

Using Longitudinal Data to Increase Community College Student Success: A Guide to Measuring Milestone and Momentum Point Attainment

*D. Timothy Leinbach and Davis Jenkins
Community College Research Center
Teachers College, Columbia University*

Most community colleges and many state community college systems collect extensive data on individual students. Unfortunately, these data are often underutilized in efforts to improve outcomes for individual students and colleges. Community college systems and their constituent colleges have only recently come to realize the potential for using student unit record (SUR) data for more than reporting student enrollments and program graduates. By organizing these data into term-by-term student transcript records over several years and incorporating individual student demographic data, colleges and states can create a powerful resource for understanding patterns of student progression and achievement over time. Understanding how students actually progress through their college programs is essential in developing strategies and choosing appropriate interventions to improve student outcomes. The challenge is to build expertise and capacity in college and state agency research departments to transform raw SUR data into meaningful information of practical use for policymakers and practitioners.

Longitudinal SUR data can be used to answer many important questions about student progression (see Jenkins & Ewell, forthcoming). This Research Tool presents a guide to using such data to measure milestone achievements and momentum point attainments of community college students. *Milestones* are measurable educational achievements that include both conventional terminal completions, such as earning a credential or transferring to a baccalaureate program, and intermediate outcomes, such as completing developmental education or adult basic skills requirements. *Momentum points* are measurable educational attainments, such as completing a college-level math course, that are empirically correlated with the completion of a milestone. Milestone and momentum point data help to illuminate patterns of student progression and achievement.

This guide is intended to help researchers in colleges and state agencies to use longitudinal SUR data to create simple

and meaningful statistics on student achievement. The model presented in this guide will enable researchers to use longitudinal SUR data to identify different student groups among first-time community college students, calculate rates of attainment of milestones and momentum points for each group, and identify barriers to success for each group. The information from such an analysis can be used to identify college practices and student behaviors that are associated with successful outcomes and inform the development of policies and practices that address barriers to achievement. By continuing to track the progress of students over time, colleges and state agencies can also measure their progress in promoting student advancement and success.

In this guide, we at the Community College Research Center (CCRC) present examples based on an analysis we conducted for the Washington State Board for Community and Technical Colleges (SBCTC) to assist in identifying momentum points and milestones for different groups of students. The analysis was conducted using transcript, demographic, and education and labor market outcome data on a cohort of more than 87,000 first-time community and technical college students who entered the Washington system in the 2001-02 academic year and were tracked over five years. These *student groups*, *milestones*, and *momentum points* serve as the foundation of the model we used to transform the Washington SUR data into functional information about student enrollment and achievement patterns.

This guide is divided into three main sections. The first section, *Milestone Model Overview*, provides a concise description and a simple yet powerful application of the model for measuring student achievement. In this section we define milestone events

Table of Contents

| | |
|--|----|
| <i>Milestone Model Overview</i> | 2 |
| <i>Milestone Model Details</i> | 4 |
| <i>Applications of the Milestone Model</i> | 7 |
| <i>Conclusion</i> | 17 |
| <i>Technical Notes 1: The Statistical Significance of Momentum Points and Milestones</i> | 18 |
| <i>Technical Notes 2: Working with Longitudinal Student Unit Record Data</i> | 21 |
| <i>References</i> | 23 |
| <i>Endnotes</i> | 24 |

and momentum points and describe procedures for grouping students by enrollment and program characteristics. The last part of this section contains an example of the model in action. The second section, *Milestone Model Details*, presents a comprehensive discussion of the model using the Washington State data as an illustration. We discuss in detail the criteria for identifying student groups and explain the particular milestone events and momentum points applicable to each group. The third section, *Applications of the Milestone Model*, contains a complete set of momentum point and milestone charts for different student groups. The salient points of each set of data are summarized. And we suggest other analyses that can be done with longitudinal SUR data. Sidebars throughout this guide describe how we handled issues and challenges that arose when using longitudinal SUR data in the milestone and momentum point analysis we conducted for the Washington SBCTC.

We also provide two additional sections of technical notes as appendices to help researchers replicate our work. *Technical Notes 1* presents findings from a multivariate regression analysis of the relationship between attaining momentum points and milestone achievements. In *Technical Notes 2*, we discuss key considerations and decisions that need to be made when working with longitudinal data. This may be useful for those researchers who must select, extract, and prepare datasets for analysis. Topics include the minimum requirements of an SUR dataset for conducting analyses, cohort selection criteria, and the length of time over which to observe students.

Milestone Model Overview

Measuring Student Achievement

Milestones

Educational achievement includes more than just the traditional “terminal” accomplishments — completing a certificate or degree or transferring to a baccalaureate institution — most often measured by colleges and states. For community college students, who enter at various levels of readiness for college and who progress through a variety of pathways at different rates, tracking intermediate achievements on the way to these more final outcomes is important to understanding barriers to success and opportunities for improving outcomes. The *Milestone Events* chart shown in Figure 1, which was developed by Peter Ewell of the National Center for Higher Education Management Systems (NCHEMS), includes several intermediate community college student achievement outcomes. Such milestones (completing ESL, fulfilling developmental education requirements, etc.) may be significant achievements from the perspective of the individual student, regardless of whether the institution measures them as formal completions. **Milestones are measurable educational achievements that include both conventional terminal completions, such as earning a credential or transferring to a baccalaureate program, and intermediate outcomes, such as completing developmental education or adult basic skills requirements.**

Besides offering an alternative to an exclusively credential-based measure of achievement, milestones are important because they vary by a student’s enrollment characteristics. Credential-based outcome measures are based on the experience of the traditional postsecondary student who enrolls continuously until degree completion. Contemporary community college enrollment patterns are much more complex both because of increasing numbers of non-traditional students and the greater range of education missions taken on by community colleges (such as expanded remedial education, including adult basic skills). Measures of community college student progression and achievement should reflect the current reality.

Our model disaggregates students into student groups by the type of program in which they enter and by their educational objective upon entry. Each student group has its own milestone events. Consequently, rates of milestone event achievement indicate *what types of students* are or are not succeeding and *where in the educational pathway* students are or are not succeeding.

Momentum Points

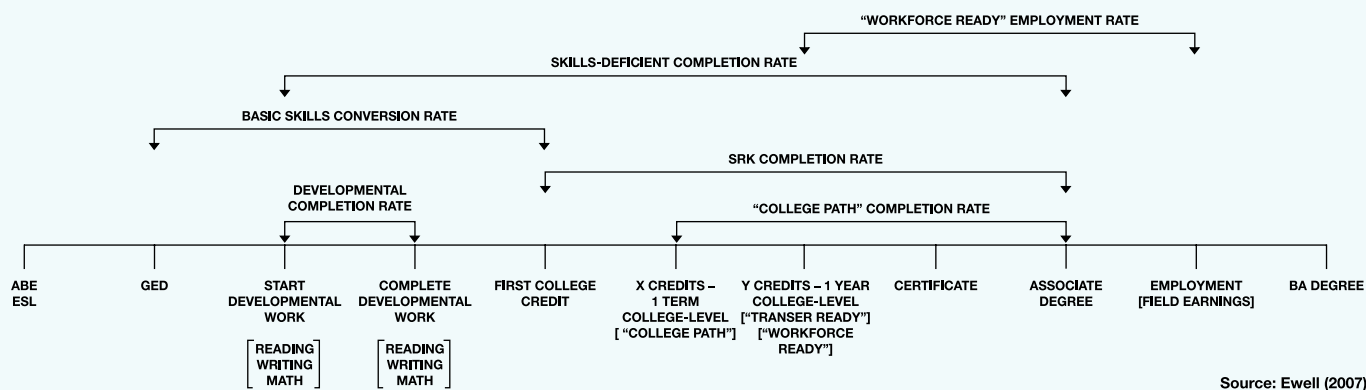
Many community college students do not reach “terminal” milestones; some do not even attain key intermediate milestones. Therefore, colleges need to know more than just rates of milestone achievement. They must also know what factors contribute to milestone achievement. Some factors that affect student success, such as a student’s educational background, demographic characteristics, and outside demands on time, are obviously beyond a college’s control. However, other factors over which institutions have more control also contribute to or detract from student achievement. For example, during a student’s enrollment, particular course completions or other educational accomplishments can provide “momentum” that propels students toward the achievement of milestone events. **These momentum points¹ are measurable educational attainments that are empirically correlated with the completion of a milestone.**

Momentum points can be particular courses (such as the first college-level “gatekeeper” math or English course), sets of courses (such as a developmental education series), or levels of educational attainment (such as one term’s worth of credits) that, once reached, increase the likelihood of completion of degrees or other milestone events (see Calcagno, Crosta, Bailey, & Jenkins, 2007). Therefore, attaining a momentum point is associated with a higher probability of achieving a milestone. The rates of momentum point attainment and the probability that a student who attains a momentum point will subsequently achieve a milestone are valuable pieces of information about factors within a college’s control that could contribute to student success.

Grouping Students

Students in any community college cohort enroll in a wide range of programs. They enter the system at one of several educational levels, and have a diverse set of objectives for their

FIGURE 1: "MILESTONE EVENTS" IN A STUDENT ENROLLMENT PATHWAY



enrollment. They may also enroll simultaneously in multiple institutions and move among institutions in a pattern referred to as “swirling” (Adelman 2006, Goldrick-Rab, 2006; Voorhees, Smith, & Luan, 2006). It would be misleading and unfair to the colleges and students to lump this great diversity of students together and expect to assess the progress of them all using the same outcome measures. Achievement criteria should consider where in the continuum of community college educational programs students begin their enrollment. For example, we would expect important milestone events of students who start in ESL (English as a second language) or ABE (adult basic education) to be different than those for students who start in college-level classes. Therefore, we need to assign students to various groups, each starting in different program levels or types and each with its own measures of achievement.

Still, students who start at different points may share the same objective, or desired finishing point. For example, as Figure 1 shows, students who start in developmental education can share the same degree goal as those who begin by taking college-level courses only. Since two groups of students that have different starting points can have similar goals, we need to create another set of student groups defined by the student’s program objective. For example, students who are divided between the developmental education group and the college-level group based on their starting enrollment may be placed together in a transfer student group if that is their shared finishing objective.

To account for this, we have established two dimensions by which to group students — one based on a student’s initial enrollment behavior, and the other based on the student’s program or objective. Students grouped by these dimensions will have different sets of achievement criteria since their milestone event and momentum point achievement measures will differ. The following is an illustration of how momentum points and milestones can be used to measure student progress.

Milestones and Momentum Points in Action

Figures 2 and 3 (page 5) illustrate the relationship between momentum point attainment and milestone achievement at different points in time for college-level students and transfer students respectively.

CCRC'S WASHINGTON STATE MOMENTUM POINT ANALYSIS

Why Milestones and Momentum Points?

The Washington State Board for Community and Technical Colleges (SBCTC) wanted to measure the performance of the system’s colleges in a way that would promote efforts to increase the rates of student progression and achievement. To accommodate the wide range of programs offered by the colleges, the SBCTC needed the measures of student progress to be appropriate to different students depending on their background and program of enrollment. They already knew that reaching the threshold of a year of college credit plus a credential provided a substantial income boost to their college-leavers (see Prince & Jenkins, 2005). This “tipping point” and other academic achievements often take students more than a year to accomplish, whereas the SBCTC needed a way to measure student progress toward achievement on an annual basis and could not wait for three- or five-year completion rates.

Through a deliberative process involving broad representation from the state’s community and technical colleges, the SBCTC used the analysis presented in this guide and other research to inform the choice of a set of *momentum points* that, once attained, correlate with the achievement of educational *milestones* (such as the tipping point). These momentum points, which can be measured by term or year, provide a useful measure of student progress toward a meaningful outcome. By measuring the attainment of momentum points (customized to each student type and with some demographic controls), the SBCTC and its affiliated colleges gained an accurate way to gauge their progress in helping their students advance toward milestones that mark educational success.

Completing one quarter’s worth of college-level credits (15 in Washington’s quarter system) is a momentum point on the way to a credential (certificate or associate degree) or transfer to a four-year college milestone. But to really propel a student toward a milestone within five years, that momentum point should probably be reached in a timely manner — within one or two quarters of a student’s first enrollment. Figure 2 provides evidence to suggest that this is true for the “college-level” students in our cohort of first-time community college students in Washington State, who began in college-level, degree-credit courses and did not enroll in remediation (N = 10,423). The vertical bars show the number who attained the 15 credit momentum point in different quarters or years following their enrollment. Thus, we see that 3,622 of these first-time college-level students attained this momentum point in their first quarter. An additional 2,697 attained it in their second quarter. It took 116 of these students until their 4th or 5th year (Y4/5) to attain it, and 2,352 never earned 15 credits during the five years of observation.

The dots that overlie the bars indicate the rate at which each set of students reached the credential or transfer milestone. For example, 55.8 percent of the students in the group who attained the momentum point in their first quarter achieved a credential/transfer milestone (within our 5 year observation window). Of those who earned 15 credits in 2 quarters, a slightly smaller 50.4 percent achieved the milestone. Those who took 3 or more quarters to attain the 15 credit momentum point had smaller rates of milestone achievement. And not surprisingly, for those who never attained the momentum point, less than 10 percent achieved the milestone. The relationship that we have demonstrated here is not one of cause-and-effect. We cannot say that reaching 15 credits in a timely manner will necessarily increase students’ likelihood of completing a credential or transferring, but we can say that for the first-time students in this cohort who did so, their chances of success were substantially higher.

Figure 3 presents a different kind of picture. This student group includes all those who enrolled in a baccalaureate transfer program, regardless of whether they started in college-level or remedial courses (N= 10,623). Their final milestone achievement is a degree or transfer (including students who have completed a set of courses to be considered “transfer-ready”). The potential momentum point examined here is the completion of one course of college-level (gatekeeper) mathematics. Observe that while the largest number (1,706) of this group attained the momentum point in their first quarter,² their rate of milestone achievement was lower than that of students who attained the momentum point later during their enrollment. It is notable that the students with the highest milestone achievement rate (nearly 80 percent) are those who waited to complete their gatekeeper math requirement until their second year of enrollment. This chart raises an important issue about course timing that could be informative for helping students navigate through college. Finally, notice that the failure to complete

any gatekeeper math course is associated with a very low probability of milestone achievement (11.3 percent success rate) for these students.

