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Introduction

As part of the 2012 SoLAR Flare gathering at Purdue University (October 1-3, 2012), colleagues from higher education institutions and technology service organizations participated in an exercise to develop a learning analytics application to improve college student performance college gateway courses. Defined as high enrollment, high failure rate courses taken by primarily first- and second-year college students, these gateway courses are critical to overall student success in college. This paper summarizes the activities of the group, including the conceptual frameworks that guided discussions and the proposed features of the analytics solution. The exercise was guided by Andrew K. Koch, Executive Vice President of the John N. Gardner Institute for Excellence in Undergraduate Education. Other group members included:

Mikel Berger	Partner	DelMar Information Technologies
Victor Borden	Professor and Senior Advisor	Indiana University
Ben Brautigam	Manager of Advanced Learning Projects	Pennsylvania State University
Michael Culbertson	Graduate Research Assistant	University of Illinois
Lee Rynearson	Graduate Assistant	Purdue University
George Siemens	Professor & Associate Director, Technology Enhanced Knowledge Research Institute	Athabasca University
Chi Wang	Business Analyst	McGraw-Hill Education Digital

Prior to attending the meeting, the group read "A call to action: Why high enrollment, high-risk, gateway courses require an intentional institutional improvement effort" – a concept paper specifically created by Koch (2012) for the purpose of defining issues and setting the context associated with unacceptably high failure rates in gateway courses across colleges and universities in the United States. For the sake of brevity, the content in that paper will not be recounted here. However, that concept paper should be viewed as necessary reading for anyone considering the solution described in this summary.

The Approach

With a topic as broad as improving institutional and student success in gateway courses, it should come as no surprise that the group decided to focus its efforts on a subcomponent of the overall gateway course failure issue. After considerable discussion, the team decided to create an analytic solution that targeted instructors. Specifically, the group decided to provide timely support to gateway course instructors through the development of an analytic solution that would provide:

- Actionable data regarding student behaviors related to successful completion of a gateway course;
- Interpretive guidance for instructors once the data is provided;
- A roster of context-specific suggested supports and/or interventions that instructors could apply to intervene with students in jeopardy of not succeeding in the course; and,
- Tracking mechanism(s) that took into account the actions taken by instructors and the actions' impact on student success.

To guide its effort, the team made use of a five component analytic model created by Campbell and Pistilli (2012). In this model, analytic solutions can be initiated and continuously refined by using five progressive steps. These steps include: 1) Gather; 2) Predict; 3) Act; 4) Monitor; and, 5) Refine.

The team also decided to draw on Chickering and Gamson's "Seven principles for good practice in undergraduate education" (1987) to further structure its work. The group decided to focus on four of the seven principles – feeling that these four principles could be best addressed by a data-based analytic solution for instructors. All seven of Chickering and Gamson's principles follow, with the four principles on which the group decided to focus being highlighted in bold, italicized font.

1. ***Encourages contact between students and faculty***
2. ***Develops reciprocity and cooperation among students***
3. Encourages active learning
4. ***Gives prompt feedback***
5. ***Emphasizes time on task***
6. Communicates high expectations
7. Respects diverse talents and ways of learning

With the Campbell and Pistilli model and Chickering and Gamson's principles providing theoretical frameworks, the group set out on its task. Specifically, the group worked to address how all four of the Chickening and Gamson's principles would be considered and advanced during each of the five components of analytics that are part of the Campbell and Pistilli model.

Table 1 illustrates how the group proposed addressing the gathering of data for an instructor-focused analytic solution – gathering data is the first component in Campbell and Pistilli's model. The first column depicts how data about contact between instructors and their students would be gathered. This aspect of the work would involve data collected from office hour logs, the frequency of emails between the instruction and student, and the frequency of participation in faculty-/instructor-led chats that are part of the course management system. The second column in Table 1 shows how data for developing cooperation and reciprocity among and between students would be gathered.

Table 1.			
Data Elements to Gather By Four Specific Chickering and Gamson Principles of Effective Practice in Undergraduate Education			
Encourages Instructor & Student Contact	**Develops Cooperation Among Students**	**Gives Prompt Feedback**	**Emphasizes Time on Task**
Office hours logs	Chat participation – student-to-student	Timeliness of Feedback (How quickly?)	Log-in frequency for students
Frequency of Email	Social learning platform involvement (Mixable, etc.)	Timing of Feedback (When did it occur during term?)	Time per log-in
Chat participation – instructor-to-student	Clicker data	Frequency of Feedback (How often?)	Activity when
			Frequency of

Data elements to be considered for this aspect of the model include the frequency of involvement in student-to-student chats that are part of the course

management system, the rate of participation in social learning environments such as Mixable, and the frequency of involvement and accuracy of responses from classroom clicker data. The third column shows

how the group wanted to gather data on prompt feedback from instructors to their students. Here the speed of provision of feedback on quizzes and exams, the timing of the feedback, and the frequency of the feedback are all data that could be gathered from the course management system as well as from electronic grade books.

Finally, the group felt that gathering data on how time on task was emphasized by instructors also had merit. This data would come in the form of the frequency with which students logged into the course management system, the duration of student visits within the

course management system, the form of activity that students undertook while they were logged into the course management system, and the frequency with which students completed assignments in the course management system.

The group then recommended that instructors use data from these sources to predict and understand student performance – thereby entering the second component of the Campbell and Pistilli (2012) model. Specifically, the team recommended having instructors predict aggregate student performance levels on each of the four Chickering and Gamson (1987) principles considered in the model. These aggregate predications would serve a benchmark that could be used for purposes of monitoring and, where merited, intervening. Individual

scores for each student on each of the four Chickering and Gamson (1987)

principles would be derived using the data elements identified in Table 1. These

scores would be juxtaposed with the corresponding instructor-predicted

aggregate score to see where students fell below, met, or exceeded each score.

The group proposed visualizing the data associated with these comparisons

through the use of a spider or web chart – a chart that displays multivariate data

in the form of a two-dimensional chart of three or more quantitative variables

represented on axes starting from the same point (Tauge, 2005, 437). An

example of what a spider chart of this nature might look like for students earning
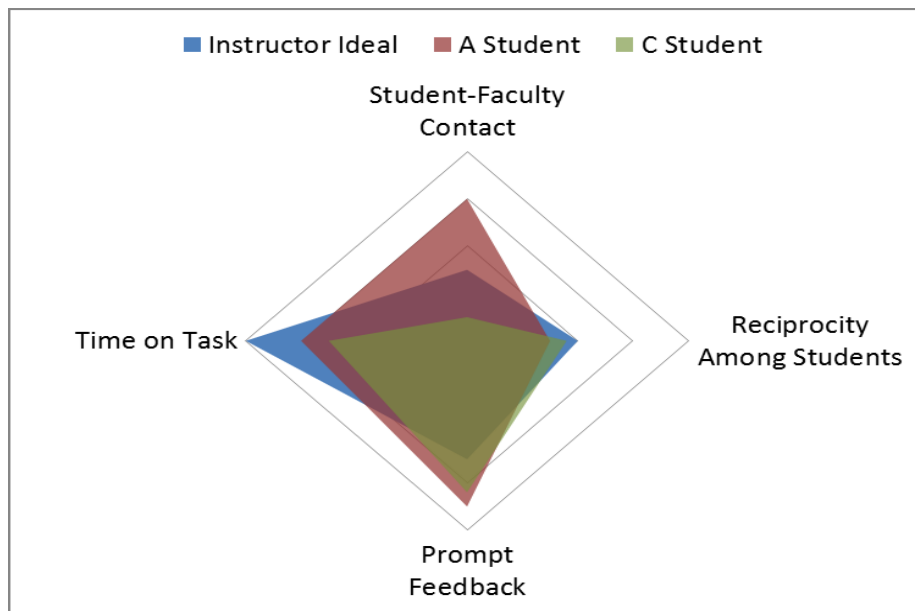
an A and a C in the courses follows in Figure 1.

Figure 1: Example spider chart showing instructor predicted and actual student performance on each of the four Chickering and Gamson (1987) principles considered for the proposed analytic solution

With the gathering and prediction components modeled, the group

proposed moving to action – the third component of the Campbell and Pistilli

(2012) analytic process. The group proposed using the same action method for guiding intervention with instructors based on all four principles. The method included:

- Providing feedback to instructors on student scores on all four principles; and,
- Including suggested actions / interventions for instructors for students who did not perform as predicted so the instructors, in turn, can reach out to the students to intervene.

