Improving Online Course Performance Through Customization: 
An Empirical Study Using Business Analytics

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ABSTRACT
The number of educational courses offered online is growing, with students often having no choice for alternative formats. However, personal characteristics may affect online academic performance. In this study, the authors apply two business analytics methods - multiple linear/polynomial regression and generalized additive modeling (GAM) - to predict online student performance based on six personal characteristics. These characteristics are: communication aptitude, desire to learn, escapism, hours studied, gender, and English as a Second Language. Survey data from 168 students were partitioned into training/validation sets and the best fit models from the training data were tested on the validation data. While the regression method outdid the GAM at predicting student performance overall, the GAM explained the performance behavior better over various predictor intervals using natural splines. The study confirms the usefulness of business analytics methods and presents implications for college administrators and faculty to optimize individual student online learning.

KEYWORDS
Generalized Additive Modeling, Online Learning, Online Performance, Personal Factors, Predictive Analytics, Regression

INTRODUCTION
The Internet has grown to influence all walks of life, including scientific research, communication, business, industry, entertainment and education. Today there are 3.2 billion Internet users consisting of 44.3% of the world population (InternetWorld Stats, 2015). With such a global reach, the Internet is one of the favored media to provide education at reasonable costs. Hence, many universities are widening their course offerings, particularly their high-demand core prerequisite courses for their degree programs online. Massively Open Online Courses (MOOC) such as Coursera, edX and Udacity are also signing up millions of students (Jordon, 2014). But, student academic success has been elusive with an average of only 7.5% course completion rate in these online courses (Kolowich, 2013). One reason may be due to a lack of course customization (Kostromina & Gnedykh, 2016). The lack of a strong social presence is another factor (Kear, Chetwynd & Jefferis, 2014). Further, asynchronous and synchronous online learning environments also have differing impacts on the learning performance (Allmendinger, 2010). Most of the online course offerings today ignore customization to student needs and utilize a one-size-fits-all approach without considering individual ways students study and their preferences to communicate over the Internet.

According to Varre, Keane, and Irvin (2011), online learning programs focus on making interfaces easy to navigate, but fail to address individual student characteristics. This is where business analytics
can play a useful role. By gathering data on the various types of student online interactions, systems equipped with analytics methods can learn to customize online presentations. Along with system customization factors, it is also necessary to know student background characteristics that are essential for performing well in an online course so that systems can match them to improve performance.

PRIOR RESEARCH

Among factors that have been found to affect a student’s level of success are: course prerequisite preparation (Marcus, 2013), time management skills (iSeek, 2015), technology infrastructure (Kukulska-Hulme & Jones, 2012), course content, structure and delivery (Teng, 2008). Other factors include getting familiar with the technology platform and course set up early, maintaining regular communication with the instructor, committing to consistent online study sessions, initiating ties with coursemates, university policies and netiquette (Harrell & Bower, 2011; Harrell & McClinton, 2016). We can group the above factors broadly into two categories: 1) System factors, and 2) Student background characteristics.

System Factors

According to Moore and Kearsley (2012), an online education system involves technology, courses, students, instructors and administrators. Technology includes access and software, whereas courses cover content and pedagogy. Students need to have prerequisite characteristics such as communication abilities and motivation. Instructors are to be technologically proficient and committed, and administrators must provide resources (Tirziu & Vrabie, 2015). Currently, many online systems are asynchronous implying students are separated geographically and in time. Synchronous systems may allow video and voice, either pre-recorded or in real time, to simulate a classroom (Latchman, Akkaraju & Gharbaran, 2010). Such systems can also capture social presence very effectively (Kear, Chetwynd & Jefferis, 2014). Lo, Chan and Yeh (2012) developed a customized learning system using neural network and demonstrated it can adapt to student cognitive styles dynamically through prior interactive sessions. However, research in customization is ongoing (Guthrie, 2012).

Student Characteristics

Unless system factors are matched to the student characteristics, a positive learning outcome is hard to achieve. A student prerequisite to taking an online course is the ability to communicate effectively (Kostromina & Gnedykh, 2016). Kim, Lee & Ryu (2013) found that students of different personality types prefer different ways to communicate. For example, video-conferencing in online systems may be of interest for the extraverted learners who prefer face-to-face interaction. In an empirical study using structural equation methodology, Castillo-Merino and Serradell-Lopez (2014) found that motivation or the desire to learn was the main variable affecting performance of online students. A related characteristic is the student level of escapist tendencies whereby a student may not be able to keep focus for long hours of study until a task is completed. Lavie (2010) has shown that when unable to cope with a complex task or when conflicting priorities clash, a student may give up. A student need also to meet a minimum level of academic and technological preparation while taking online courses (Tirziu & Vrabie, 2015). Gender and age have also been identified to be important student characteristics in online learning (Kappas & Kramer, 2011). Further, for students who take online courses in a language medium that is different from their own spoken language, the language barrier can negatively affect performance (Liu, Liu, Lee & Magjuka, 2010). Despite the globalization and higher international awareness and many students are most likely continuing to have to take online courses primarily in English.
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