These two figures are powerful, yet easily-interpreted graphic depictions of the momentum point and milestone relationship. We present others later in this paper when we describe the model in more detail.

Milestone Model Details

Student Groups: Start to Finish

Here we describe in detail the two criteria for selecting student groups that we introduced in the previous section and then explain the corresponding momentum points and milestone events associated with each group.

Starting Point: Student Groups by Enrollment Program Type

The first step is to group students by their initial course enrollments or their required placement in remediation.³ If placement test scores⁴ or data on whether students have been placed in remediation are available, they can be used to assign students to an adult basic skills or developmental education group. From our work analyzing SUR data in Washington and other states, we have found that many students who are required to take remediation may not enroll in the required course or courses during their first term. They may delay their enrollment in remedial courses until a later term or never enroll in remediation at all. Conversely, we have also found students who enroll in developmental, ABE, or ESL courses even though their placement test scores do not indicate that they need remediation. One must establish rules on handling these inconsistencies (see p. 6 sidebar for the choices we made with the Washington data). If information on whether a student has been placed in remediation is not available (as it is not for Washington students in developmental education), then one must depend exclusively on course-taking behavior to determine a student’s remedial placement. Developmental education students may be assigned to a single developmental education group or may be disaggregated by type of developmental education (reading, writing, math).

Any student not required or not enrolled in remedial courses is assigned to the college-level enrollment group. This group combines those enrolling in only one or two courses for personal enrichment or skill upgrading as well as those in workforce training, degree, and transfer programs.

Expected Finish: Student Groups by Program/Objective

Despite starting at different points many students still share the same expected finishing point, such as a credential, transfer, or program completion. The second dimension on which to identify student groups is their expected program outcome or enrollment objective. This is based on the student’s program objective at matriculation, reported by the student, or inferred by the college based on a student’s course enrollments, major, and other information. Caution must be taken as this

FIGURE 2: COLLEGE-LEVEL STUDENTS
MILESTONE ACHIEVEMENT RATE BY QUARTER/YEAR WHEN MOMENTUM POINT ATTAINED
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE

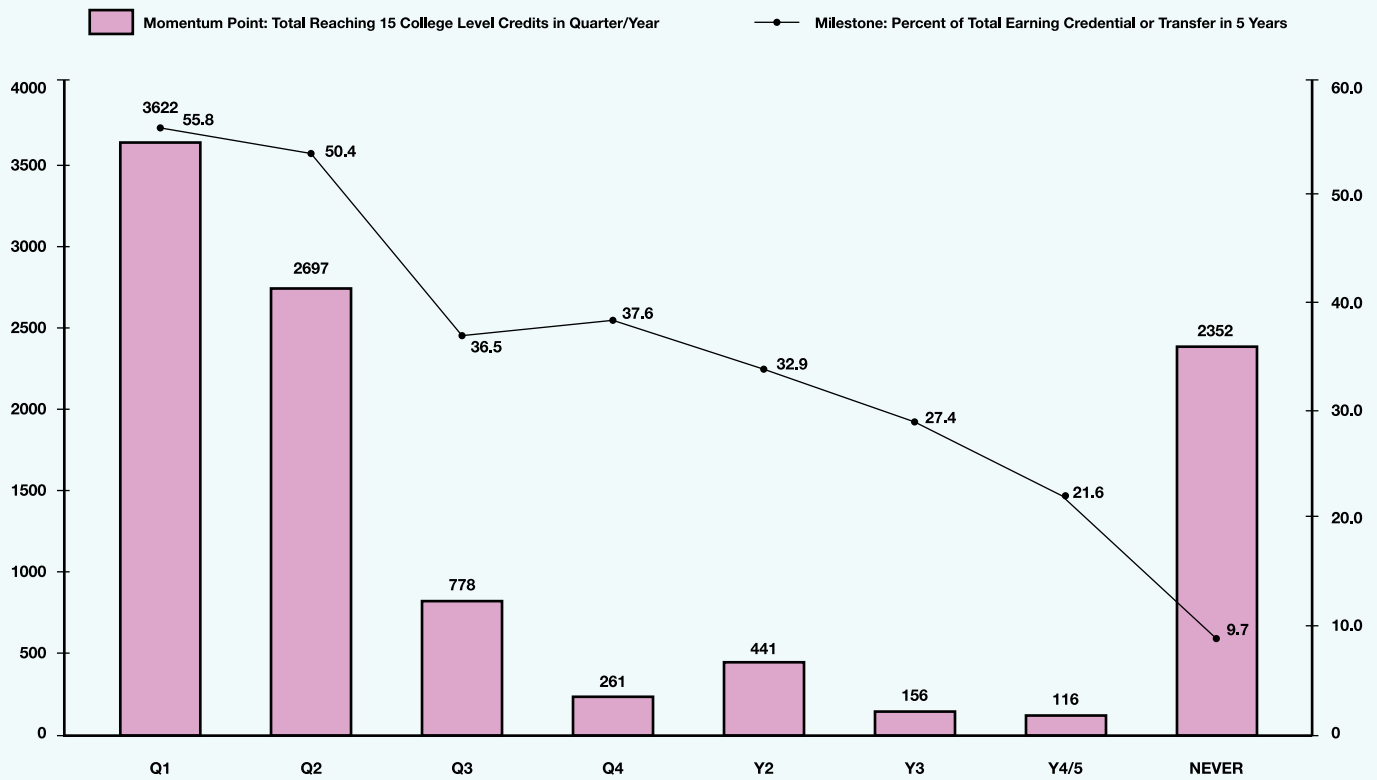
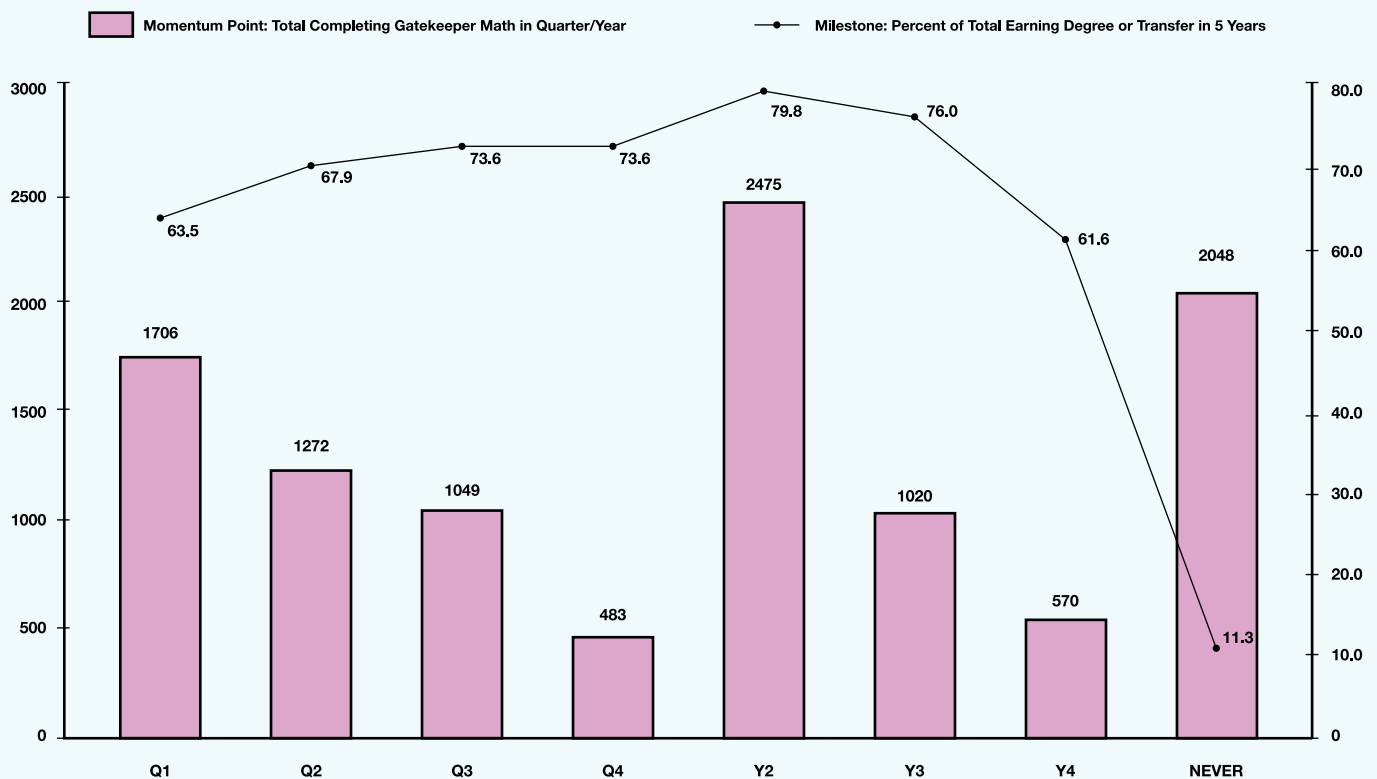


FIGURE 3: TRANSFER STUDENTS
MILESTONE ACHIEVEMENT RATE BY QUARTER/YEAR WHEN MOMENTUM POINT ATTAINED
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE



information on student objectives may be unreliable, may change over time (Bailey, Jenkins, & Leinbach, 2006), or, as in the case of students not seeking a credential or to transfer, may be arbitrary (Ewell, 2007; Adelman, 2005). The collection of student objective or program information and its classification in the dataset may vary by system or college, but often exists in some form in SUR data.

Student Group Milestone Events and Momentum Points

The next task is to identify a set of milestone events and momentum points that represent genuine achievement for each student group.

Milestone Events by Student Group

We selected milestone events from those described in the report *Community College Bridges to Opportunity Initiative: Joint state data toolkit* (Ewell, 2007), from which Figure 1 is taken. See Table 1 (page 8) for the list of milestone events. The table has columns for the four student groups defined by the program of initial enrollment (ESL, ABE, developmental, or college-level) and two additional groups defined by student program objective (vocational or transfer). We list the corresponding milestone events below each group. The events represent a set of successful outcomes for each student group.

Identifying success for students starting in remediation (ESL, ABE, and developmental) would seem straightforward: simply measure completion of remediation and transition into college-level work. However, the reality of student achievement is more complex. Even though each type of remediation has a defined highest-level course, students often finish their remedial program and succeed in college-level classes without completing the full sequence of remedial courses (including the highest level course). Other students may complete a remedial program but not continue on with college-level classes. Consequently, we define two distinct milestones that signal success in remediation: 1) being college-ready, and 2) transitioned to college-level. College readiness is achieved with the completion of remediation under one of several scenarios. In our momentum point analysis using the Washington data we stipulated that, to achieve the transition to college milestone, ESL and ABE students must complete two college-level courses (six credits in Washington). Passing two different courses indicates the capacity to succeed with college work. This success can be achieved regardless of whether students complete their basic skills program. Developmental education students achieve the transition milestone by completing a college-level course in their area (or areas) of remediation.

The milestone events for the college-level vocational and transfer student groups are straightforward since the measures are standard components in an SUR dataset. Students who start exclusively in college-level courses (4th column) have transfer and credential milestones by which their success is measured.⁵ Milestones for workforce training students (5th column) include certificate and associate degree credentials

CCRC'S WASHINGTON STATE MOMENTUM POINT ANALYSIS

Student Groups by Program of Enrollment

The dataset on Washington State community and technical college students used in CCRC's analysis has information on student placements into adult basic skills but not into developmental education. For the former we assigned students into either the ESL or ABE group if they were required to take adult basic skills or if they enrolled *in their first term* in ESL or ABE. The ESL and ABE groups are separate, though a student could be included in both groups if so assigned. Students who were not assigned to or enrolled in adult basic skills in their first term but did enroll in a later term were not classified as enrolled in an ABE or ESL group. We reasoned that if students did not enroll in an ESL or ABE course in their first term, then it was not an instrumental need for their enrollment in college-level courses and therefore should not be used to identify their starting enrollment group.

After removing all the adult basic skills students, we next identified the developmental education students. Since we had no information on students required to take developmental education, we assigned to this group students who enrolled in developmental education at *any time* during their enrollment. In contrast to basic skills students, we relaxed the requirement that they be enrolled in developmental education in their first term. Since a student's developmental education requirement may be to remediate a specific deficiency (in reading, writing, or math) that does not preclude enrollment in other college-level courses, then students may delay enrolling in the required class until later in their education. However, this does not obviate the need for remediation, and we therefore classified them as developmental education students. To simplify our model, we did not separate developmental education students by subject (reading, writing, and math), but aggregated them into a single group.

All students who were not assigned to the adult basic skills or the developmental education group were assigned to the college-level group. These were students who enrolled only in college-level courses and never in developmental education. Assignments to adult basic skills, developmental education, and college-level student groups were all mutually exclusive.

as well as apprenticeship program completions. Students in a transfer program (last column) are measured against the milestone achievements of earning an associate degree, transferring to a four-year institution, or being "transfer ready." In

cases where transfer-readiness is not already flagged, it can be determined using a student's transcript records.⁶

Momentum Points by Student Group

Working with the Washington SBCTC we created a master list of potential momentum points, some applicable to particular student groups and others applicable to multiple student groups. The momentum points include individual course completions, such as the first college-level or “gatekeeper” math or English course, levels of credit completions overall and within specific time periods, completion of remedial levels, and other types of course completions. We identified a number of measures that can reasonably be expected to be completed by students at different enrollment levels and programs, or that might be expected to increase a student's likelihood of completing a program or credential. Many of these have been shown to correlate with college success (see Prince & Jenkins, 2005; Adelman, 2005; Adelman, 2006; Alfonso, Bailey, & Scott, 2005) while others are important pathway achievements.⁷ From this list we selected momentum points applicable to each student group and their milestone events to include in the model. These are listed in Table 2 (page 9) by student group. Note that although each student group has its own set of momentum points, there are several shared momentum points across groups.

The next section presents an application of the milestone model using the milestone events and corresponding momentum points identified above.