It merits noting that the suggested actions in the second element of this component should be based on existing resources / efforts whenever possible. In other words, suggested interventions should not require faculty to draw on resources that do not yet exist at the institution.

The effort would be monitored – the fourth component of the Campbell and Pistilli (2012) model – via an examination of the interventions that instructors selected to determine what (if any) changes occurred in student performance on assignments and final course grades in connection with the actions / interventions. Activities that occurred within each of the four Chickering and Gamson (1987) principles would be analyzed to see what worked or did not work within each principle. Over time, a tool would be created for advisors or key administrators that allows for examination and analysis across for students across courses – to see if there are practices than span disciplines and/or instructors.

The monitoring of data would lead into the fifth component of the Campbell and Pistilli analytic model – the refine component. Where the data and

outcomes suggest, the proposed instructor analytic solution would be recalibrated. At the very least, each year the norms that were established for each of the four principles should be recalibrated using the findings from the previous year's work. Over time, those working with the proposed solution should consider the addition of other Chickering and Gamson (1987) principles as well as other theoretical and data components – components coming from outside of Chickering and Gamson's work.

As pointed out in the Koch (2012) concept paper that created as advance reading for the SoLAR Flare 2012 meeting, decreasing student failure rates in gateway courses is absolutely necessary for the nation to realize its Completion Agenda goals. Retention rates and the graduation rates that are ultimately attained have remained relatively flat for the last four decades. To remain viable in both the economic and democratic senses, the United States must have more students succeed in college and subsequently complete degrees and/or certificates than it has done in the last decades of the twentieth and first decades of the twenty-first centuries – and the first step toward succeeding in college is succeeding in gateway courses.

We believe that analytic solutions can be a part of the overall effort to improve student success and advance the nation's college completion agenda. But, as this exercise showed, analytic efforts are hard. They must be well-defined and applied in local context – which is why the proposed gateway course effort is narrowly focused on instructors and four principles of Chickering and

Gamson's (1987) work. The proposed solution, like predictive analytic solutions of any type, must be administered as a continuous quality improvement effort – an effort that applies data to action and then uses additional data to continuously promote excellence in the gateway courses and beyond.

To the extent possible, we hope that the description of the efforts taken by the gateway course-focused group at SoLAR Flare 2012 can inform your institution's predictive analytic efforts. Ultimately, you are the local experts – you know best the data sources and the potential partners at your institution. Where you find merit, we encourage you to consider this paper as you act to apply analytics to improve the experience in gateway courses at your institution. In so doing, you will be thinking globally while you act locally to increase student learning and success.

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Improving Accessibility and Success Rates for First-Generation and Low-Income Students

James E. Willis, III and Viktoria A. Strunk,

Nontraditional students face a dearth of challenges beginning with accessibility to higher education and continuing through successful completion of a program. One of the difficulties in educational research of so-called "nontraditional" students is articulating the characteristics that define what might classify a student as nontraditional. Levin's (2007) nuanced definition of "traditional" student is helpful here as a point of distinction: "They are viewed as students who have continued their education from high school to college or university, thus their age at college entry is seventeen, eighteen, or nineteen. They are also viewed as full-time students … [other characteristics] include high school completion, second or next generation of postsecondary education attendance within a family, and English as a first language" (p. 6). The Advisory Committee on Student Financial Assistance (2012) cites such characteristics as age ("typically 25 and older"), demography ("socioeconomic status, ethnicity, and first-generation and employment status") and "at-risk characteristics" including "delays enrollment into postsecondary education, attends part-time, is financially independent of parents, works full-time while enrolled, has dependents other than a spouse, is a single parent, [and] lacks a standard high school diploma" (p. 13). Of importance here, too, is the chosen lexicon of terminology like "at-risk" in terms of research perception and student

intervention efficacy; instead, more descriptive terms like "first-generation" or "low-income" tend to be more helpful. Engle's (2007) research in first-generation students yields important distinctions in this terminology: "First-generation students are disproportionately overrepresented in the most disadvantaged groups relative to participation in higher education. Demographically, first-generation students are more likely to be female, older, Black or Hispanic, have dependent children, and come from low-income families than students whose parents have college degrees" (p. 25). While the focus herein is on students who meet the criteria of first-generation and low-income, there are numerous other characteristics that may signify nontraditional status.

Recent literature indicates a drastic increase over the past four decades in the number of students classified as nontraditional. Schuetze and Slowey (2002) attribute fundamental changes in society to this increase, noting that "the change from an elite to a mass system of higher education occurred in the last decade of the twentieth century in virtually all developed societies. It is now acknowledged that this expansion is in the process of transforming fundamentally the very nature of higher education in terms of structure, purpose, social and economic role" (p. 309). Levin (2007) positions this significant change specifically indicating that 25 percent of students in 1970 were classified as nontraditional, whereas by 1999 that number had risen to 73 percent (p. 23). The Center for Postsecondary and Economic Success (2011) recently published data points that

reflect this changing trend: "Today's typical college student is no longer an 18-year-old recent high-school graduate who enrolls full-time and has limited work and family obligations. Students today are older, more diverse and have more work and family obligations to balance" (p. 1). For example, The Center for Postsecondary and Economic Success (2011) states that 36 percent of undergraduates in 2008 were age 25 or older and 40 percent of undergraduates were classified as low-income; this is defined as "family income was less than 200 percent of the Federal Poverty Line" (p. 1). The make-up of today's nontraditional student begs the question of *how* colleges and universities are meeting the needs of the nontraditional student. The Advisory Committee on Student Financial Assistance (2012) offers numerous suggestions including "consistent life coaching for at-risk students … use of faculty as student mentors … student services, such as the library, tutoring, and instructional support, should be available 24/7 in a variety of formats, including in-person, online, by phone, email, or chat" (p. 75-76).

In the plethora of challenges facing today's nontraditional student, perhaps the definition of success would be to define the obstacles to accessibility of collegiate education, identify the major root causes of attrition, and develop actionable plans to help individual students overcome educational barriers. In a key foundational model, Metzner and Bean (1987) identified "background and defining variables" including "age, hours enrolled, educational goals, high school performance, ethnicity, and gender" and analyzed how they fit within a

system of "academic variables, environmental variables, and social variables" (p. 17). In terms of access of first-generation and low-income students to undergraduate education, Engle (2007) identifies "…lower levels of academic preparation, lower educational aspirations, less encouragement and support to attend college, particularly from parents, less knowledge about the college application process, and few resources to pay for college" (p. 28) as leading factors. Accessibility is often directly tied to financial means because "although federal need-based grant aid still plays an important role in access for low-income students, current evidence suggests that merit-based grant programs do not adequately serve this population" (St. John, Musoba, Simmons, & Chung, 2002, p. 3). Indeed, as the Advisory Committee on Student Financial Assistance (2002) posits, "… this year alone due to record-high financial barriers, nearly one-half of all college-qualified, low- and moderate-income high school graduates – over 400,000 students fully prepared to attend a four-year college – will be unable to do so, and 170,000 of these students will attend no college at all" (p. v). The development of specialized programs to help nontraditional students is critical for any measure of success. The Advisory Committee on Student Financial Assistance (2012) offers a number of potential points of improvement from the national to the institutional level, including "… creating better structures for lifelong learning among our general population, initiating more effective workforce credentialing, testing new technologies and methods for use in our education system, promoting educational opportunities across the

country, and bringing people with new perspectives and diverse skills into the academy as both learners and institutional partners" (p. 67-79).

The academic barriers present in the lives of nontraditional students may be multifaceted and complex. The major question for research into accessibility and success models of higher education for nontraditional students centers on the difficulty of helping students who face multiple barriers (such as full-time employment while a student, caring for dependents, financial pressures, etc.). Choy (2002) elucidates one of the major difficulties of nontraditional students: "Two-thirds of highly nontraditional students perceived their primary role to be that of an employee, suggesting that school did not have first claim on their time and energy" (p. 19). These same students were also inclined to report "…that working has a negative effect on their grades" (Choy, 2002, p. 9). In a study conducted on academic services provided to nontraditional students, Keith (2007) found, "Although older students are profiled as vulnerable, barriers that the literature indicates may thwart attainment of nontraditional students were rarely reflected in increased use of services. In all of the models tested, only three variables were significant – age, employment status, and stress from increased tuition" (p. 1127).

