who are more or less likely to use Degree Compass. That information helped the university target outreach initiatives about how to utilize Degree Compass to inform students who were unaware of the system and about how to help users who were less likely to have previously used suggestion systems.

1.4. Findings

The latest performance statistics for Degree Compass show that the software successfully predicts grades to within .6 of a letter grade, on average, and correctly predicts whether the student will earn a passing or a failing grade with 92% accuracy. The level of prediction accuracy remains constant across course level, subject, and student grade classification. (The predictions use only academic grade data. They do not use demographic information about the student or information about the course instructor.)

Grade distributions among all students across the four APSU campuses showed a baseline probability of 0.62 to 0.63 that a student would earn an A or a B in any particular course. By comparison, a detailed analysis showed that students who took a course for which Degree Compass predicted they would earn an A or B were significantly more likely to actually earn an A or B than this baseline. Indeed, at each campus, more than 90% of students who took a course in which they were predicted to get at least a B actually earned an A or a B grade. This effect was evidenced at every school and at every course level, from developmental classes through upper-division courses.

Using Degree Compass as part of academic advising has helped steer students towards more classes in which they would more readily succeed. A comparison of student grades before the introduction of the system with those today shows a steadily increasing proportion of passing grades. Results in Fall 2012, for example, were almost five standard deviations better than those from Fall 2010. The effect was especially pronounced for students who were Pell Grant recipients, with a 4% increase between Fall 2010 and Fall 2012 in the likelihood that a student would earn an A, B, or C (a 7.7 standard deviation swing).

1.5. Communication of Results

Degree Compass has two main groups of stakeholders: students and faculty advisors. Austin Peay's student newspaper has featured several articles that explain how Degree Compass can help create a successful degree program. University staff have made presentations about Degree Compass and its features to the Student Government Association and created outreach initiatives through the university's African American and Hispanic cultural centers and its military and adult-student centers.

For APSU faculty, the university has offered several informational presentations to audiences from each campus, as well as general sessions organized by the faculty senate. Degree Compass is also part of the experience for new faculty training. In addition, the university has introduced training sessions for professional advisors and summer advisors for incoming freshmen. A series of presentations about Degree Compass and its features has been offered at each of Austin Peay's four campuses, including sessions for senior leadership, professional advisors, and groups of faculty.

1.6. Influence on Campus Practices

Use of Degree Compass has now become deeply ingrained on APSU's campus. The data show compellingly that when students take courses identified as being the best fit for them, they do significantly better. This observation raises the importance of the availability of these courses so that they can be part of the student's schedule. Students should take the courses they *need* rather than courses that simply have seats available. APSU has begun to apply the institutional data gathered from Degree Compass to tailor course schedules so that courses students need will be available to help them advance effectively through their academic programs. Data from Degree Compass also help Austin Peay anticipate future course demand and optimize course schedules.

Predicted course grades can also be used to target supplementary instructional initiatives. Austin Peay uses predicted grade information to guide students who are predicted to earn poor grades in particular courses toward campus tutoring and academic mentoring. Predicted grades also provide an accurate baseline measure about a student's classroom performance, and faculty groups involved in curricular redesign have begun to use this baseline information. One group that is investigating the effectiveness of supplementary instructional intervention will analyze whether students who receive additional instruction earn grades significantly higher than the baseline grade predictions.

2. Reflection on Design, Methodology, and Effectiveness

2.1. Project Design, Data Collection, and Analysis

The design as it was implemented was very effective in yielding the anticipated information and was certainly sufficient to confirm the demonstrable effect of Degree Compass on student success. The university is now pursuing more granular information about how best to communicate the information to students and also about how given information influences student choice. New data-gathering structures are being designed that will enable administrators to see students at the point of their choosing one class over another. New data will be invaluable in further refining the Degree Compass architecture and the interface that helps students make course choices.

Degree Compass has also become an influential tool for faculty advising. Although academic advising involves many subtleties, analysis shows that Degree Compass's predictions are dependably accurate across the curricular spectrum. Degree Compass is now becoming a valued information tool to assist advisors as they work with their students.

2.2. Effectiveness and Influence on Campus Practices

The Tennessee Complete College Act of 2010 changed the way in which state funds are distributed to state institutions. Funding that was previously linked to campus enrollment is now linked to how many students at each campus successfully complete their degrees and graduate, as well as to how many students make progress past programmatic milestones. In other words, funding is linked not to recruitment but to student success, progress, and graduation. The significant increases in passing grades since Degree Compass's introduction to APSU, and the choices that guide students towards the courses that will move them the most effectively through their degree, have had a profound impact on student success and progress. As part of an array of initiatives, Degree Compass has helped APSU make the largest increases in student success and completion among Tennessee's universities over each of the past two years, with a correspondingly significant impact on institutional funding.

While the initial scope of the project was to provide this system for students at APSU, support from the Bill & Melinda Gates Foundation has enabled analysts to also gather data from one other university and two community colleges in Tennessee. That has enabled the assessment of the accuracy of the grade predictions in a variety of higher education settings with differing populations of students.

3. Supporting Materials

Tristan Denley, "Austin Peay State University: Degree Compass," in *Game Changers: Education and Information Technologies*, ed. Diana G. Oblinger (Louisville, CO: EDUCAUSE, 2012), http://www.educause.edu/research-publications/books/game-changers-education-and-information-technologies.