Applications of the Milestone Model

Milestone Achievement of Washington State Community College Students

Here we apply the model described above to longitudinal SUR data on Washington State community and technical college students. We present a series of figures with milestone achievement and momentum point attainment counts and rates using data from the Washington State 2001-02 cohort of first-time community and technical college students. For each of the six student groups — ESL, ABE, developmental, college-level, vocational, and transfer — there is a set of three figures. These are Figures 4.1 to 9.3 (found on pages 11 through 16). The first figure in each set (Figures 4.1, 5.1, 6.1, etc.) shows the total number of students in the group, the number who achieved any milestone, and the number who achieved each type of milestone within the five-year period of observation. The second figure in each set (Figures 4.2, 5.2, 6.2, etc.) shows the number of students who attained each momentum point. The third figure in each set (Figures 4.3, 5.3, 6.3, etc.) provides

CCRC'S WASHINGTON STATE MOMENTUM POINT ANALYSIS

Student Groups by Program/Objective

In the Washington dataset used in this analysis, students are classified according to their purpose for enrolling. This information is derived from information obtained at the time of registration and enrollment. Washington's categories are *transfer*, *workforce training* (vocational education, including credential-seeking), *basic skills*, and *other*. Many students who start in adult basic skills classes (and whom we assigned to an ESL or ABE student group by enrollment) have transfer or workforce training goals. Under this second dimension of program/objective they would be assigned to the transfer or workforce group. According to the Washington SBCTC, students with *other* objectives are enrolled for personal interest (and are not seeking a degree or to transfer) or otherwise do not fit one of the other categories. In the model we present here we excluded both the *basic skills* and *other* student types. We excluded the former because they are merely a subset of those students in the basic skills group assigned by enrollment and the latter because this catch-all group combines a wide range of students and requires additional disaggregation that complicates the simple model in our example.

the rate of milestone achievement conditional on momentum point attainment. Put simply, it answers the question: Of those students who attained a momentum point, what percentage subsequently achieved a milestone? And, the converse: Of those who did not attain a momentum point, what percentage subsequently achieved a milestone? Thus, we can determine if the achievement rate is any different for those who attain the momentum point and those who do not. We discuss briefly the results of each figure below.

Milestone Achievement

Figure 4.1 for the ESL student group reveals that only 2,143 of the 10,762 ESL students (less than 20 percent) ever achieved the ESL milestone of college ready or of transitioned to college. One thousand six hundred thirty-two (1,632) of the students reached college-ready status (completed their ESL program), and only 751 students ever transitioned to college (as measured by completion of two college-level courses) within five years of starting their ESL. Note that the disaggregated milestone counts do not sum to the total number who achieve any milestone since some students may achieve both milestones. This simple graphic presents evidence of the very low five-year achievement rates of these ESL students.

ABE students exhibit higher rates of milestone achievement than their peers in ESL, but the rates are still disturbingly low (see Figure 5.1). Of the 9,977 ABE students, 4,802 of them (slightly less than one-half) achieved an ABE milestone event. Most of these achieved one of the college ready milestones and slightly more than half (2,486) transitioned to college and completed two college-level courses. One explanation for the higher rate at which ABE students achieve milestones compared with ESL students is that ABE students tend to have the clear objective of a GED or high school diploma, which

TABLE 1: MILESTONES EVENTS BY STUDENT GROUP

| Student Group by Enrollment | | | | Student Group by Program/Objective | |
|--|--|---|---|--|--|
| ESL | ABE | DEVELOPMENTAL | COLLEGE-LEVEL | VOCATIONAL | TRANSFER |
| <ul style="list-style-type: none"> College ready (completed ESL) Transitioned to college-level (completed x number of college credits) | <ul style="list-style-type: none"> College ready (completed ABE) Transitioned to college-level (completed x number of college credits) | <ul style="list-style-type: none"> College ready (completed developmental ed.) Transitioned to college-level (completed college-level "gatekeeper" course in area of remediation) | <ul style="list-style-type: none"> Earned certificate of less than 1 year Earned certificate of 1 year or more Earned associate degree Transferred or transfer ready Completed program or training | <ul style="list-style-type: none"> Earned certificate of less than 1 year Earned certificate of 1 year or more Earned associate degree Completed program or training Completed apprenticeship | <ul style="list-style-type: none"> Earned associate degree Transferred or transfer ready |

may motivate students to complete. One thousand six hundred twenty-two (1,622) ABE students did earn a GED, and another 425 earned a high school diploma over the five years (not shown).

Figure 6.1 shows the milestone achievement figures for developmental education students (termed “pre-college” in Washington State). Seventy percent (20,186 of 28,524) achieved a developmental education milestone of being college ready or transitioning to college by completing a college-level course in their remedial area.

Figure 7.1 shows the achievement figures for students who enrolled exclusively in college-level classes. Figures 8.1 and 9.1 are for those in vocational education (termed “workforce training” in Washington State) and transfer programs, respectively. These latter two groups may include students required to take developmental education. The achievements counted are credentials, program completion, transfer, and transfer-ready. Overall, their rates of achievement are rather low. Slightly more than one-fourth (10,423 of 41,339) of all college-level students achieved any milestone within five years. Most of these transferred, became transfer-ready, or earned associate degrees. Observe that the achievement rates are lower for those in workforce training programs and higher for those in transfer programs. The former group may be less inclined toward formal completions and could merely be seeking some training for a particular job or career advancement.

Momentum Point Attainment

The second set of figures (4.2, 5.2, 6.2, etc.) shows momentum point attainment counts for each of the potential momentum points assigned to each student group. Students who start in any of the remedial groups have a limited set of meaningful

CCRC'S WASHINGTON STATE MOMENTUM POINT ANALYSIS

College Ready Milestone Achievement

Because there is no one pathway to college readiness for remedial students, we identified several possible course completion scenarios to define milestone achievement for each of the remedial student groups.

Markers of ESL completion include: 1) completion of ESL level 6; 2) completion of ESL level 5 and one other ESL course; or 3) completion of three ESL courses. Achievement in any one of the three measures qualifies a student as college-ready. Level 6 is the highest level of ESL, so completion of this level is the most obvious indicator of program completion. A student who completes two ESL courses, one of which is level 5 (the next-to-highest), or completes three ESL courses at any level, exhibits an acquisition of English sufficient to be ready for college.

In Washington, ABE course levels are identical to those of ESL. Therefore, we assigned the parallel three markers of completion for ABE students. We also added the following additional markers: 4) completion of a high school completion program; 5) earning a high school diploma; or 6) earning a GED. The latter two are obvious indicators of ABE milestone achievement. Empirical examination of high school completion course completion patterns in the Washington data suggest that either level of the course (equivalent to ABE levels 5 and 6) are adequate preparation for college work.

The markers we used for college ready milestone achievement for developmental education students are: 1) completion of developmental education level 4 (the highest level of developmental education) in a given developmental subject (i.e., reading, writing, or math); or 2) completion of three developmental education courses in a subject.

momentum points on the way to milestone achievement. The primary momentum point is the completion of a single course in their remedial area. Thus, Figure 4.2 shows that slightly less than 60 percent (6,374 of 10,762) of ESL students ever completed even one ESL course. This is a disappointingly low rate for those needing English either for further education or to thrive in an English-speaking society. An even smaller proportion of ABE students, 45 percent (4,495 of 9,977), completed even one ABE course, as shown in Figure 5.2. Notice that this rate is lower than that for ABE students who achieved any ABE milestone (Figure 5.1). This shows

TABLE 2: POTENTIAL MOMENTUM POINTS BY STUDENT GROUP

| ESL | ABE | DEVELOPMENTAL | COLLEGE-LEVEL | VOCATIONAL | TRANSFER |
|---|---|---|---|---|--|
| <ul style="list-style-type: none"> Completed 1 ESL course Completed a career exploration or introduction course | <ul style="list-style-type: none"> Completed 1 ABE course Completed a career exploration or introduction course | <ul style="list-style-type: none"> Completed 1 developmental education course Completed a career exploration or introduction course | <ul style="list-style-type: none"> Completed 1 CL gatekeeper math Completed 1 CL gatekeeper English Completed 15 CL credits Completed 30 CL credits Completed 30 CL credits in 1 year Completed 15 voc credits Completed 30 voc credits Completed 30 voc credits in 1 year Completed a career exploration or introduction course | <ul style="list-style-type: none"> Completed 1 CL gatekeeper math Completed 1 CL gatekeeper English Completed 15 CL credits Completed 30 CL credits Completed 30 CL credits in 1 year Completed 15 voc credits Completed 30 voc credits Completed 30 voc credits in 1 year Completed a career exploration or introduction course | <ul style="list-style-type: none"> Completed 1 CL gatekeeper math Completed 1 CL gatekeeper English Completed 15 CL credits Completed 30 CL credits Completed 30 CL credits in 1 year |

Note: CL = college-level

that some ABE students were circumventing the standard educational pathway by transitioning to college directly. Figure 6.2 shows the developmental education course completion by pre-college students. Well over 85 percent of these students (24,797 of 28,524) completed at least one developmental course in five years. We also included a second momentum point for all remedial students. This is the completion of a career exploration or introduction course. These are overview courses designed to provide students background information on the opportunities, benefits, and entry requirements for various careers. By gaining knowledge of college and career options, students who completed such courses might become more motivated to persist through remediation. The rates of completion in these classes were very small (less than 1 percent of ESL students, 3 percent of ABE students, and 10 percent of developmental students). The reason may be that these are college-level credit classes that may be out of reach for the basic skills students until they complete their remediation.

Students who start in college-level courses and those in the workforce and transfer groups have many more momentum points to examine. Figure 7.2, for example, shows a set of momentum points for college-level students. These include completion of a college-level math course, completion of a college-level English course, and threshold levels (15 and 30 credits) of college-level credits and vocational credits. The rates of momentum point attainment were all very low, especially for gatekeeper math and English courses, which presumably are pre-requisites for many upper-level courses, program completion, or transfer. Since we define momentum points as attainments that propel students toward milestones, with these low attainment rates we would expect achievement rates to be low as well. Figures 8.2 and 9.2 show the momentum point completion counts for workforce and transfer students on a subset of the momentum points for

college-level students. Again, only a small proportion of these students attained these momentum points.

Conditional Probability Rates

Using the counts of momentum point attainment and milestone achievement, we are able to calculate the probability of achieving a milestone event after having attained a given momentum point. This conditional probability can be compared against the proportion of students who did not attain the momentum point but did achieve the milestone to determine if the relationship suggests that *momentum point attainment is positively associated with milestone achievement*. If this relationship exists, then there is evidence that the momentum point may contribute to student milestone achievement. These conditional probability rates are shown in the third set of figures (Figures 4.3, 5.3, 6.3, etc).⁸

Figure 4.3 shows the milestone achievement rates of ESL students who did and those who did not complete the momentum point of ever completing any ESL course. We see that 28.3 percent of students who did complete an ESL course managed to achieve an ESL milestone event, while only 7.7 percent of those who did not complete an ESL course achieved such a milestone. Since the ESL milestone achievement occurs either by completion of the ESL program (necessitating completion of at least one ESL class) or completing two college-level courses, those who still reached the milestone without ever completing ESL must have transitioned directly to college by completing the two college-level courses. However, due to the low rates of ESL milestone achievement, attaining the momentum point of one ESL course completion is not a guarantee of milestone completion. Compare this to the conditional probability of milestone achievement for students who completed a career exploration or introductory course. While nearly all of the students who attained this momentum point achieved the milestone, it is likely that because career exploration and introductory courses are college-level

courses, the completion of such a course could only be attained by those students who already completed their ESL milestone. Nonetheless, this figure suggests that ESL students may benefit from the career exposure and guidance offered by such a course while they are still in basic skills.

The conditional probabilities for ABE students who attained momentum points (see Figure 5.3) do not exhibit the clear differences found with ESL students. However, they also show higher rates of conditional probability of milestone achievement. Because of the limited scope of basic skills programs, identifying distinct momentum points that clearly propel students toward achievement may be difficult. In contrast, observe in Figure 6.3 that for pre-college students who attained the momentum point of completing even one pre-college course in their area, their probability of achieving the milestone of being college ready or transitioning to college is over 80 percent. With this little bit of momentum, these students have a high likelihood of completing developmental education and moving on to college-level classes.

In the college-level student group we see clearly the value of momentum point attainment. Notice in Figure 7.3 that the conditional rate of milestone achievement is at least twice as large for students who attained the various momentum points than for those who did not. The difference is particularly strong for those students who completed the gatekeeper math and English courses, each of which more than triples one's likelihood of achieving a milestone. Note that completion of 30 credits — either college-level or specifically vocational credits — in a timely manner (within the first year) provides a greater boost in that likelihood of milestone achievement.

The importance of momentum point attainment for milestone achievement is also evident for those students in workforce training. In particular, the threshold level of the attainment of 30 vocational credits becomes even stronger. Remember that only about 20 percent of all workforce students achieved a milestone in five years, but for those who managed to earn 30 credits, 58.4 percent achieved a milestone, as did 60 percent of those who accumulated their credits within one year (see Figure 8.3). Transfer students, who had higher achievement rates overall than workforce students, exhibit the importance of completing gatekeeper math and English to propel them toward associate degrees or transfer milestone achievement. Notice in Figure 9.3 that more than 70 percent of those who completed gatekeeper math achieved a milestone, while only 11 percent of those who never took such a course reached their milestone within five years. Earning 30 credits within one year also indicates a critical threshold for milestone achievement for this group.

Conclusions

The figures in this section present evidence of the rate of milestone achievement and the momentum points that lead to them. With these data we can track students' progress toward educational achievement and can observe the relationship between intermediate attainments and ultimate success.

Where those relationships prove strong, as with gatekeeper classes and timely credit accumulation, we gain information on educational pathways that may increase the chances of student achievement. Caution must be taken when describing these relationships, however. These analyses do not show causality. That is, we cannot say that attaining any particular momentum point causes milestone achievement since there are undoubtedly other individual student characteristics (such as student motivation) and external factors that influence student outcomes. However, we do see clearly that students who attain particular momentum points do have substantially higher rates of milestone achievement.