Helping nontraditional students achieve success requires a number of considerations. The Advisory Committee on Student Financial Assistance (2012) puts forth suggestions for individual student success models including "provid [ing] students with a variety of options including online learning, low- or no –

cost education…assistance with prior learning assessment to complete their

credentials…aligning their mission to serving nontraditional students…in-person

and hybrid programs in multiple locations…counsel[ing] students to attend a

traditional institution if that is the best route for them to complete a degree…

[and to] use courses, tests, and trial periods to help students determine the best

institution to serve their needs" (p. 74). More specifically, students

matriculating into proprietary schools often state that they had already attended a

college or university but had dropped out because they felt like a number, almost

as though their instructors did not even know who they were in the auditorium-

style classrooms. Borden (2004) classifies this trait as "swirling" but what it

really defines is that students, in this case nontraditional students, are themselves

identifying what has not worked for them in the past and are trying, through their

own determination, to belong to an environment that will support them and all

the characteristics that make them unique. The academic setting may consider a

threefold plan to help nontraditional students achieve success:

Utilize smaller focus groups with similar cohorts for individualized attention

These groups need to be developed from day one of new student

orientation so that the students feel the connection that they need to succeed.

Ekman, Garth, & Noonan (2004) bring this out specifically: "The success

enjoyed by these [studied] institutions in educating students from the bottom

socioeconomic quintile is directly proportional to the knowledge they develop

about each one. If a college does not really know the student, how can the

student know that the school believes in him or her?" (p. 120).

Utilize direct intervention with advisors, which includes a decreased academic
load, at least in the beginning of the program

The students will be able to communicate with the advisor if they are

able to take on more credits with their busy lifestyles; in turn, advisors will be

better prepared to help. Schlossberg's (1989) work in "mattering" indicates that

"many adult learners felt they mattered to an advisor or to an institution. This

feeling kept them engaged in their learning" (p. 11). The focus should be

retention and what works best for the student. Here, Schlossberg (1989)

concludes that "the creation of environments that clearly indicate to all students

that they matter will urge them to greater involvement … institutions that focus

on mattering and greater student involvement will be more successful in creating

campuses where students are motivated to learn, where their retention is high,

and ultimately, where their institutional loyalty for the short- and long-term

future is ensured" (p. 14). Gone are the days of teacher-centered education, at

least with nontraditional students. As Rendón (1994) articulates, "old ideas,

practices, and conventions that have nothing to do with today's students die hard

in the academy. But die they must. And they must be replaced with new policies

and practices that are tailored to a new student majority that bears little

resemblance to the student of days gone by" (p. 45).

Keep students enrolled to prevent stopping out (taking off an academic term or more) and/or dropping out

Stratton, O'Toole, and Wetzel (2005) demonstrate, "From an individual perspective, students who drop out lose because they do not receive the substantial financial reward, the earnings differential, that college graduates receive. From a social perspective, these individuals fail to repay, in terms of tax revenue, the financial subsidy implicit in the low-cost tuition they may receive from taxpayers" (p. 22).

In addition, addressing financial aid concerns expeditiously is important to help nontraditional students achieve success. Hart (2003) points out the unique financial needs of nontraditional students: "Many would argue that the basic system is again the root cause; the financial system was designed and implemented for more traditional students who are dependent on their parents' resources, have not been part of the workforce, go to college full-time, and graduate as soon as possible" (p. 105).

Though a staggering majority of all undergraduates today meet "nontraditional" descriptive characteristics, there are nuances that need to be examined in order to fully understand resilience in the lack of sweeping, institutional changes. Recent research by Johnson and Nussbaum (2012) examined different types of coping mechanisms in a model that incorporated "task-oriented, emotion-oriented, avoidance-oriented coping" (p. 45). This research demonstrated that "traditional students may be disadvantaged in

comparison to nontraditional students in the sense that they may not be as developmentally prepared, or self-regulating, to cope with the stressors of college and, therefore, may benefit from instruction, resources, and services geared towards fostering adaptive coping strategy use" (p. 52). Whereas there may be academic preparation, financial aid, and other concerns for nontraditional students, this recent study suggests that nontraditional students may actually be better equipped to cope with hardships in the collegiate experience. Sheard's (2009) work on hardiness in educational settings demonstrates the importance of "commitment" because it is "the only hardiness attitude significantly correlated with, and predictive of, academic achievement" (p. 199). Chao and Good (2004) approach the barriers of nontraditional students with a qualitative design that argues for the value in specialized counseling to address five specific criteria for obtaining a college education: "Life transition, career development, financial investment, motivation, [and] support systems" (p. 8). What bind these together is a sense of "hopefulness" that "motivated their efforts related to financial concerns, career development, relationships, and life transitions. Indeed, hopefulness provided the self-efficacy and resilience for them to believe they could overcome their difficulties in these five areas" (p. 8). Rendón's (1994) research in student validation also helps demonstrate how "enabling, confirming and supportive process initiated by in- and out-of-class agents that foster academic and interpersonal development" contributes to the coping mechanisms of

nontraditional students (p. 44).

The greater implications to addressing the needs of nontraditional students in terms of higher education can be examined in terms of the sheer number of students who are, in fact, "nontraditional." Choy (2002) sums the findings in a major study:

> The "traditional" student is not typical. Fully three-quarters of all postsecondary students in 1999-2000 had at least one nontraditional characteristic. The most highly nontraditional students (those with four or more nontraditional characteristics) were concentrated in public 2-year institutions, with two-thirds enrolled in this type of institution…Among beginning postsecondary students seeking bachelor's and associate's degrees, nontraditional students were much more likely than traditional students to leave without earning any degree. They were most at risk of dropping out in their first year. Compared with their traditional counterparts, nontraditional beginning students who left their first institution were more likely to leave postsecondary education altogether… (p. 19).

As a society, the success of nontraditional students in higher education cannot be stressed enough: from a financial, sociological, and educated society perspective, it is critical to meet the needs of first generation and low-income students (St. John, Musoba, Simmons, & Chung, 2002, 1-2; 21-22).

Student success models for nontraditional students are vital in their evolution with an ever-changing society. Cabrera, Nora, and Castaneda's (1993) modeling demonstrates "an integrative framework in understanding the interplay among individual, institutional, and environmental variables in the college process" (p. 136). De Vito (2009) recently argued for a tripartite approach of "accessibility, affordability, and accountability" (p. 5). This approach was

developed, in part, by work done earlier by Zemke and Zemke (1995) who demonstrated that nontraditional student "adult learning is problem centered" and "adult learners are motivated by appeals to personal growth or gain" (p. 42-43). In a similar argument, Schuetze and Slowey (2002) suggest that nontraditional students may become "lifelong learners" (p. 321). Of the suggested institutional changes, perhaps the most applicable deals with reshaping the context of skills and education: "For the skills and qualifications that have been acquired in informal and non-formal learning settings – at the workplace, through the media, in community activities or everyday-life learning – to be recognized, it is necessary to develop procedures for their assessment, recognition and certification. With respect to the admission to higher education this means more procedures for the assessment and recognition of experiential learning, especially that based on vocational education and work experience" (p. 323). The implications on an individual student level ought to be brought out specifically: students becoming lifelong learners certainly have the transformative ability to help develop a better-educated society.

The composition of the current undergraduate population is nontraditional. Schuetze and Slowey (2002) summarize this succinctly: "As a part of the process of expansion and heterogenization, new groups of students who, for a complex range of social, economic and cultural reasons were traditionally excluded from or under-represented in higher education, have come to participate in increasing numbers" (p. 324). The potential for institutions to

programmatically address the needs of nontraditional students is both

strategically sound and responsible to propagate the ethos of twenty-first century

education.

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An Adaptable Model for Improving Accessibility and Success Rates for First-Generation and Low-Income Students

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Introduction

As evidenced by leading educational research, today's nontraditional student constitutes the majority of the college student population (Choy, 2002). Higher education institutions have an ethical, intellectual, and financial responsibility to consider and meet the unique needs of nontraditional students. Often such a mandate is met with words of agreement, but implementing institutional measures to assess and address these needs are a completely different challenge altogether (Watson, 2009; Brock, 2010). There are numerous demographic and socio-economic variables that may qualify a student as nontraditional (Giancola, Munz, & Trares, 2008). For the purposes of this analysis, "nontraditional" refers to individuals who are first-generation and low-income students. Refining the analysis based on these two groups helps focus the educational model to more directly address the needs of this student population. Furthermore, it is important to highlight that nontraditional students often have needs as unique as the individuals themselves and therefore it is unfair to generalize about a "one-size-fits-all" model of assessing and tackling their educational obstacles (Kasworm, 2008). Patience, innovation, and creativity are needed institutionally to drive the model of educational success.