Additional Analyses

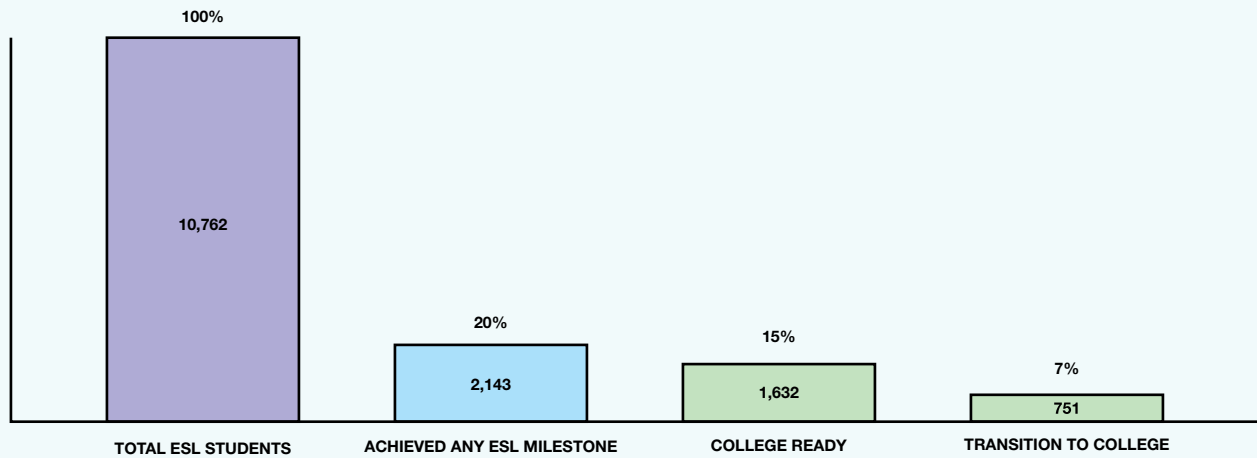
The figures we have so far discussed represent only a small slice of the vast potential for analyses using longitudinal SUR data. Here we describe some additional analyses that may be useful in guiding community college educators and policymakers toward actions that could increase rates of student success.

Disaggregate results for key student groups

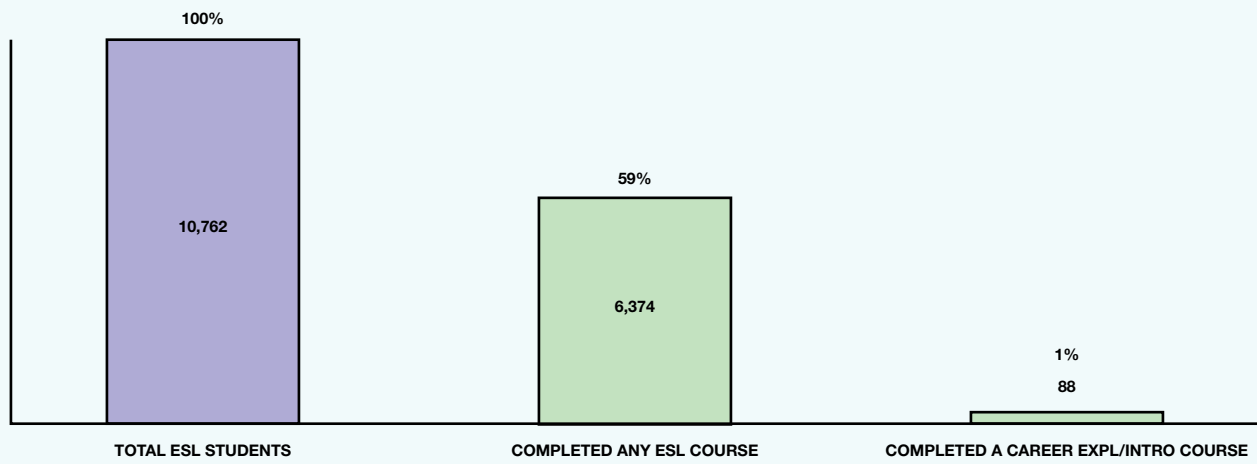
A first obvious extension is to disaggregate the student groups. Simple disaggregation by demographic characteristics can prove highly illuminating. Race or ethnicity and gender are obvious breakdowns, but disaggregating by age is also useful. Research shows that age can be an important explanatory variable (Adelman, 2005; Calcagno, Crosta, Bailey, & Jenkins, 2007; Horn, Cataldi, & Sikora, 2005). We have found the following three age divisions most informative: Under 20 (typical college age), 20-24 (students with some work experience), and 25 and older (older students, usually with career and family obligations). If available, SES (socioeconomic status) is a useful explanatory categorization. Students from higher SES categories have higher achievement rates (see, e.g., Cabrera, Burkum, & La Nasa, 2003). In addition, SES and age often interact as younger students tend to come from higher SES households.⁹

Students can also be disaggregated by features of their enrollment. Characteristics such as the intensity (full-time or part-time) of a student's first-term enrollment create informative categories. Beginning full-time students can have a very different perspective on school than part-time students, so separating the two allows the researcher a way to group similar students. This, for example, is a way to disaggregate the diverse group of all college-level students that we used above. Selecting students who persist from the first to the second term allows the researcher to focus on students who already have some momentum and then to follow their enrollment to determine what features enable a student to carry on that momentum toward a milestone. Financial aid received in the first term (either a dummy variable for receipt of any aid or the numeric amount received) is useful, particularly in multivariate regressions (see *Technical Notes 1* and *2*) as an explanatory variable. However, because some students, such as those who attend part-time, may have trouble qualifying for financial aid, this variable can be confounding.

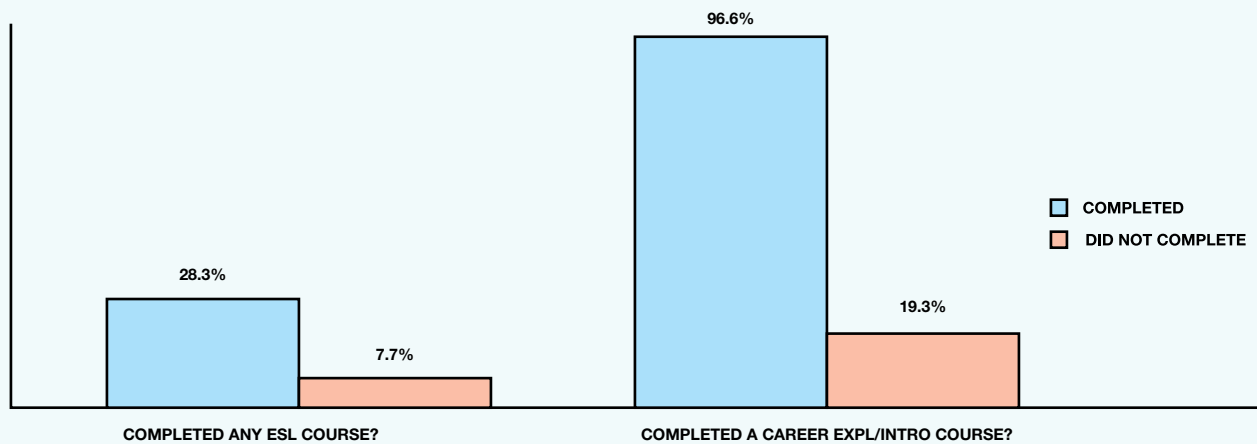
**FIGURE 4.1: ESL STUDENTS
FIVE-YEAR MILESTONE ACHIEVEMENT TOTALS
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



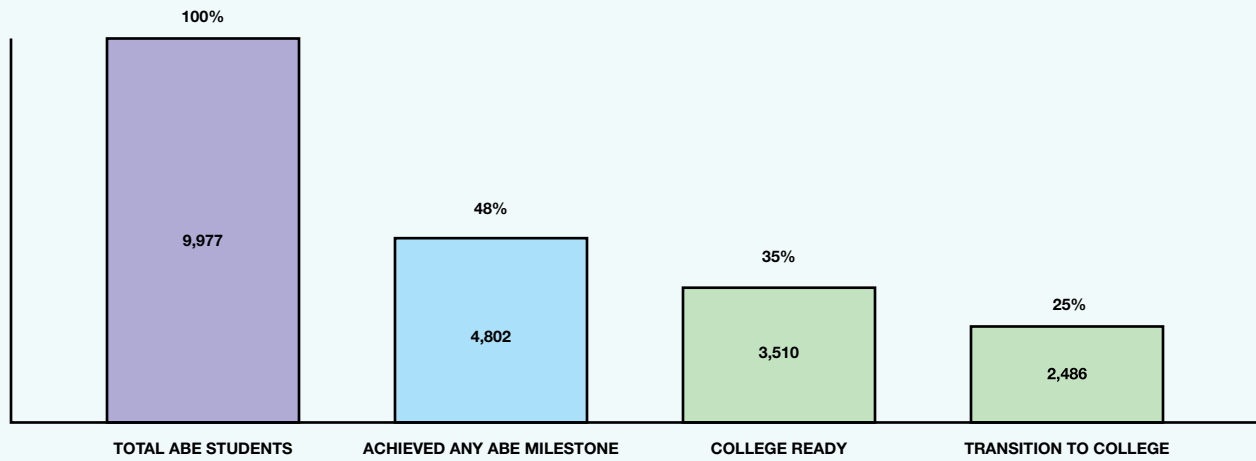
**FIGURE 4.2: ESL STUDENTS
FIVE-YEAR MOMENTUM POINT ATTAINMENT TOTALS
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



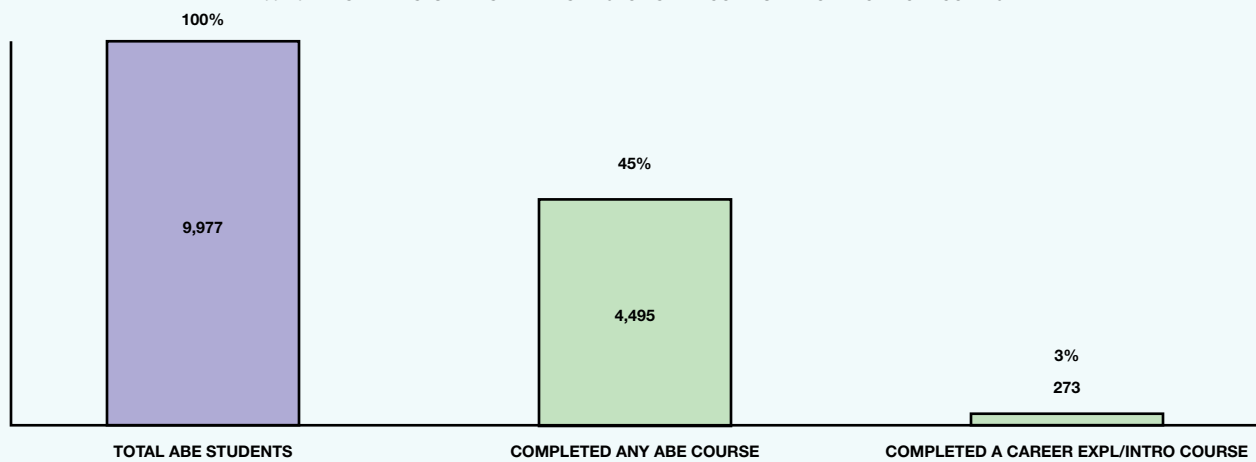
**FIGURE 4.3: ESL STUDENTS
PROBABILITY OF MILESTONE ACHIEVEMENT CONDITIONAL ON MOMENTUM POINT ATTAINMENT
2001-02 FIRST-TIME STUDENTS IN WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



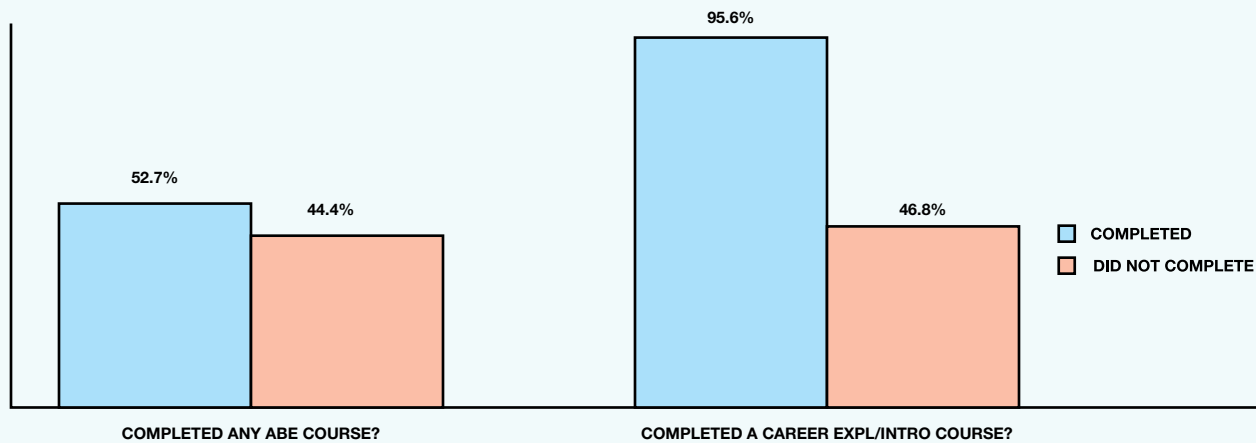
**FIGURE 5.1: ABE STUDENTS
FIVE-YEAR MILESTONE ACHIEVEMENT TOTALS
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



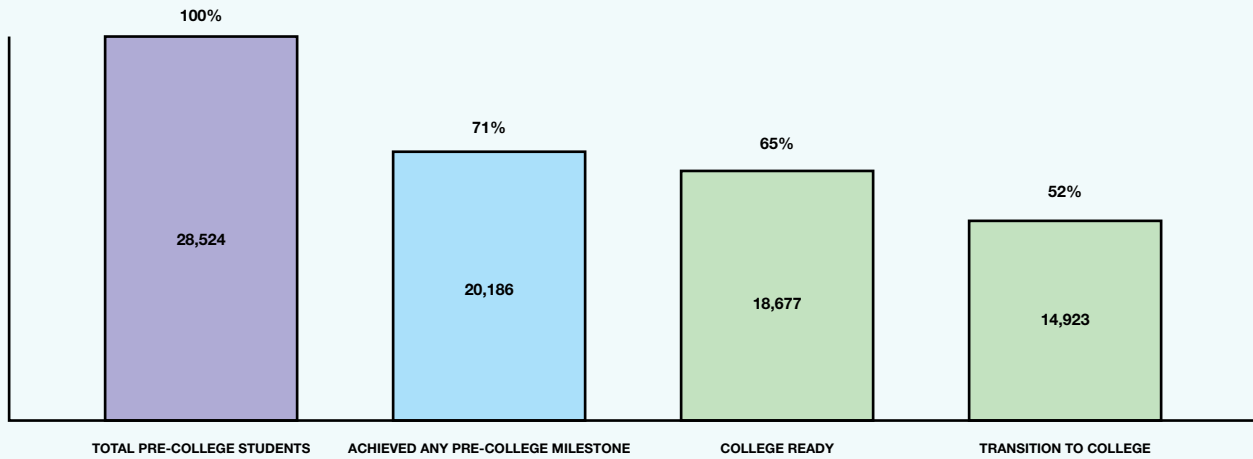
**FIGURE 5.2: ABE STUDENTS
FIVE-YEAR MOMENTUM POINT ACHIEVEMENT TOTALS
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



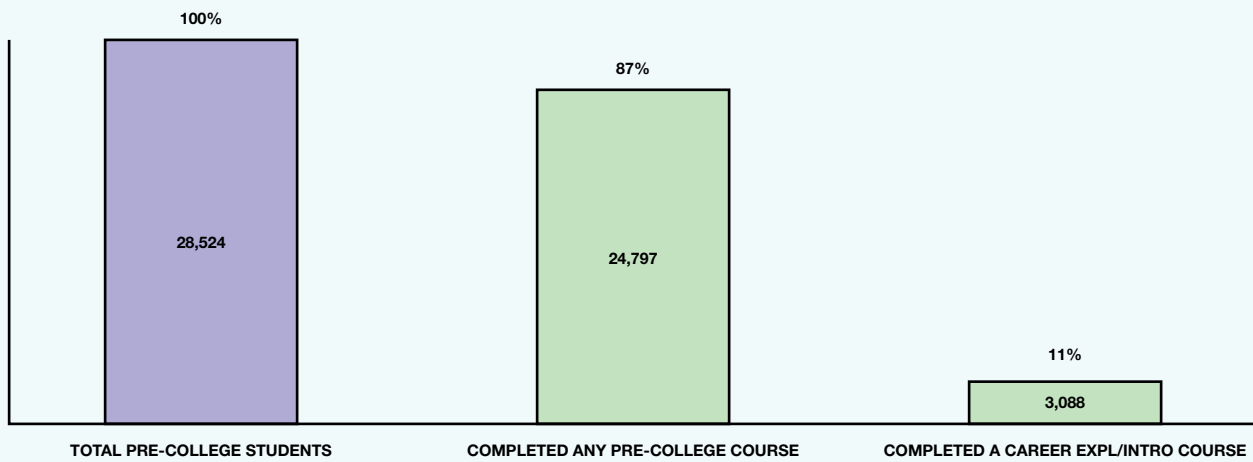
**FIGURE 5.3: ABE STUDENTS
PROBABILITY OF MILESTONE ACHIEVEMENT CONDITIONAL ON MOMENTUM POINT ATTAINMENT
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



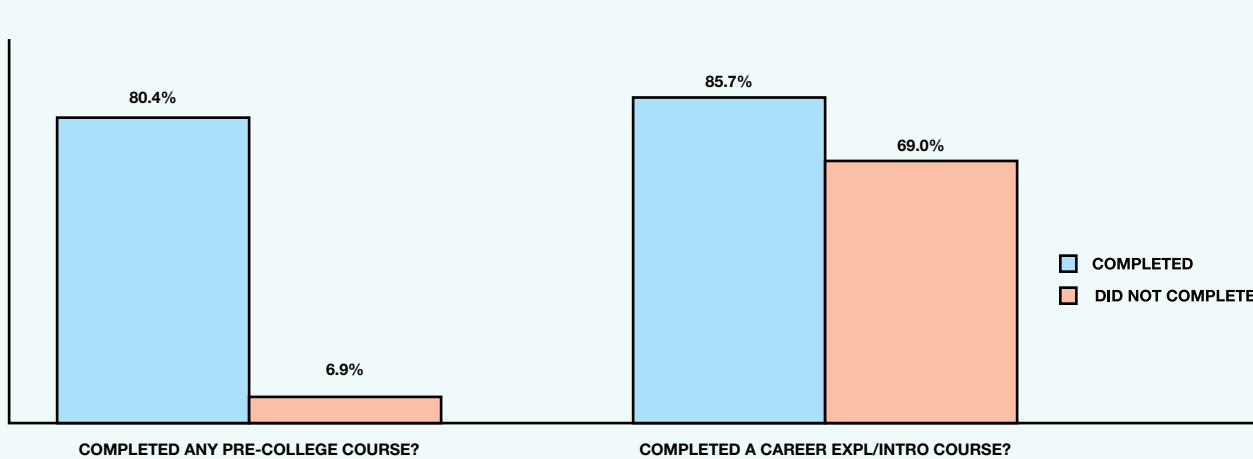
**FIGURE 6.1: PRE-COLLEGE STUDENTS
FIVE-YEAR MILESTONE ACHIEVEMENT TOTALS
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



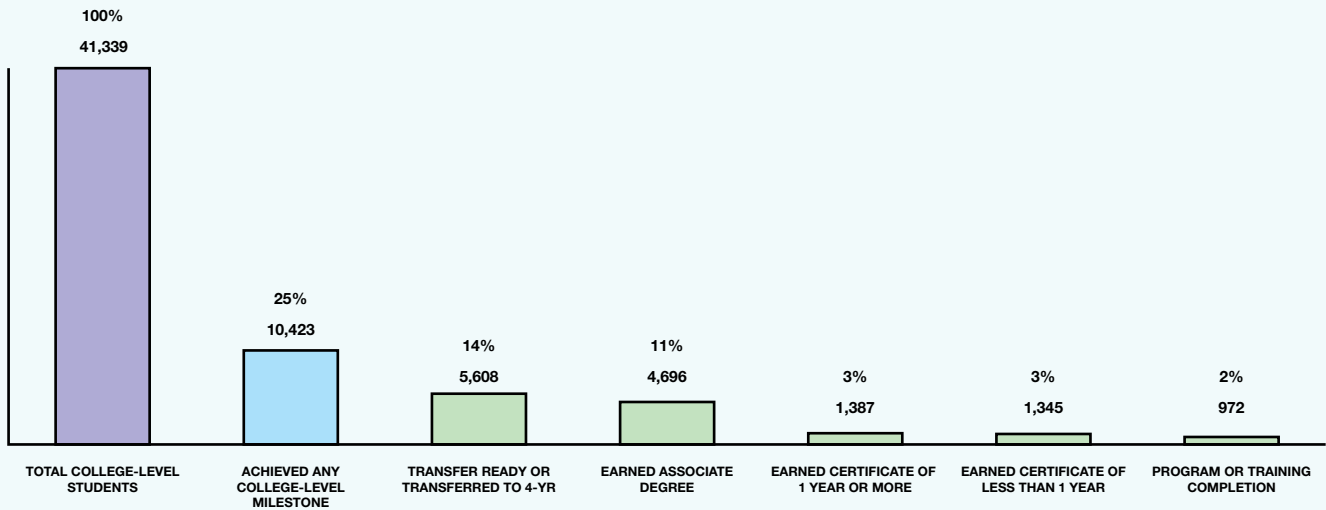
**FIGURE 6.2: PRE-COLLEGE STUDENTS
FIVE-YEAR MOMENTUM POINT ATTAINMENT TOTALS
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



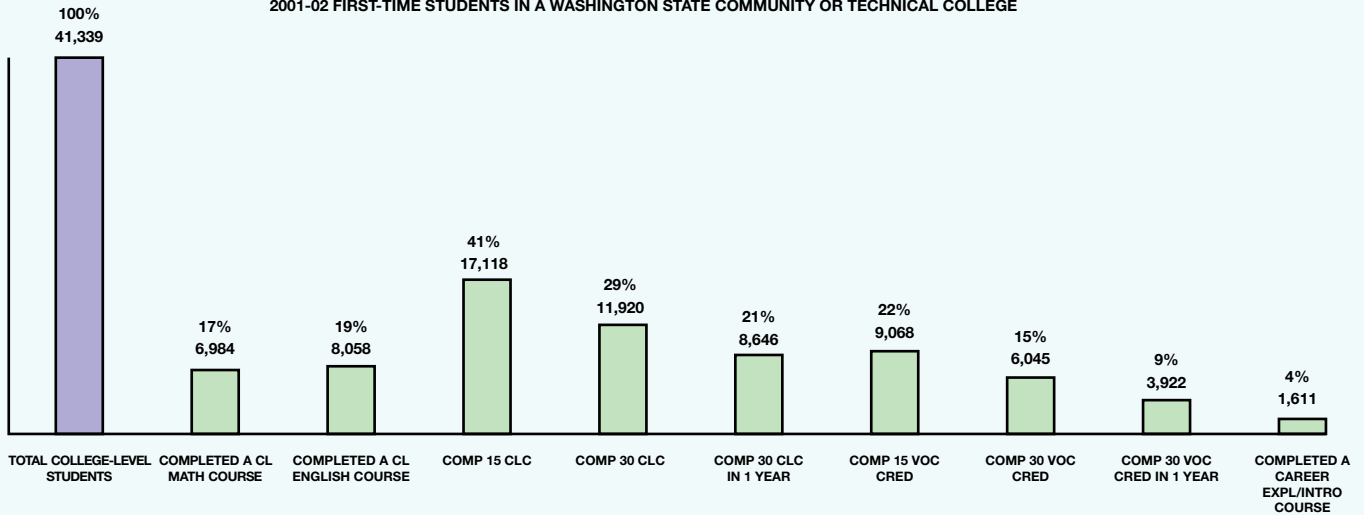
**FIGURE 6.3: PRE-COLLEGE STUDENTS
PROBABILITY OF MILESTONE ACHIEVEMENT CONDITIONAL ON MOMENTUM POINT ATTAINMENT
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



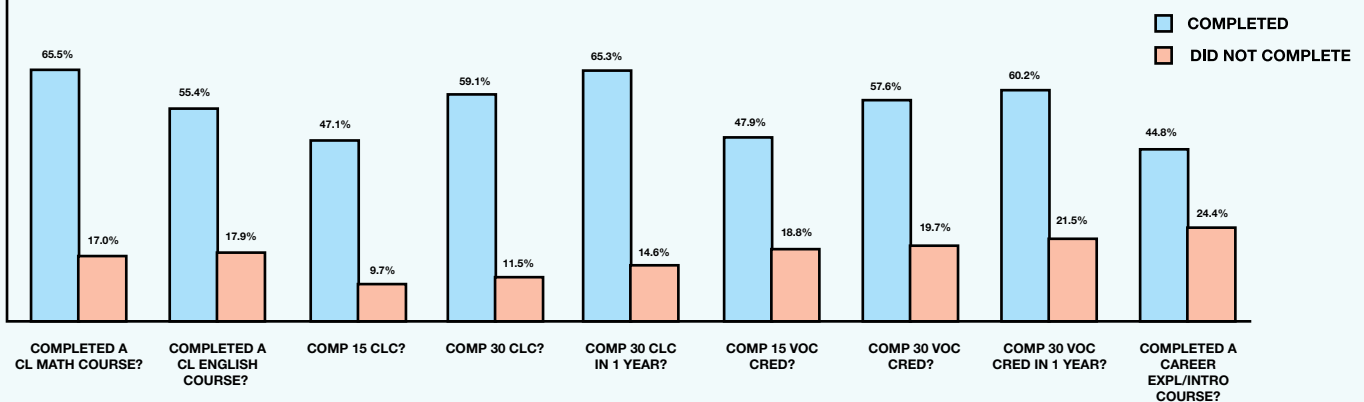
**FIGURE 7.1: COLLEGE-LEVEL STUDENTS
FIVE-YEAR MILESTONE ACHIEVEMENT TOTALS
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



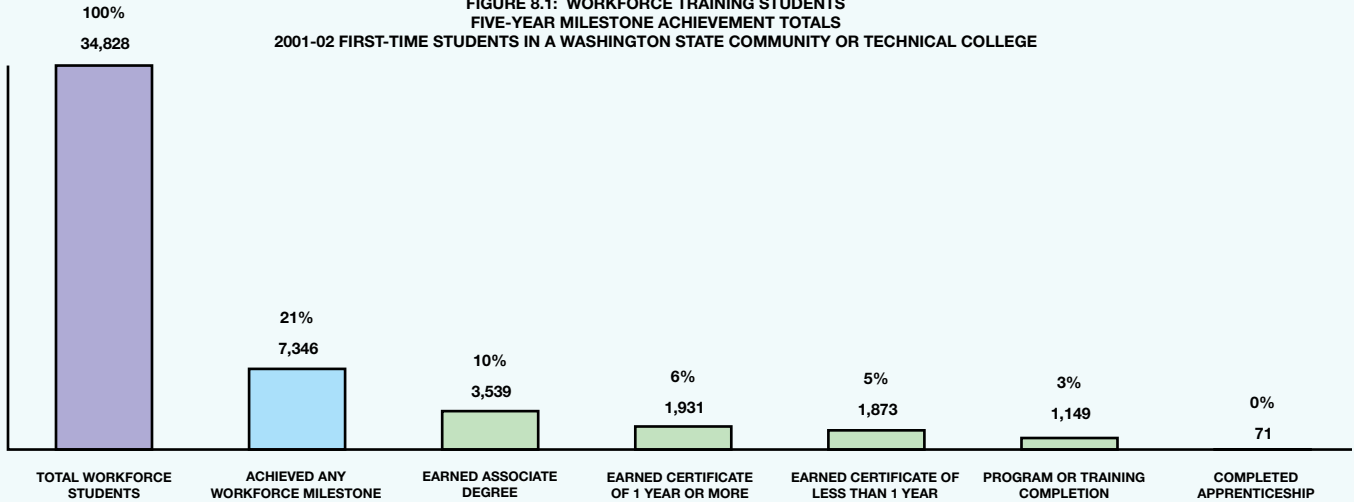
**FIGURE 7.2: COLLEGE-LEVEL STUDENTS
FIVE-YEAR MOMENTUM POINT ATTAINMENT TOTALS
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