In the age of "big data" and predictive analytics, modeling is a powerful tool to identify and examine the early warning signs of educational obstacles in the nontraditional student population (Campbell, DeBlois, & Oblinger, 2007). There are four central themes that drive our proposed model: (1) the importance of formalized student advising, (2) early detection of obstacles along with subsequent interventions, (3) individualized attention to specific obstacles, and (4) identifying educational obstacles by which an institution may enact change as well as personal obstacles which an institution has very little – if any – control, save that of perhaps supportive counseling.

Actionable Change: Themes to a Model

These four central themes driving a model of educational success are useful only in terms of what actionable intelligence they produce. The unique obstacles facing a first-generation and low-income student indicate that any analytical model should be adaptable and malleable according to the needs of a given institution (Pascarella, Pierson, Wolniak, & Terenzini, 2004) and that serve different actionable outcomes based on student cohort characteristics. The proposed model takes into consideration the variety of educational environments including large research and mid-size universities, small liberal arts colleges, career-oriented colleges, online schools, and community colleges. Additionally, this proposed model is not intended to solve the complex, multivariate challenges of nontraditional students, but rather it aspires to help schools think

through some of the problems and then deal with both aggregate and individual data points. The model's key feature is *adaptability*.
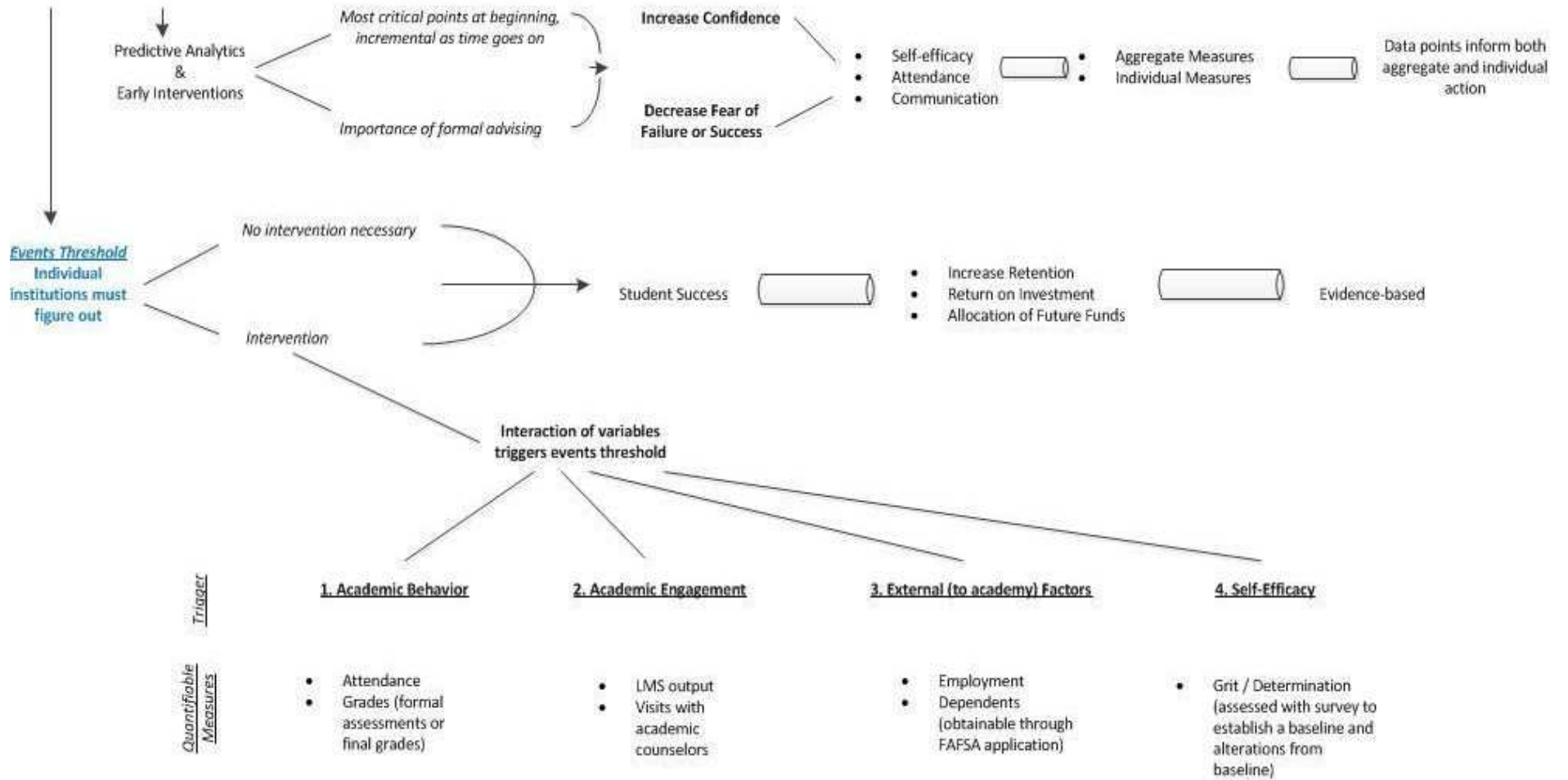
While this may be open to interpretation, it is meant to highlight how a collegiate institution might function more efficiently to help the population of nontraditional students. The efficaciousness of this analytical model rests with several key measures taken from the interplay of aggregate and individual data. These measures are quantifiable and important to all institutions of higher education. They take into account student retention across multiple cohorts (Cabrera, Nora, & Castañeda, 1993), return on investment (Stewart & Carpenter-Hubin, 2000-2001), and clarity for the allocation of future funding for student intervention programs (Hagedorn, 2005).

At this point it becomes possible to describe an analytical model to address student success in first-generation and low-income populations. The model's adaptability, aspirations for student success, and measures of key indicators provide a framework within which to describe how aggregate and individual data points become critical interlocutors of scalable change. Figure 1 on the following page is a visual representation of a working model that is both action-based with respect to the target population and adaptable to different educational institutions.

Nontraditional Students

Event-Based Points of Completion: A Model

Milestones in a Student's Lifecycle

Predictive Analytics & Early Interventions

Most critical points at beginning, incremental as time goes on

Importance of formal advising

Increase Confidence

Decrease Fear of Failure or Success

- Self-efficacy
- Attendance
- Communication

- Aggregate Measures
- Individual Measures

Data points inform both aggregate and individual action

Events Threshold
Individual institutions must figure out

No intervention necessary

Intervention

Student Success

- Increase Retention
- Return on Investment
- Allocation of Future Funds

Evidence-based

Interaction of variables triggers events threshold

Trigger

Quantifiable Measures

1. Academic Behavior

- Attendance
- Grades (formal assessments or final grades)

2. Academic Engagement

- LMS output
- Visits with academic counselors

3. External (to academy) Factors

- Employment
- Dependents (obtainable through FAFSA application)

4. Self-Efficacy

- Grit / Determination (assessed with survey to establish a baseline and alterations from baseline)

* Note: individual factors must be set by institution according to population of traditional/nontraditional students

Factors might include a designation of low, medium, or high.

An Events-Based Model: Discussion

Nontraditional Students: A Model of Events-Based Points of Completion, is both action-based with respect to the target population and adaptable to different educational institutions. It is premised on the idea that there are milestones in every student's life cycle from admissions to matriculation to graduation at which different interventions can support student success. Identifying, predicting, and acting upon the most critical milestones, typically at the beginning of the student life cycle, will determine success or failure (Calcagno, Crosta, Bailey, & Jenkins, 2007). In terms of the student life cycle, "success" is defined as completion of the academic program in order to fulfill the necessary requirements for graduation; conversely, "failure" is defined as a prolonged or permanent interruption in a course of study that leads to a student dropping out and not achieving their educational goals. Critical milestones and their metrics must be determined and applied by the individual institution. They may be purposely vague such as evaluating if students are able to obtain materials for class, or highly targeted like a measurement of the first grades assessed in a given class. The critical measurements are theorized to become more refined and tightly-spaced as the student navigates through the curriculum naturally flowing with a formal advising system whereby students receive the institutional support needed to progress.