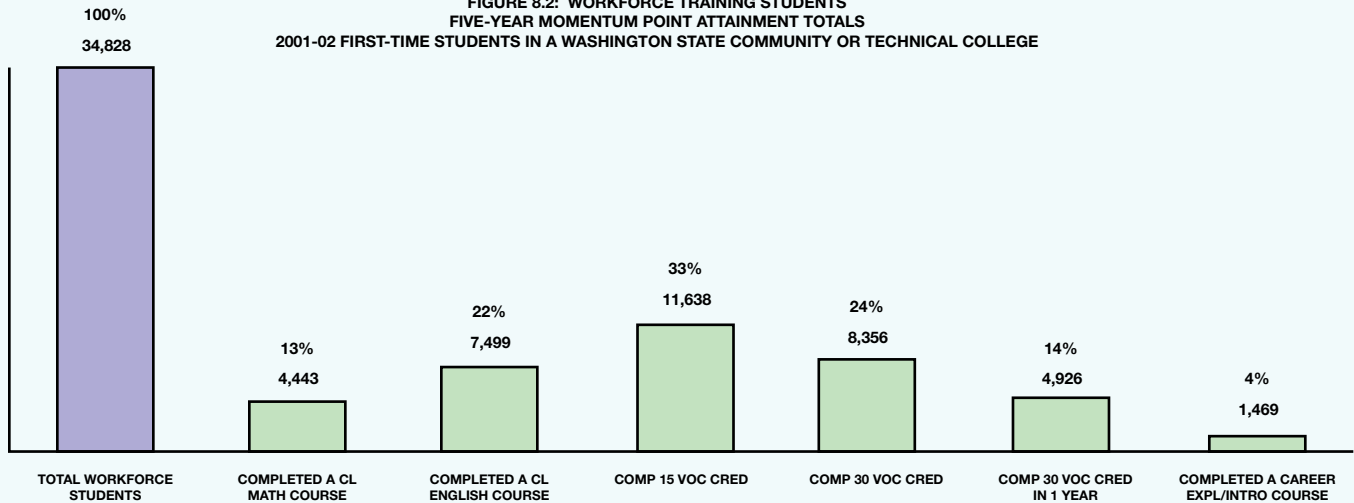
**FIGURE 7.3: COLLEGE-LEVEL STUDENTS
PROBABILITY OF MILESTONE ACHIEVEMENT CONDITIONAL ON MOMENTUM POINT ATTAINMENT
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



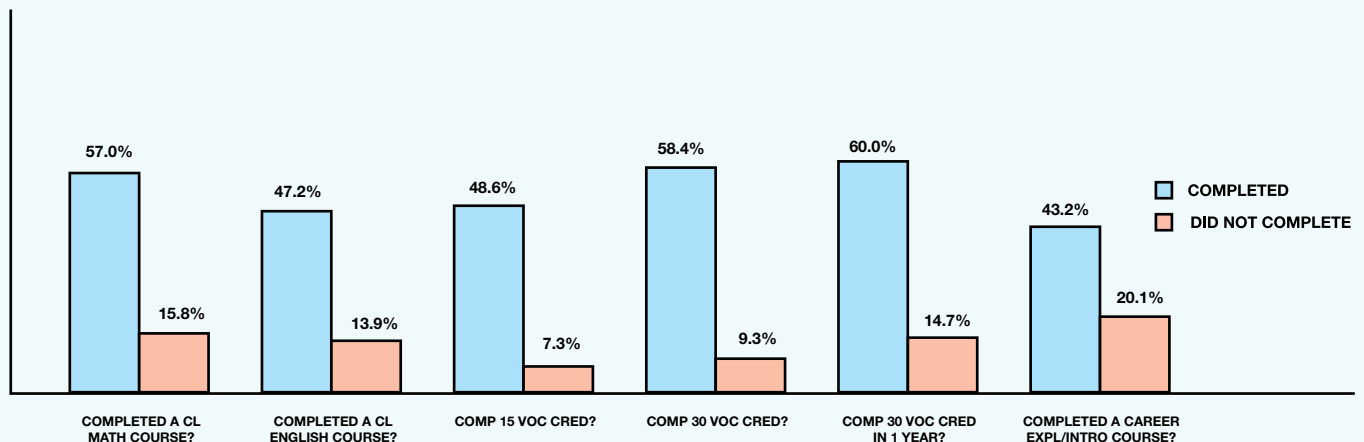
**FIGURE 8.1: WORKFORCE TRAINING STUDENTS
FIVE-YEAR MILESTONE ACHIEVEMENT TOTALS
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



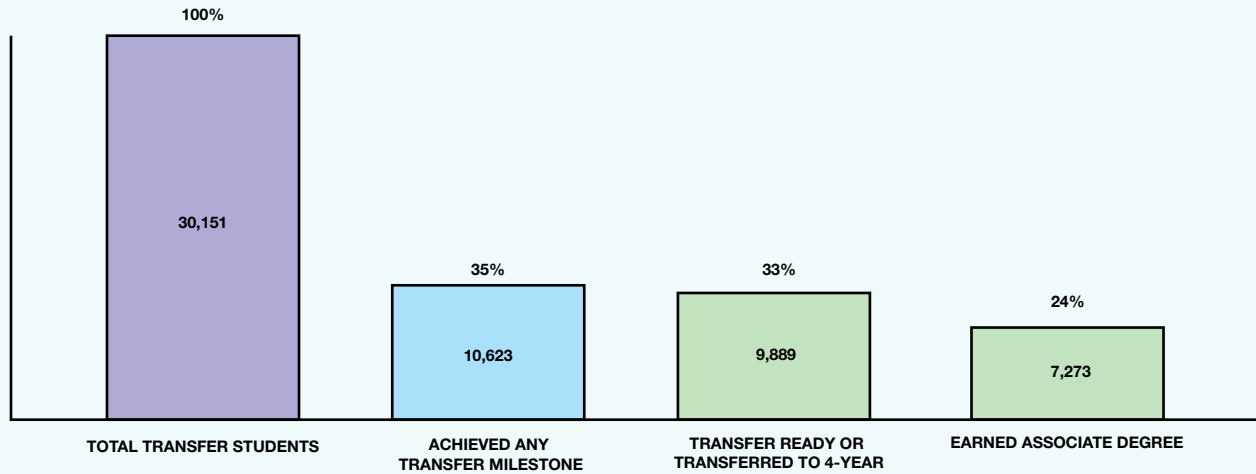
**FIGURE 8.2: WORKFORCE TRAINING STUDENTS
FIVE-YEAR MOMENTUM POINT ATTAINMENT TOTALS
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



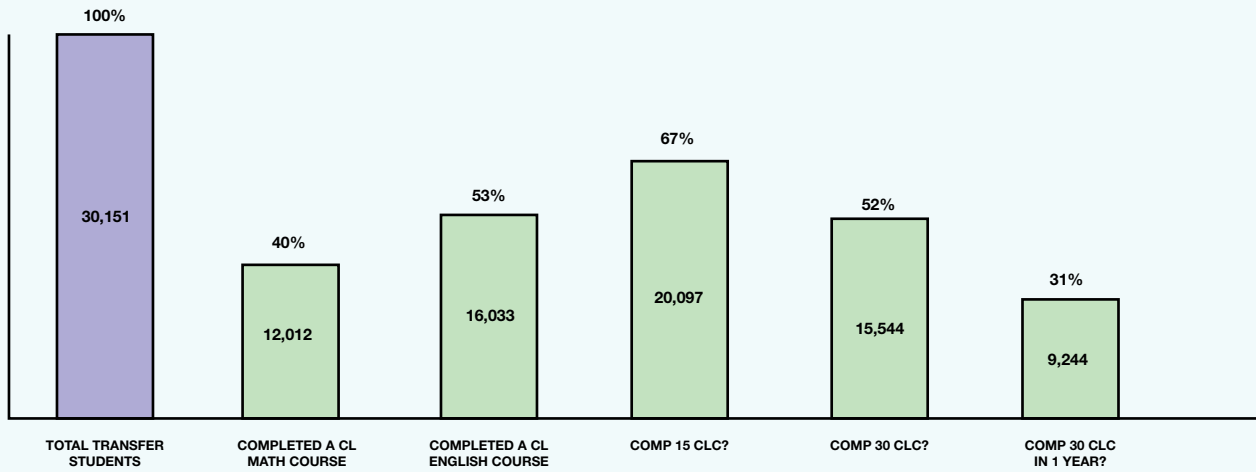
**FIGURE 8.3: WORKFORCE TRAINING STUDENTS
PROBABILITY OF MILESTONE ACHIEVEMENT CONDITIONAL ON MOMENTUM POINT ATTAINMENT
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



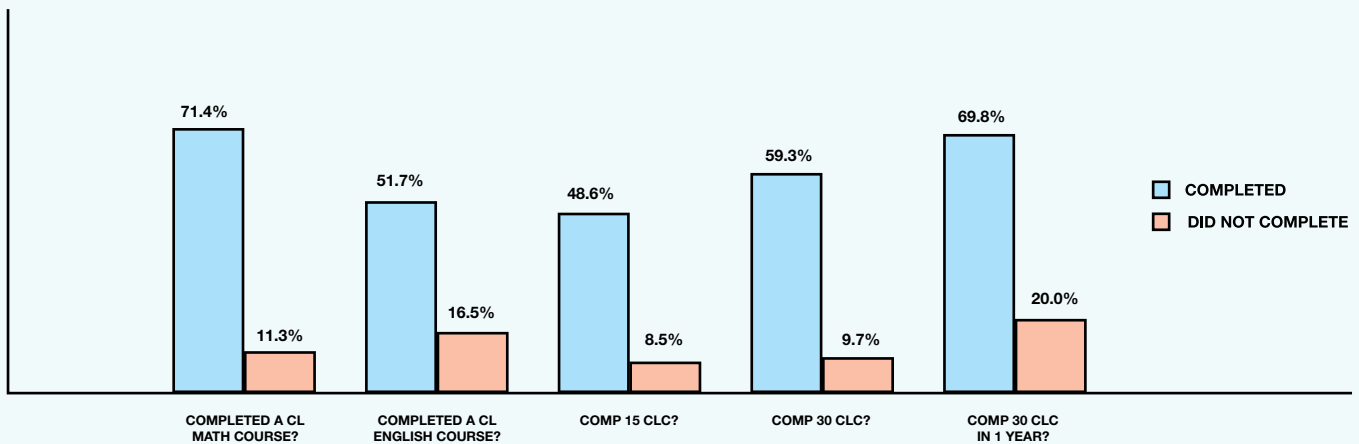
**FIGURE 9.1: TRANSFER STUDENTS
FIVE-YEAR MILESTONE ACHIEVEMENT TOTALS
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



**FIGURE 9.2: TRANSFER STUDENTS
FIVE-YEAR MOMENTUM POINT ATTAINMENT TOTALS
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



**FIGURE 9.3: TRANSFER STUDENTS
PROBABILITY OF MILESTONE ACHIEVEMENT CONDITIONAL ON MOMENTUM POINT ATTAINMENT
2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE**



Tracking remedial students who advance to college-level coursework

In the model we present, we track remedial students only through the completion of their remediation and transition to college. For those who make that transition, their enrollment should be tracked for other milestone achievements at the college level. Some preliminary work we have done using the Washington data suggests that those students who begin in and complete remedial programs succeed in college-level vocational and transfer programs at similar or better rates than those students who begin at the college level. To do this kind of comparison, care must be taken to observe the two different groups of students over the same length of time. For example, students who start in remediation may not begin their college courses until several terms after they begin their postsecondary enrollment. See the sidebar for a discussion of how we handled this issue when working with the Washington data.

Other analyses

Other types of research that could be conducted using longitudinal SUR data include more sophisticated analyses using multivariate regressions to assess the statistical significance of the relationships between momentum points and milestones that we have presented descriptively here. We carried out some preliminary multivariate analyses using the Washington data, the results of which we discuss briefly in *Technical Notes 1*.

Conclusion

The methodology for identifying milestones and momentum points presented in this guide can be useful for highlighting gaps in achievement among different student groups, gaps that also represent potential opportunities for improving student outcomes. The method is limited, however, in the extent to which it can help to diagnose the causes of the achievement gaps observed and to formulate strategies for addressing them.

The diagnosis of achievement gaps and the development of strategies for improving outcomes should be left to those best positioned and equipped to do so — faculty, student services staff, and administrators. Therefore, states should disaggregate state-level analyses by college and make the results available to colleges for their own use. Within colleges, faculty and staff should be encouraged to review and

CCRC'S WASHINGTON STATE MOMENTUM POINT ANALYSIS

College-level Enrollment of Remedial Students

When observing the college-level course-taking of those students who start in remediation, we must determine at what point in their enrollment they become “college-level.” For many students there is no clear transition point from remedial to college-level — for example, they may enroll in college classes before completing their remedial program. Therefore, we must decide whether we define them as “college-level” from the point at which they complete remediation or the point at which they start college-level classes.

In the Washington case, we determined that only when students complete all of their remediation are they at the same “starting line” as students who began exclusively in college-level courses. This is the point at which they become “college-level” students. Any college-level credits earned by remedial students prior to completing remediation are counted as “previous credits earned.” Since we had only a total of five years of data for our observation, we required that students in remediation must have completed their remediation within two years of their start, so that we had at least three years over which to observe their college-level enrollment. Since three years of college-level course-taking is the minimum that any remedial student could have, we set three years from first college-level enrollment as the period of time over which we observed any student in the comparison.

All students who were not assigned to the adult basic skills or the developmental education group were assigned to the college-level group. These were students who enrolled only in college-level courses and never in developmental education. Assignments to adult basic skills, developmental education, and college-level student groups were all mutually exclusive.

Engaging Educators in Research to Inform Policy

The analysis described in this guide was used to inform the design of a performance funding policy for Washington State’s community and technical colleges. To advise on the design of the policy, the Washington State Board for Community and Technical Colleges convened a broadly representative advisory committee comprised of institutional researchers from the colleges as well as other staff, administrators, and faculty from colleges throughout the system. The advisory committee reported to a task force of board members, college trustees, presidents, faculty, and staff that made recommendations to the SBCTC on what momentum points should be used in the design of a performance funding scheme the state is developing to encourage colleges to work to improve student outcomes. Using the analysis conducted by CCRC as well as other research, the SBCTC staff, together with the advisory committee, recommended to the taskforce a set of six salient momentum points that will serve as “pay points” in the new scheme. By involving college representatives from the start in this process, the Washington State Board sought to create a sense of ownership for the new policy and ensure that it would support practices that result in increased success for students.

discuss analyses of milestone and momentum attainment by their students. Based on further investigation of the causes of barriers that thwart student success and evaluation of previous efforts to address them, faculty and staff should be empowered to develop strategies for helping students overcome barriers to advancement and for accelerating their progress.

Promoting broad engagement in the discussion of research such as that described in this guide will enhance buy-in from faculty, counselors, and others who work directly with students, thereby increasing the likelihood that the results of the research will be used to inform improvements in practice on a substantial scale.