The "top-level" features of this model are meant to engage the less quantifiable, but still critical components for increasing self-confidence and

decreasing the fear of failure (or in some students, the fear of success). These psychological components might be assessed with the metrics of self-efficacy, attendance records, and communication with faculty and staff. The amalgamation of these top-level features is important in aggregate measures and individual measures alike. The data points, working together in a qualitative and quantitative interplay, paint a more complete picture of how schools might begin to fill out what the critical measures of an events' threshold for triggering intervention might be. Specifically, if a school suggests that a study skills preparatory course might greatly benefit its students, this model might usefully measure the outcomes of the course. Through measures of self-efficacy (independent studying and skill-based confidence), attendance records, and measures of student interactions with faculty and staff, an institution might assess if a study skills course increases student confidence and decreases fear of failure (or success). Data points in the aggregate including grades and attendance and an individual's qualitative perceptions of efficacy can lead to actionable outcomes. In this case the data would be used to justify the decision to continue or discontinue the study skills course.

 With these top-level metrics in place, an events' threshold can be established to make data-driven decisions on whether or not to intervene in an individual student's life cycle. An institution's determination of whether an intervention is necessary or not will determine, even in a *post hoc* analysis, a student's success or failure. To examine this a bit further, if a school elects not to

intervene on a certain data point, perhaps with grades of D or F on students' first college quizzes, a strong correlation may be seen after the fact when student dropout rates are analyzed. Conversely, the institution that decides to offer tutoring to students with D or F grades on their first college quiz may measure a correlation between higher retention and student success in later courses. As central as the intervention component is to the model, the measurements that may assess its efficaciousness tend to be a bit broader. Schools may put in measures of retention against a control group to assess the effectiveness of certain intervention programs. Likewise, a return on investment for a specific technology, such as a predictive analytics component tied into a learning management system, might be used in terms of student success through a program. Because these metrics are evidence-based, the examination of retention and return on investment may also drive administrative conversations about future allocation of funds for specific programs.

It may be argued that an educational model is only worth as much as its actionable items where the interaction of variables triggers the event threshold that indicates a need for intervention and that offers a range of potentially effective interventions. Here are some suggestions to help guide an institution to determine the interactions of certain key triggers common amongst first-generation and low-income students. The measures of these triggers are specifically quantifiable. While there may be many other possible triggers, the

ones offered in this model are those which may be easiest to quantify and, therefore, equip a school for intervention:

1. *Academic behavior*. A student's behavior can be quantified with attendance records, which tend to be binary in nature (a student is either in attendance or not), but can be captured as frequency/percentage of attendance. It is also possible to quantify and evaluate a student's grades, preferably as early in a semester as possible and often. While final grades may be good fodder for research, the actionable items for retention and student success need to be assessed early in the semester for students to seek or be offered help.

2. *Academic engagement*. A student's engagement in a given class may be quantified with the help of a learning management system (LMS). Engagement could include metrics on student discussion posts and use of other LMS course related resources and features. Additionally, it is possible to quantify types and frequencies of visits with academic counselors which may help identify students who are having multiple difficulties (frequency of visits) or students who are isolated (infrequency of visits). It is important to consider how the inverse may also indicate what should be actionable. In this case infrequent visits may indicate mastery rather than disengagement.

3. *External (non-academic) factors*. Nontraditional students typically have multiple commitments outside of their schoolwork including those

pertaining to employment and family. In terms of what is quantifiable, employment records may be gathered during orientation and number of dependents may be gathered from students' Free Application for Federal Student Aid (FAFSA) form. This type of data may assess students' outside commitments and, thus, what competes for their time.

4. *Self-efficacy*. Nontraditional students often have a determination to succeed that may be less pronounced in other student groups. While more difficult to quantify than other aforementioned measures, it is possible to develop a survey to assess a "grit" factor, or a personal determination to succeed in college. Once a baseline grit factor is determined, further quantifications of deviance from this baseline may indicate need for intervention.

The purpose of describing these four factors is to begin an institutional conversation to determine what can be measured in terms of actionable analytics. Each of the chosen factors might include a low, medium, or high indicator depending upon institutional characteristics like typical demography, curriculum structure, and scheduling considerations. Such indicators will also allow for some flexibility within the model, especially as differing institutions think about how their own internal culture might have divergent priorities.

Implications and Conclusion

The model presented is flexible and specialized enough to describe some of the unique needs of nontraditional students, but also generalizable enough to suggest how institutions may begin to form plans for actionable intelligence. Although it is impossible to fully portray the individual needs of nontraditional students, institutions should consider how aggregate data of students might help shape programs and interventions. Further, institutions should attempt to put into place quantifiable measures that can assess actionable change on the parts of individual students and entire cohorts. The proposed model takes the challenge of addressing the needs of nontraditional students by establishing a triggering system based on early indicators. This provides a way for institutions to turn seemingly disparate information into quantifiable metrics.

The sustained thesis in this educational model is adaptability to continuous change, variable refinement, and production of actionable metrics. The purpose of this model is twofold. In the broad sense, it may help institutions begin productive conversations to address the needs of first-generation and low-income students. In an ambitious sense this educational model provides a way forward to develop a methodology for assessing various forms of data to enact systemic change for better serving the growing nontraditional student population. In either case, the model can serve as a discussion base for the many contributors on campus and beyond that must coordinate to support student success.

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College Completion: A Case for Addressing Issues Surrounding Degree Attainment Rates in American Higher Education

Matthew D. Pistilli and Brent M. Drake

In 2009, a confluence of events and data releases focused attention on the need for a more highly-educated workplace. The United States had just sworn in a new president who was saddled with an economy that was in the throes of the worst recession since the Great Depression. Unemployment was at 7.8% and climbing (it would later top out at 10.0% in October of the same year) (U.S. Bureau of Labor Statistics, 2012). The Organization for Economic Co-Operation and Development [OECD] released its yearly *Education at a Glance* report, which placed the United States 18th among the 25 OECD countries with regard to college going rates of 20-29 year olds (OECD, 2009, Chart C1.1). Further, the OECD indicated that the United States' graduation rate ranked 16th among OECD nations (Chart A3.2). Further, Bowen, Chingos, and McPherson published *Crossing the Finish Line*, in which they asserted that the attainment rate for American students "is both too low and stagnant" (2009, p. 223). They also posited that not only did the overall graduation rate matter, but the time it took to graduate was equally as important (Bowen et al., 2009, p. 224). In short, multiple pieces of data pointed to the same thing: the United States was lagging in both college-going and college-completion rates, and a faltering economy forced businesses to reexamine their workforce needs. Further, more attention needed to be placed on getting students to complete a degree or credentialing program, and

to do so in a timely manner.

One month into his presidency, Barak Obama, in his address to a joint session of Congress, asserted that "by 2020, America will once again have the highest proportion of college graduates in the world … every American will need to get more than a high school diploma." Earlier in the same speech, he asserted that "right now, three-quarters of the fastest-growing occupations require more than a high school diploma. And yet, just over half of our citizens have that level of education. We have one of the highest high school dropout rates of any industrialized nation. And half of the students who begin college never finish" (2009). Around the same time, Lumina Foundation for Education announced its "Big Goal," wherein they were to work "to increase the proportion of Americans with high-quality degrees and credentials to 60 percent by the year 2025" (Lumina Foundation, 2009, p. 1). More recently, in July, 2012, Lorrain Woellert of Bloomberg indicated that roughly three million jobs are going unfilled due to the need for a more highly skilled workforce (p. 1). Compounding the issue is the fact that nearly 30% of undergraduates who take loans to finance their education drop out before completing their degree – and these students are more than four times as likely to default on their loans than their peers who took loans and graduated from college (Mui & Khimm, 2012). These facts clearly indicate a growing need to address the completion rate for students in higher education.

But what is success? In the end, the goal is to have more students com-

plete college than are currently doing so. Lumina Foundation for Education has staked a mark at 60% of all adults should hold some form of a collegiately-granted credential by 2025. President Obama's goal is to see 10 million more graduates from community colleges and universities by 2020 – a number that is two million greater than what is projected given current trends. Obama's plan further calls for every American to have *at least* one year of higher education and/or advanced training. Complete College America, a not-for-profit organization headed by Stan Jones (former Indiana State Representative and Indiana Commissioner for Higher Education) focuses less on hitting a specific number and more on increasing the number of students who complete their degrees in a timely manner. His suggestions are more programmatic and structural in nature: devising procedures and policies to help students navigate through courses more efficiently, creating structure through block schedules, working with individual states who, in turn, work with their state-funded institutions to impact student success.