Technical Notes 1: The Statistical Significance of Momentum Points and Milestones

The tables and figures presented in the body of this guide are all based on simple descriptive statistical analysis. In this first technical notes section we provide an example of a somewhat more sophisticated, multivariate analysis of the relationship between attainment of momentum points and achievement of educational milestones.

Momentum Points That Lead to Milestones

The model and figures using Washington data discussed in the previous sections suggest a strong relationship between the attainment of some momentum points and milestone achievement for different groups of students. As we noted, these counts and probabilities cannot prove causality. Yet we can be more certain at least about the correlation between particular momentum points and milestones by using multivariate logistic regressions with milestone events as the dependent variable (i.e., the outcome being explained) and momentum points, with controls for student characteristics as the independent variables (i.e., the explanatory factors).

When we performed such regressions using the Washington data, we used the same six student groups defined above (ABE, ESL, developmental, college-level, vocational, and transfer). We used transition to college as the milestone achievement dependent variable for remedial students (ESL, ABE, and pre-college). For ESL and ABE students the transition to college occurs with the completion of any two college-level courses. For pre-college students the transition to college occurs with completion of a college-level course in the area of the student's remedial requirement (reading, writing, or math). Measuring the milestone achievements in this way allows us to use the college-ready achievement measures as independent variables that help explain the milestone achievement.¹⁰ Therefore, the momentum point explanatory variables for ESL students include:

- Completion of any ESL course
- Completion of ESL level 6 (highest level)
- Completion of ESL level 5 and one other ESL course
- Completion of any three ESL courses

Momentum point explanatory variables for ABE students include:

- Completion of any ABE or GED course
- Completion of ABE level 6 or GED level 2 (highest levels)
- Completion of ABE level 5 or GED level 1 and one other ABE course
- Completion of any three ABE courses
- Completion of any high school completion course
- Completion of a GED
- Completion of a high school diploma

Momentum point explanatory variables for pre-college students include:

- Completion of a pre-college course in area of remediation
- Completion of pre-college-level 4 (highest level) in area of remediation
- Completion of any three pre-college courses in area of remediation

The milestone events used as the dependent variables in the regressions for the college-level, workforce, and transfer students are the following credential and transfer outcomes: transfer to a four-year or transfer-ready; associate degree; certificate of one year or more; certificate of less than one year; or program or training completion.¹¹ The explanatory variables that we used to test possible momentum points for college-level students are:¹²

- Completion of gatekeeper math course
- Completion of gatekeeper English course
- Completion of 15 college-level credits
- Completion of 30 college-level credits
- Completion of 30 college-level credits in one year
- Completion of 15 vocational credits
- Completion of 30 vocational credits
- Completion of 30 vocational credits in one year
- Completion of a career exploration/introduction course

In all the regressions we included a set of demographic and enrollment pathway explanatory variables (such as full-time or part-time enrollment) to act as controls for other factors that may affect the achievement of a milestone outcome. Table 3 lists the dependent and explanatory variables and their means for each student group.

For each of the student groups, we performed a stepwise logistic regression, starting with the demographic variables and introducing additional variables to observe the impacts of the enrollment and momentum points. For simplicity we do not include here the full table of regression results with marginal effects and standard errors. Instead, we include a table summarizing the findings in which a '+' indicates a positive and statistically significant (at the .05 level) correlation between the explanatory variable — demographic or momentum point — and the milestone for the student group. Having the given characteristic or attaining the momentum point indicated is

**TABLE 3: 2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE
ENROLLMENT THROUGH SPRING 2005-06
STUDENT CHARACTERISTICS
(CELL PERCENTS BY STUDENT GROUP)**

| | ESL | ABE | Pre-College | College Level | Workforce | Transfer |
|--|--------|-------|-------------|---------------|-----------|----------|
| Total Students | 10,762 | 9,977 | 28,524 | 41,339 | 34,828 | 30,151 |
| Demographic and Enrollment Characteristics | | | | | | |
| Female | 53.9 | 50.4 | 55.3 | 50.2 | 50.6 | 53.2 |
| Under 20 at start | 9.6 | 42.2 | 52.4 | 25.9 | 19.2 | 53.5 |
| 20-24 at start | 21.4 | 22.2 | 20.0 | 21.5 | 18.4 | 23.9 |
| 25 or older at start | 69.0 | 35.5 | 27.6 | 52.7 | 62.4 | 22.5 |
| White, non-Hispanic | 14.4 | 56.8 | 70.1 | 66.2 | 60.0 | 70.7 |
| African American, non-Hispanic | 5.2 | 8.7 | 5.8 | 3.9 | 5.1 | 5.2 |
| Hispanic | 43.9 | 10.1 | 7.5 | 4.6 | 8.7 | 6.8 |
| Asian/Pacific Islander, non-Hispanic | 19.9 | 6.4 | 8.8 | 6.6 | 6.7 | 9.0 |
| Native American, non-Hispanic | 0.2 | 4.3 | 2.1 | 1.5 | 1.6 | 1.9 |
| R/E Unknown | 16.4 | 13.7 | 5.8 | 17.2 | 17.9 | 6.4 |
| SES: highest | 11.4 | 8.4 | 15.6 | 21.2 | 15.2 | 21.1 |
| SES: higher | 18.4 | 16.1 | 20.5 | 22.2 | 19.6 | 23.4 |
| SES: middle | 19.1 | 22.3 | 22.7 | 21.1 | 22.3 | 21.5 |
| SES: lower | 22.1 | 24.3 | 21.2 | 19.6 | 21.8 | 18.5 |
| SES: lowest | 29.1 | 29.0 | 19.9 | 15.9 | 21.1 | 15.5 |
| With children or dependents | 54.0 | 47.2 | 32.1 | 34.5 | 47.3 | 23.1 |
| Received financial aid | 6.5 | 22.2 | 52.1 | 23.9 | 32.4 | 39.3 |
| Student start: any ESL | 100.0 | | | | 8.2 | 1.5 |
| Student start: any ABE | | 100.0 | | | 6.9 | 2.0 |
| Pre-college student | | | 100.0 | | 23.8 | 54.7 |
| Momentum Points | | | | | | |
| Ever completed an ESL course | 59.2 | | | | | |
| Ever completed ESL level 6 | 4.4 | | | | | |
| Completed ESL level 5 and 1 other ESL course | 7.7 | | | | | |
| Completed 3 or more ESL courses | 11.4 | | | | | |
| Ever completed an ABE or GED course | | 45.1 | | | | |
| Ever completed ABE level 6 or GED level 2 | | 9.4 | | | | |
| Completed ABE level 5 and 1 other ABE or GED course | | 4.7 | | | | |
| Completed 3 or more ABE or GED courses | | 2.7 | | | | |
| Ever completed a high school completion course | | 10.3 | | | | |
| GED | | 16.3 | | | | |
| High School completion | | 4.3 | | | | |
| Ever completed a pre-college course | | | 86.9 | | | |
| Pre-college student completed PCC level 4 course in PCC area | | | 65.2 | | | |
| Pre-college student completed 3 PCC courses in PCC area | | | 11.0 | | | |
| Ever completed college-level gatekeeper math | | | | 16.9 | 12.8 | 39.8 |
| Ever completed college-level gatekeeper English | | | | 19.5 | 21.5 | 53.2 |
| Ever completed a career exploration/introduction course | | | | 3.9 | 4.2 | |
| Ever completed 15 college-level credits | | | | 41.4 | | 66.7 |
| Ever completed 30 college-level credits | | | | 28.8 | | 51.6 |
| Completed 30 college-level credits within 1 year | | | | 20.9 | | 30.7 |
| Ever completed 15 vocational credits | | | | 21.9 | 33.4 | |
| Ever completed 30 vocational credits | | | | 14.6 | 24.0 | |
| Completed 30 vocational credits within 1 year | | | | 9.5 | 14.1 | |
| Milestone Events | | | | | | |
| College ready | 15.2 | 35.2 | 65.5 | | | |
| Transition to college | 7.0 | 24.9 | 52.3 | | | |
| Transferred to a 4-yr or transfer ready | | | | 13.6 | | 32.8 |
| Associate degree | | | | 11.4 | 10.2 | 24.1 |
| Certificate of 1 year or more | | | | 3.4 | 5.5 | |
| Certificate of less than 1 year | | | | 3.3 | 5.4 | |
| Program or training completion | | | | 2.4 | 3.3 | |
| Any milestone success (for student group) | 19.9 | 48.1 | 70.8 | 25.2 | 21.1 | 35.2 |

Shaded cells are not applicable to the student group.

correlated with increased likelihood of achieving the milestone.¹³ A ‘-’ indicates a negative and statistically significant relationship. Observe in Table 4 (page 20) that across all student groups the demographic variables exhibit a statistical relationship that is not unexpected and similar to those found in other studies of factors affecting community college student success (Adelman, 2006; Alfonso, Bailey, & Scott, 2005; Calcagno, Crosta, Bailey, & Jenkins, 2007). In general, females, students of Asian background, and students from higher SES households all exhibit increased

likelihood of milestone achievement when compared with their reference categories (male, white, and lowest SES, respectively). Students with dependents and students of Hispanic background were less likely to achieve milestones. The one distinctive finding is that when compared to younger students, students aged 20-24 and 25 and above were significantly less likely to achieve milestones among the ESL, ABE, and pre-college students, while these age groups were more likely to achieve milestones among the college-level, workforce, and transfer students.

TABLE 4: 2001-02 FIRST-TIME STUDENTS IN A WASHINGTON STATE COMMUNITY OR TECHNICAL COLLEGE STUDENT CHARACTERISTICS AND MOMENTUM POINTS CORRELATED WITH MILESTONE EVENTS (BY STUDENT GROUP)

| | ESL | ABE | Pre-College | College Level | Workforce | Transfer |
|--|-----------------------|-----------------------|-----------------------|--|--|---|
| Milestone Events | Transition to College | Transition to College | Transition to College | Transfer, Transfer-Ready, Associate Degree, Certificate, or Program Completion | Associate Degree, Certificate, or Program Completion | Transfer, Transfer-Ready, or Associate Degree |
| Demographic and Enrollment Characteristics | | | | | | |
| Female | | + | + | + | + | + |
| 20-24 at start | - | - | - | + | | + |
| 25 or older at start | - | | - | | + | |
| African American, non-Hispanic | | + | - | | | - |
| Hispanic | - | | - | | | |
| Asian/Pacific Islander, non-Hispanic | + | | + | + | + | + |
| Native American, non-Hispanic | | - | - | - | | |
| R/E Unknown | | - | | + | | |
| SES: highest | | + | + | + | | + |
| SES: higher | | + | + | + | | + |
| SES: middle | | + | + | | | |
| SES: lower | | | | | | |
| With children or dependents | | - | - | | | - |
| Received financial aid | + | + | + | + | + | |
| Student start: any ESL | | | | | - | - |
| Student start: any ABE | | | | | | - |
| Pre-college student | | | | | - | - |
| Momentum Points | | | | | | |
| Ever completed a career exploration/introduction course | | | | - | | |
| Ever completed an ESL course | | | | | | |
| Ever completed ESL level 6 | + | | | | | |
| Completed ESL level 5 and 1 other ESL course | + | | | | | |
| Completed 3 or more ESL courses | | | | | | |
| Ever completed an ABE or GED course | | | | | | |
| Ever completed ABE level 6 or GED level 2 | | - | | | | |
| Completed ABE level 5 and 1 other ABE or GED course | | | | | | |
| Completed 3 or more ABE or GED courses | | | | | | |
| Ever completed a high school completion course | | + | | | | |
| GED | | + | | | | |
| High School completion | | | | | | |
| Ever completed a pre-college course | | | | | | |
| Pre-college student completed PCC level 4 course in PCC area | | | + | | | |
| Pre-college student completed 3 PCC courses in PCC area | | | + | | | |
| Ever completed college-level gatekeeper math | | | | + | + | + |
| Ever completed college-level gatekeeper English | | | | + | + | + |
| Ever completed 15 college-level credits | | | | + | | - |
| Ever completed 30 college-level credits | | | | + | | + |
| Completed 30 college-level credits within 1 year | | | | + | | + |
| Ever completed 15 vocational credits | | | | + | + | |
| Ever completed 30 vocational credits | | | | + | + | |
| Completed 30 vocational credits within 1 year | | | | - | + | |

+ Indicates a statistically significant (.05 level) positive correlation between the characteristic or momentum point and the milestone events.
 - Indicates a statistically significant (.05 level) negative correlation between the characteristic or momentum point and the milestone events.
 Shaded cells are not applicable to the student group.

Looking at the momentum points that correlate with milestone achievement for specific groups, we see a significant and positive relationship for ESL students who managed to complete either the highest level of ESL or two ESL classes including level 5. We cannot determine here whether there are characteristics about the students who completed the highest levels of ESL that also pushed them to transition to college-level or whether the attainment of competency in English provided them with the confidence and skills to transition. In contrast to ESL students, ABE students who complete the highest level of ABE (level 6) actually have a significant negative correlation with transition to college. Only those ABE students who completed a course toward high school completion (but not those who earned a high school diploma) or earned a GED have a significant positive correlation. As a GED or diploma is a pre-requisite to entering college-level courses, we should

expect that ABE students must attain this momentum point in order to transition successfully to college. Those who do not aspire to that credential may enroll in basic skills classes with the purpose of remediating specific educational deficiencies to improve their employment situation rather than to continue their education. Finally, as we would expect, pre-college students who completed either the highest level of developmental education or any three developmental education classes in their area of need were more likely to transition successfully to the college level.

For college-level, workforce, and transfer students, practically all of the gatekeeper course completions and credit thresholds are positive and significant for any milestone achievement. Passing the basic gatekeeper courses in math and English are very strongly correlated with postsecondary achievement. Somewhat

surprising is the negative correlation for college-level students who earned 30 vocational credits in one year. We would expect this accomplishment to easily propel a student toward a credential or transfer. However, this result may reflect a large group of students who enrolled with the specific intention of brief, yet intense, skills training for job advancement. In such cases, a credential may not be necessary for their educational objectives.

In general, the logistic regression results show support for the relationship of many momentum points with milestone achievement for their respective student groups. Still, we cannot say with certainty that momentum point attainment is the reason for student milestone achievement, because individual motivation or other characteristics that correlate both with momentum point and milestone success could also play a causal role. Yet, clearly it is necessary for students to attain certain momentum points to increase their likelihood of achieving educational milestones.