Over the last six years there have been moderate gains in completion rates. However, for students who begin at four-year institutions the six-year graduation rate still only stands at 58.3% (a gain of 2.9 percentage points), and for students who begin at two-year institutions the 150% completion rate is only 29.9% (a gain of 0.6 percentage points) (National Center for Education Statistics, 2012). Additionally, success, in whatever form, has to ensure that all students are impacted by any reforms that are made. This includes students attend-

ing full-time and part-time at four-year, two-year, and for-profit institutions. Of particular note, however, are specific populations most at risk for not completing their degrees, which are illustrated in the following table.

Population	Attending Full-Time			Attending Part-Time		
	1-year certificate in 1.5 years	2-year degree in 3 years	4-year degree in 4 years	1-year certificate in 1.5 years	2-year degree in 3 years	4-year degree in 4 years
Hispanics	18.5%	11.1%	46.5%	9.1%	2.6%	16.7%
Older (25+ at entry)	30.2%	14.4%	27.0%	11.3%	4.6%	10.6%
Low-income (Pell grant eligible)	23.1%	11.8%	45.2%	10.9%	4.3%	17.3%
All students	27.8%	18.8%	60.6%	12.2%	7.8%	24.3%

Jones (2011) indicates that of those who do graduate, certificates that should take one year to complete take 3.3 years for full-time students compared to 4.4 years for part-time students. Two-year associate degrees, on average require 3.8 years and 5 years, respectively, to complete. Four-year bachelor degrees fare slightly better, with full-time students taking only 4.7 years to complete and part-time students requiring 5.6 years. Jones (2011) continues, by noting that giving full-time community college an extra year or four-year college students two extra years to complete their degrees only increases each by about 4.9%. Other populations at risk of not completing a degree include African-Americans, of whom only 42% graduate with a four-year degree within six years and only 11% complete an associate's degree within three years. (IPEDS, 2007);

first-generation students, of whom only 52% remained enrolled in a four-year degree program three years after starting one (Choy, 2001); and, minority women, of whom only 22 percent of African-Americans and 13 percent of Hispanics earning a four-year degree by age 26 (white women didn't fare much better, having only 36% completing within the same timeframe) (Bowen, Chingos, & McPherson, 2009, p. 8).

Barriers for these, and truly, all student populations do exist – some of which are within the power of a given institution to manage, others which need to be acknowledged by an institution in an effort to work with students facing them. For example, at the point of entry there is an issue with students who are "undermatched" to institutions. That is students ending up at a less selective institution than one they appear to be qualified for. Students who wind up "undermatched" graduate at rates that are 15 percentage points lower than their similarly qualified peers (Bowen et al., 2009). Bowen and his colleagues (2009) also point out that an articulation problem appears to exist for students starting at two-year institutions, as students who start in two-year colleges are far less likely to ever obtain a bachelor's degree.

Furthermore, once a student is enrolled at an institution a common barrier can be full-time attendance; as indicated by Jones' research (2011), students who attend college full-time complete their degrees at rates demonstrably higher than their part-time counterparts. However, students attending part-time often do so because they need to work, have familial responsibilities, or simply can't afford

to attend full-time. Additionally, analysis at an individual institution level has indicated that even among full-time students even attempting enough credit hours for on-time completion let alone earning enough is not a common practice (Drake, 2012).

Students entering college in need of remediation present another significant challenge. Currently only 4 in 10 remedial students at community colleges complete their remedial courses, only 1 in 10 remedial students graduate from community colleges in three years, and only a third of remedial students earn bachelor's degrees in six-years (Complete College America, 2012). Beyond remediation courses, student success in gateway courses as well as repeats of said courses delay students' on-time completion (Drake, 2012). Also, the frequency and timing of students changing of majors impacts their completion and time to degree (Drake, 2012; Foraker, 2012).

Other barriers include working more than 20 hours a week (regardless of schedule), simply being a minority, first-generation, or low-income student, or falling behind in completed credits in the first year of college (Astin & Oseguera, 2005). Finally, 40 years of higher education literature indicates the importance of students' motivational factors such as commitment, integration, and engagement at their institutions (Reason, 2009). The challenge is determining which barriers can be directly addressed through programming and intervention by an institution, and then taking said action to address them.

Because inaction also is a form of action, there exists the opportunity for

us to do nothing. However, Bowen et al. note that "As is increasingly recognized, the United States can no longer claim that it is "first-in-class" in terms of a continuing progress in building human capital…in the United States only 56 percent of entering students finished college, an outcome that placed the country second to the bottom of the rank-ordering of countries by completion rate." (2009, p. 4). Further, the economy that so badly needs skilled, college-educated workers will continue to falter and the United States' presence as the strongest economy in the world will no longer be so. To that end, and more pointedly, Baum, Ma and Payea indicate that college completion is highly correlated, and nigh on a prerequisite for, having a higher median income and overall lifetime earnings, greater satisfaction with jobs and doing fulfilling work, and obtaining quality health care and retirement benefits (2010).

The implications for increasing completion and graduation rates for higher education are many, at both the individual institution level and the national level. First, students will progress through degree programs faster, possibly without having to repeat courses. If less students have to repeat courses, then more students who haven't taken a given course will be able to get into that course, meaning less sections of that same course will need to be offered. That frees up faculty/instructors on campuses to teach other courses *as well as* frees up classroom space, of which there often is precious little. The cost savings to institutions from this is enormous.

Second, getting more students through to graduation means that more

students from all populations will graduate. Thus, more minority students, low-income students, and first-generation students will earn degrees, which, in turn, will begin to close the gap in earnings and earning potential between these populations and their white, affluent, second-generation or later peers.

Finally, institutions that succeed in raising their graduation/completion rates and shortening the time to degree will have created, as Hrabowski and Seuss (2010) noted, "a climate that encourages (1) asking good questions, (2) being honest about both strengths and challenges, and (3) developing innovative problem-solving strategies and initiatives that address particular issues, including programs that connect students to faculty, staff, and each other" (p. 60). In creating this climate, all students will have a better chance of succeeding, and the institution will have done a great deal to better itself.

In an era of accountability and transparency, it is imperative that institutions work to improve them. Completion agendas must be created and institutionalized. As pointed out in *The Completion Agenda: A Call to Action* from the American Association of Community Colleges, "completion should be made a part of [an] institution's strategic plan" (p. 3). They continue, noting that institutions have "a responsibility to increase completion rates" (p. 3). Complete College America (2011) advocates that "colleges and universities must make graduation, not head counts, their measure of success." Between the resources made available and emphases placed on graduation rates, the very great potential exists for higher education to stem the tide of people leaving college with no credential

or degree. The application of analytics to existing data can only aid us in that

effort.

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**A Learning Analytics Methodology for Impacting the
College Completion Agenda in Higher Education**

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Introduction

In 2009, a confluence of events and data releases focused attention on the need for a more highly-educated workplace. The United States had just sworn in a new president who was saddled with an economy that was in the throes of the worst recession since the Great Depression. Unemployment was at 7.8% and climbing (it would later top out at 10.0% in October of the same year) (U.S. Bureau of Labor Statistics, 2012). The Organization for Economic Co-Operation and Development [OECD] released its yearly *Education at a Glance* report, which placed the United States 18th among the 25 OECD countries with regard to college going rates of 20-29 year olds (OECD, 2009, Chart C1.1). Further, the OECD indicated that the United States' graduation rate ranked 16th among OECD nations (Chart A3.2). Further, Bowen, Chingos, and McPherson published *Crossing the Finish Line*, in which they asserted that the attainment rate for American students "is both too low and stagnant" (p. 223). They also posited that not only did the overall graduation rate matter, but the time it took to graduate was equally as important (p. 224). In short, multiple pieces of data pointed to the same thing: the United States was lagging in both college-going and college-completion rates, and a faltering economy forced businesses to

reexamine their workforce needs. Further, more attention needed to be placed on getting students to complete a degree or credentialing program, and to do so in a timely manner.

One month into his presidency, Barak Obama, in his address to a joint session of Congress, asserted that "by 2020, America will once again have the highest proportion of college graduates in the world … every American will need to get more than a high school diploma." Earlier in the same speech, he asserted that "right now, three-quarters of the fastest-growing occupations require more than a high school diploma. And yet, just over half of our citizens have that level of education. We have one of the highest high school dropout rates of any industrialized nation. And half of the students who begin college never finish" (2009). Around the same time, Lumina Foundation for Education announced its "Big Goal," wherein they were to work "to increase the proportion of Americans with high-quality degrees and credentials to 60 percent by the year 2025" (Lumina foundation, 2009, p. 1). More recently, in July, 2012, Lorrain Woellert of Bloomberg indicated that roughly three million jobs are going unfilled due to the need for a more highly skilled workforce (p. 1). Compounding the issue is the fact that nearly 30% of undergraduates who take loans to finance their education drop out before completing their degree – and these students are more than four times as likely to default on their loans than their peers who took loans and graduated from college (Mui & Khimm, 2012).

These facts clearly indicate a growing need to address the completion rate for students in higher education.

Ultimately the goal in the college completion agenda is to have more students complete college with a credential than are currently doing so. Lumina Foundation for Education has staked a mark at 60% of all adults should hold some form of a collegiately-granted credential by 2025. President Obama's goal is to see 10 million more graduates from community colleges and universities by 2020 – a number that is two million greater than what is projected given current trends. Obama's plan further calls for every American to have *at least* one year of higher education and/or advanced training. Complete College America, a not-for-profit organization headed by Stan Jones (former Indiana State Representative and Indiana Commissioner for Higher Education) focuses less on hitting a specific number and more on increasing the number of students who complete their degrees in a timely manner. His suggestions are more programmatic and structural in nature: devising procedures and policies to help students navigate through courses more efficiently, creating structure through block schedules, working with individual states who, in turn, work with their state-funded institutions to impact student success.

Over the last six years there have been moderate gains in completion rates. However, for students who begin at four-year institutions the six-year graduation rate still only stands at 58.3% (a gain of 2.9 percentage points), and for students who begin at two-year institutions the 150% completion rate is only

29.9% (a gain of 0.6 percentage points) (National Center for Education

Statistics, 2012). Additionally, success, in whatever form, has to ensure that all

students are impacted by any reforms that are made. This includes students

attending full-time and part-time at four-year, two-year, and for-profit

institutions. Of particular note, however, are specific populations most at risk for

not completing their degrees, which are illustrated in the following table.

Jones (2011) indicates that of those who do graduate, certificates that

should take one year to complete take 3.3 years for full-time students compared

to 4.4 years for part-time students. Two-year associate degrees, on average

require 3.8 years and 5 years, respectively, to complete. Four-year bachelor

degrees fare slightly better, with full-time students taking only 4.7 years to

complete and part-time students requiring 5.6 years. Jones (2011) continues, by

noting that giving full-time community college an extra year or four-year college

students two extra years to complete their degrees only increases each by about

4.9%. Other populations at risk of not completing a degree include African-

Americans, of whom only 42% graduate with a four-year degree within six years

and only 11% complete an associate's degree within three years. (IPEDS, 2007);

first-generation students, of whom only 52% remained enrolled in a four-year

degree program three years after starting one (Choy, 2001); and, minority

women, of whom only 22 percent of African-Americans and 13 percent of

Hispanics earning a four-year degree by age 26 (white women didn't fare much

better, having only 36% completing within the same timeframe) (Bowen, Chingos, & McPherson, 2009, p. 8).

Barriers for these, and truly, all student populations do exist – some of which are within the power of a given institution to manage, others which need to be acknowledged by an institution in an effort to work with students facing them. For example, at the point of entry there is an issue with students who are "undermatched" to institutions. That is students ending up at a less selective institution than one they appear to be qualified for. Students who wind up "undermatched" graduate at rates that are 15 percentage points lower than their similarly qualified peers (Bowen et al., 2009). Bowen and his colleagues (2009) also point out that an articulation problem appears to exist for students starting at two-year institutions, as students who start in two-year colleges are far less likely to ever obtain a bachelor's degree.

Furthermore, once a student is enrolled at an institution a common barrier can be full-time attendance; as indicated by Jones' research (2011), students who attend college full-time complete their degrees at rates demonstrably higher than their part-time counterparts. However, students attending part-time often do so because they need to work, have familial responsibilities, or simply can't afford to attend full-time. Additionally, analysis at an individual institution level has indicated that even among full-time students even attempting enough credit hours for on-time completion let alone earning enough is not a common practice (Drake, 2012).

Students entering college in need of remediation present another significant challenge. Currently only 4 in 10 remedial students at community colleges complete their remedial courses, only 1 in 10 remedial students graduate from community colleges in three years, and only a third of remedial students earn bachelor's degrees in six-years (Complete College America, 2012). Beyond remediation courses, student success in gateway courses as well as repeats of said courses delay students' on-time completion (Drake, 2012). Also, the frequency and timing of students changing of majors impacts their completion and time to degree (Drake, 2012; Foraker, 2012).

Other barriers include working more than 20 hours a week (regardless of schedule), simply being a minority, first-generation, or low-income student, or falling behind in completed credits in the first year of college (Astin & Oseguera, 2005). Finally, 40 years of higher education literature indicates the importance of students' motivational factors such as commitment, integration, and engagement at their institutions (Reason, 2009).

The challenge is determining which barriers can be directly addressed through programming and intervention by an institution, and then taking said action to address them. Solving this challenge requires expanding access and completion effectiveness. The authors believe that data can help institutions to match and guide students to completion of an appropriate credential. As such this paper is an overview of a process (figure 1) that can assist institutions in
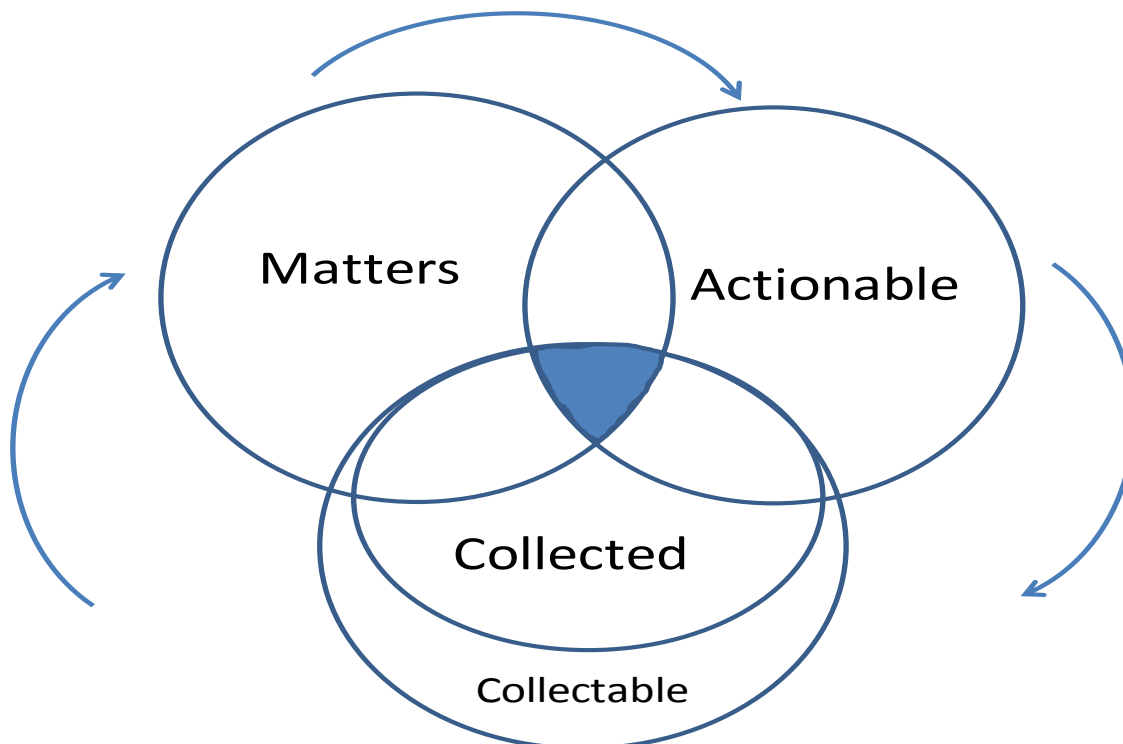
Figure 1. Process for addressing data analytic questions

developing data analytic methods to address student completion at their institution.

The Process

     As indicated in figure one the process is cyclical in nature, moving through the stages of what data are collectable and collected by your institution, conducting initial analyses to determine what of the data matters, focusing on the subset of data that are actionable and reexamining the process to determine how your models can be refined and additional data points added. The goal of the analytical process is for the user to determine what data are collected at their institution, that matter in relation to college completion, and allow for action at the institution.

     The first step in the process is a thorough examination of what data are collectable by your institution to inform your students' completion rates. This

involves both a close examination of all the data points that are actually collected at your institution as well as those data that are identified within the literature as relevant. Relevant data likely available at institutions tend to cluster among five broadly defined data themes: incoming, selection, learning, performance, and administrative

Incoming data are those elements typically held within the enrollment management offices such as admissions, financial aid, and the registrar. These elements include standardized test scores, high school transcript information, location, extracurricular information, income factors, institutional placement exams, parental education, cognitive assessments, and key demographic markers such as gender and race. Selection data elements pertain to the students' choice of institution including academic interest profiles, admissions essays focusing on leadership and participation in areas of interest, recommendations from professionals, career exploration batteries, past subject data, and sequence of previous courses. Learning elements focus on what is occurring in your institution's classrooms including course outcomes, detailed activity data within the course, attendance data, assessments of learning objectives, instructor demographics, class sizes, advising demographics, course modality, and instructional design models. Performance data are focused on how students are proceeding at your institution. They included summative course grades, and formative gradebook data, assessments of learning objectives, types of classroom assessments, student satisfaction, teacher evaluations, retention, and graduation.

Finally, administrative data are focused primarily on campus system metrics such as use of campus resources, use of and quality of academic advising, use of academic technologies, course withdrawals, add/drop rates, course retake behavior, majors, change of majors, timing of major changes, and student course loads.

Almost all of these elements have the potential to be highly related to student completion rates at your institution, so to make the task of gathering elements more feasible one should focus on what elements the institution has readily available, what of those items can be accessed with the lowest efforts, and finally what elements you may need to focus on trying to gather in the future.

Once you have identified what of the potential collectable data are actually collected and readily accessible at your institution you must conduct correlational analysis to determine which of the data points are related to your metrics of student success. This will allow you to ascertain which of the elements truly matter. While there are a myriad of ways to broadly define student success at an institution, we recommend focusing on those data elements that predict: 1. Course completion, 2. Term to term retention, and 3. Graduation. Additionally, it is necessary to examine the differentiation of the correlates by key demographic subgroups on your campus.

After you have determined which of the data elements truly matter via their prediction of student success at your institution the next step is to identify

the subset of correlates that are readily actionable at your institution. Those actions must be linked and holistic and fit within your institution's environment and mission. You need to focus on what is doable, cost effective, and indicates the best combination of potential risk and impact. For instance while student pre-entry measures of academic ability are highly predictive of student success at institutions it serves little purpose to focus efforts on increasing entering students' academic profile if you work at an open access institution.

Once you have determined what actions you will take at your institution based on the correlates of student success you must continue to holistically review the process and the implications of your actionable steps. One should focus on how well recommendations were enacted, the impact on aforementioned student success metrics, and any road blocks that occurred in implementation efforts. This continual evaluation of your efforts will help you identify revisions to your initial correlational models. This will lead you to examine what additional data you can collect, that relates to and better predicts student success at your institution, and that you can take actionable steps upon.

Conclusion

In an era of accountability and transparency, it is imperative that institutions work to improve their students' success. Completion agendas must be created and institutionalized. Complete College America (2011) advocates that "colleges and universities must make graduation, not head counts, their measure of success." Between the resources made available and the emphasis

placed on graduation rates, the very great potential exists for higher education to stem the tide of people leaving college with no credential or degree. The application of analytics to existing data can only aid us in that effort.

     Institutions that succeed in examining and enacting methods that increase their students' success and ultimate graduation will create what Hrabowski and Seuss (2010) describe as, "a climate that encourages (1) asking good questions, (2) being honest about both strengths and challenges, and (3) developing innovative problem-solving strategies and initiatives that address particular issues, including programs that connect students to faculty, staff, and each other" (p. 60). In creating this climate, all students will have a better chance of succeeding, and the institution will have done a great deal to better itself.

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Supplemental Materials

Overview of Supplemental Materials

Two additional papers were written for the SoLAR Flare conference at Purdue University, and both were thoroughly investigated and discussed during the event. However, as of the time when this volume was being assembled, final potential solutions had not yet been drafted into a form that would be suitable for publication. Given that the goal of the conference was to create dialogue around a topic that could be addressed and mitigated (to some extent), the organizers felt it prudent to include in this document both papers with the intent of having the reader utilize them – and potentially the other thought papers – as foundations for exercises with colleagues and other interested parties.

To that end, the following two papers focus on the needs of and challenges facing student veterans on our college campuses and increasing success of college women majoring in science, technology, engineering or math (STEM). Using the analytic model outlined on pages XX-XX, we suggest that readers take these papers as a starting point for determining how one might begin to address these concerns using analytics. Further, we challenge those developing a solution to put them into practice, and to report on the results.

Following these two papers are the biographies for the editor of the volume, as well as for those authoring the thought papers for which the solutions were developed. Finally, a roster of institutional affiliation for those contributing to the solution papers is also included.

Student Service Members and Veterans on Campus
Stacie F. Hitt

More than 2 million service members have been deployed in Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) since 2001 (U.S. Armed Forces Surveillance Center, 2011). Since 2009, when the Post 9/11 GI Bill went into effect, more than 1.3 million veterans have accessed U.S. Department of Veterans Affairs (VA) education benefits of all types, representing an investment by U.S. taxpayers of $18.8 billion in military veterans' education (U.S. Department of Veterans Affairs, 2012). Due to the military drawdowns, which began in September 2010, and general force reductions, the number of student service members and veterans on campuses throughout the country is expected to increase substantially in the coming years (Steele, Salcedo, & Coley, 2010).

The challenge

Only 4% of Vietnam era veterans completed a college degree before their GI Bill benefits expired, despite the fact that more of them used GI Bill benefits than veterans of either World War II or Korean War eras (Card & Lemieux, 2000; Horan, 1990). While the Vietnam era GI Bill and its subsequent amendments provided some tuition assistance for those who paid into the programs during their service, the amounts were insufficient to cover the costs of a college education and veterans needed additional resources to finish school (Boulton, 2008). These issues have largely been addressed in the newest iteration of the GI Bill and other tuition assistance programs, but as many as 70% of OIF and OEF student veterans report moderate to major non-financial challenges in the transition from military service to education (Steele, Salcedo & Coley, 2010). Universities and colleges may not be well informed or equipped to address the unique needs and expectations of these highly capable students, unintentionally contributing to poor completion rates. In light of anticipated increased enrollment of student service members and veterans, the postsecondary community has an important opportunity to understand the non-financial barriers to postsecondary success and to take appropriate actions

that are effective, but do not overburden already strained resources.

Defining success

Student veterans are no more homogenous than any other student group, but a few

general assumptions may help define success metrics. Compared to civilian students, student

veterans are older and more likely to be first-generation, transfer students, and distance learners

(National Survey of Student Engagement, 2010). Although they are also more likely to be

enrolled part-time than their civilian counterparts, the number of student veterans who are

enrolled full-time is noteworthy in light of their many other commitments. For these reasons,

degree completion may not be an appropriate measure of success. Many students return to or

Table 1. Age, gender, and academic status of first year civilian and veteran students			
	Civilian (n = 362,000)[a]	Veteran – combat (n = 4,840)[a]	Veteran – non-combat (n = 6,160)[a]
< 24 years old	94%	64%	21%
≥ 24 years old	6%	36%	79%
Male	35%	70%	85%
Dependents	32%	62%	
Transfer	9%	28%	45%
Full-time	95%	83%	77%

(U.S. DoE, 2011; IAVA, 2012; NSSE, 2010[a])

enter postsecondary education seeking certifications, licensure, or other training that can expedite

their pathway to meaningful employment (U.S. Department of Veterans Affairs, 2012). For this

group of students, success might be defined as attainment of academic goals within the eligibility

period of their education benefits, i.e. not a customary cohort graduation rate.

Among the group of student veterans, who are seeking a postsecondary degree,

indicators of academic success should be similar to those of civilian students. Do student

veterans remain enrolled for three consecutive semesters? Are their course add/drop patterns or

other measures of persistence similar to civilian students? How do change rates of academic

major compare? And, of course, how do grade point averages of the two groups compare within

the same academic major or program of study?