Technical Notes 2: Working with Longitudinal Student Unit Record Data

Here we provide technical notes useful for those researchers who wish to transform student transcript data into a longitudinal SUR dataset for use in the milestone model or other statistical analyses.

Data Requirements for Longitudinal Analysis

Longitudinal analysis of student enrollments and achievements requires data on individual students. Ideally, this includes fixed demographic and background data for each student, usually stored in one or more student characteristics records, and enrollment data that contain one record per *student per course per term* for every term in which a student enrolls. All records must be linked by a unique student identifier. Most colleges have such data as part of their electronic student information systems. A recent 50-state survey found that 40 states have SUR databases for their public higher education institutions (Ewell & Boeke, 2007). These databases encompass information on 81 percent of the nation's total student headcount enrollment, although they vary in the scope and depth of the information they contain.

Each student course record should include the course subject, course level, credits attempted, and credits earned. Needed too are term-by-term data elements on credentials earned or program completions. Financial aid data, though not essential, can be a useful explanatory variable. Finally, to track whether students go on to enroll in a baccalaureate program (or are ready to do so), some record of student transfer or transfer-readiness must exist. The former may come from a link with the state university system or may be obtained from the National Student Clearinghouse, a membership service with a student enrollment and degree database. Institutionally-defined

transfer readiness is usually measured by a threshold level of credit accumulation and distribution along with some core requirement completions. Students meeting these requirements can be flagged as prepared for junior status in a baccalaureate program regardless of whether they actually transfer or earn a credential.

To measure the economic impacts of enrollment, a set of employment data (preferably including the time before, during, and after enrollment) is needed. This may be unemployment insurance (UI) wage data or may come from another state source. Graduate survey data are not recommended because of their limited time scope, unreliability, and lack of comprehensiveness.

See Table 5 (page 22) for a complete list of recommended minimum data requirements for a longitudinal student achievement analysis.

Cohort Selection Criteria

When reporting to the U.S. Department of Education for the IPEDS Student-Right-to-Know Graduation Rate Survey, colleges use a cohort of *first-time full-time degree-seeking* students who are enrolled in the *fall term* of the reporting year. The selection criteria presume a postsecondary model in which most students start in the fall with the new school year, begin with no prior postsecondary education, and enroll continuously full-time until they complete a credential. This limits the student cohort to a small and unrepresentative sample of community college students (Bailey, Jenkins, & Leinbach, 2006; Bailey, Crosta, & Jenkins, 2006). We will use these italicized characteristics (*first-time*, *full-time*, *degree-seeking*, and *fall term*) to identify the criteria by which to select students for our analysis cohort. *First-time* describes the student's *previous enrollment* in the system. *Full-time* defines

CCRC'S WASHINGTON STATE MOMENTUM POINT ANALYSIS

CCRC's Washington State Momentum Point Analysis

The dataset CCRC and the Washington SBCTC constructed for analysis of student achievement contains complete transcript and demographic data, including a proxy measure for SES derived from the U.S. Census block group characteristics for the student's address (Crosta, Leinbach, & Jenkins, 2006) for all first-time students in a Washington community or technical college (CTC) during the 2001-02 academic year (summer 2001 through spring 2002). The transcript data are complete for every term of CTC enrollment through spring 2006 and include all information listed in Table 5. The 2001-02 cohort contains 87,820 true first-time students. For all students in the cohort we also received data on other postsecondary enrollment (for transfer) and quarterly unemployment insurance (UI) wage records from 1990 through 2006.

TABLE 5: IDEAL MINIMUM SET OF STUDENT UNIT DATA ELEMENTS FOR LONGITUDINAL ANALYSIS

| Category | Element | Required | Term by Term Data |
|------------------------|---|----------|-------------------|
| Student Identification | Unique student identifier | * | |
| Demographics | Race/Ethnicity | | |
| | Gender | | |
| | Age | | |
| | SES | | |
| Educational Background | Highest level of education completed | | |
| | Previous credentials | | |
| | Ability measure (standardized test score) | | |
| Program | Program in which enrolled | * | * |
| Course | Course subject | * | * |
| | Course type | | * |
| | Level | * | * |
| | Credits | * | * |
| | Credits earned | * | * |
| | Grade | | * |
| Financial Aid | Type | | * |
| | Amount | | * |
| Credential | Credential type earned | * | * |
| Transfer | Institution/Level to which transferred | | * |
| | Transfer-ready | * | * |
| Employment | Working | | * |
| | Wage | | * |

the *intensity* of initial enrollment. *Degree-seeking* combines the student’s *program* and *objective*. *Fall term* refers to the student’s *timing* of initial enrollment. We discuss each of these criteria in logical order.

Previous Enrollment

For our cohort we want only true first-time students. These are students who are enrolled for the first time in the community college system. We exclude students who enrolled previously in any capacity and for any length of time. We choose this strict definition in order to observe the complete community college enrollment history of each student without the complication of previous credits.

Researchers may choose to make exceptions to this strict definition of first-time students for students who enrolled beyond a specified number of years prior to the cohort year and for those who were in dual enrollment (taking college courses while still in high school for concurrent high school and college credit). A previous enrollment may be sufficiently distant in the past to deem it as having no impact on the student’s current enrollment achievements. In a sense, such a student is making a “fresh start” with his or her current enrollment. One objection to this choice is that a student may have earned prior credits that can be credited toward current enrollment. With this in mind, the analyst must decide how many years, if any, are sufficiently distant to allow a student to be considered first-time.

Timing

Community college cohorts should not be confined to students who begin their enrollment in the fall term. Not only does

this exclude a large proportion of beginning students, but the restriction also distorts the characteristics of first-time community college students. For example, in the 2001-02 cohort of first-time students in Washington, only 41 percent started in the fall quarter, while 24 percent started in the winter, 21 percent in the spring, and 14 percent in the summer.¹⁴ This distribution is affected by the large numbers of students in ABE and ESL programs, which are administered by the Washington SBCTC and account for 44 percent of the students in the cohort. Less than one-third of the students who enrolled in adult basic skills (ABE or ESL) started in the fall term, while 39 percent of students in college-level vocational (called workforce training by the SBCTC) programs and 55 percent of those in transfer programs started in the fall. Similarly, the fall-starters included 57 percent of all the students who were under 20, 40 percent of those 20-24, and only 35 percent of those who were 25 and over. This sample of distributions indicates that the fall cohort does not represent a typical slice of all first-time students in Washington State’s community colleges.

Intensity of Enrollment

Community college students follow many enrollment pathways to reach their educational objectives. Continuous full-time enrollment is the exception rather than the rule among these institutions, even during a student’s first term. Many students never enroll full-time (or mix terms of full- and part-time enrollment), may start and stop their enrollment in any term, or may not enroll for several terms. To restrict the cohort by enrollment intensity severely limits the cohort population being observed. In our work in Washington State, we used all students in the cohort.

Program/Objective

Needless to say, not all students at community and technical colleges are seeking a credential or transfer to a four-year college. Many complete their education without ever completing a credential. And within any given cohort are students with a wide range of previous education and preparation for college-level work. Among the most obvious divisions are between those requiring remediation in reading, writing, or math, and those fully prepared for college-level work. Also, many students enter with deficiencies in basic skills or in English-language proficiency, or they lack a high school diploma or the equivalent. Such a range of students will necessarily have a variety of educational needs, will start at different enrollment levels and in different programs, and will likely have different objectives for their enrollment.

Length of Observation

Other work by CCRC (Bailey, Jenkins, & Leinbach, 2006) shows that three years is too brief a period over which to observe enrollment of community college students, who increasingly enroll over several years and often require much more than 150 percent of the expected full-time period to complete a credential. Yet, while choosing longer periods makes it possible to observe more complete enrollment histories, this also pushes back the beginning year of the cohort so that it may be less representative of current students and enrollment patterns. For example, capturing seven years of enrollment history through 2006 requires a 1999 student cohort. Given the rapidly changing nature of enrollment patterns and demographic shifts in some areas, it is reasonable to ask whether this set of students should be used in analyses that will determine policy in 2007, which in turn will affect students arriving at the college in the years after 2007. Short of finding consensus on the best length of time over which to observe students, very often the determining feature of longitudinal observation is the availability of data. In cases where the data resources are available, we recommend a *five year period* of observation as a highly informative length of time.

References

- Adelman, C. (2005). *Moving into town—and moving on: The community college in the lives of traditional-age students*. Washington, DC: U.S. Department of Education.
- Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school through college*. Washington, DC: U.S. Department of Education.
- Alfonso, M., Bailey, T., & Scott, M. (2005). The educational outcomes of occupational sub-baccalaureate students: Evidence from the 1990s. *Economics of Education Review*, 24(2), 197-212.
- Bailey, T., Crosta, P. M., & Jenkins, D. (2006). *What can Student Right-to-Know graduation rates tell us about community college performance?* CCRC Working Paper No. 6. New York: Columbia University, Teachers College, Community College Research Center.
- Bailey, T., Jenkins, D., & Leinbach, D. T. (2006). *Is student success labeled institutional failure? Student goals and graduation rates in the accountability debate at community colleges*. CCRC Working Paper No. 1 (updated version). New York: Teachers College, Community College Research Center.
- Cabrera, A. F., Burkum, K. R., & La Nasa, S. M. (2003). *Pathways to a four-year degree: Determinants of degree completion among socioeconomically disadvantaged students*. Presented at the annual meeting of the Association for the Study of Higher Education, Portland, OR.
- Calcagno, J. C., Crosta, P. M., Bailey, T., & Jenkins, D. (2007). Stepping stones to a degree: The impact of enrollment pathways and milestones on community college student outcomes. *Research in Higher Education*, 48(7), 775-801.
- Crosta, P. M., Leinbach, D. T., & Jenkins, D. (2006). *Using census data to classify community college students by socioeconomic status and community characteristics*. CCRC Research Tools No. 1. New York: Teachers College, Columbia University: Community College Research Center.
- Ewell, P. (2007). *Community College Bridges to Opportunity Initiative: Joint state data toolkit*. Austin, TX: Bridges to Opportunity Initiative and Community College Leadership Program, University of Texas at Austin.
- Ewell, P. & Boeke, M. (2007). *Critical connections: Linking states' unit record systems to track student progress*. Indianapolis, IN: Lumina Foundation for Education.
- Goldrick-Rab, S. (2006). Following their every move: How social class shapes postsecondary pathways. *Sociology of Education*, 79(1), 61-79.
- Horn, L., Cataldi, E. F., & Sikora, A. (2005). *Waiting to attend college: Undergraduates who delay their postsecondary enrollment*. (NCES 2005-152). Washington, DC: U.S. Department of Education, National Center for Education Statistics.
- Jenkins, D. & Ewell, P. (forthcoming). Using state student unit record data to improve community college student success. In Bers, T. (Ed. of forthcoming issue), *New Directions for Community Colleges*.
- Prince, D. & Jenkins, D. (2005). *Building pathways to success for low-skill adult students: Lessons for community college policy and practice from a statewide longitudinal tracking study*. New York: Columbia University, Teachers College, Community College Research Center.
- Voorhees, R. A., Smith, G. P., & Luan, J. (2006). Researching community college student transitions. In Voorhees, R. A., and Smith, G. P. (Eds. of special issue on community college student transitions), *Journal of Applied Research in the Community College*, 13(2), 177-188.
- Zeidenberg, M., Jenkins, D., & Calcagno, J. C. (2007). *Do student success courses actually help community college students succeed?* CCRC Brief No. 36. (June). New York: Columbia University, Teachers College, Community College Research Center.

Endnotes

1. The term was taken from Clifford Adelman’s ground-breaking work on student progression; see Adelman (2005) and Adelman (2006).
2. The 2,475 in the Y2 bar are students who completed gatekeeper math in any of the four quarters during their second year.
3. We use the terms “remediation” and “remedial” to include all types of non-college-level courses, including developmental education (termed “pre-college” by the Washington SBCTC), adult basic education (ABE), and English as a second language (ESL). The latter two we refer to collectively as adult basic skills.
4. Placement tests may be specific to a college or system or may be commercial standardized tests such as ACCUPLACER and COMPASS (assessments to determine placement in remediation) or the SAT and ACT (general college entrance exams).
5. Students in this group who are enrolled for personal enrichment or skills upgrading may not have a transfer or credential goal. However, these students are also assigned to the *other* student group by program/objective (not shown in table), which would include non-transfer and non-credential milestone events.
6. The Washington SBCTC defines “transfer ready” as having completed at least 45 college credits with a GPA of 2.0 or higher, a college-level English course, a college-level math course, and a minimum set of “distribution” courses. Note that Washington community and technical colleges operate on a quarter, rather than a semester, system.
7. Recent work by CCRC (Zeidenberg, Jenkins, & Calcagno, 2007) suggests that taking a *student success course* (courses in study, test-taking, and time management skills) increases the likelihood of educational success for community college students. Although completion of this type of course is another potential momentum point, the Washington data did not identify such courses.
8. In *Technical Notes 1*, we employ a regression analysis that allows us to control for other factors in milestone achievement and that establishes the statistical significance of the relationships we observe here.
9. In a separate project, CCRC worked with the Washington SBCTC to develop a measure of SES for each student by linking student addresses with Census tract information (Crosta, Leinbach, & Jenkins, 2006).
10. We ran the model with different milestone outcomes, but we discuss only the model with transition to college here. Other results are available upon request from CCRC.
11. See Table 1 for the milestone events applicable to each group.
12. See Table 2 for the momentum points applicable to each group.
13. The marginal effect, not included here, indicates the magnitude of that effect.
14. All percents are the authors’ calculations.

D. Timothy Leinbach served until recently as a Research Associate at the Community College Research Center, Teachers College, Columbia University. He is currently the manager of U.S. operations for Summit Expeditions and Nomadic Experience, a trekking and safari company.

Davis Jenkins is a Senior Research Associate at the Community College Research Center, Teachers College, Columbia University.

The research on which this guide is based was funded in part by the Ford Foundation through the Community College Bridges to Opportunity Initiative (www.communitycollegecentral.org). Additional funding for research and for the development of the guide was provided by Lumina Foundation for Education as part of the Achieving the Dream: Community Colleges Count initiative (www.achievingthedream.org). The authors are grateful to Tina Bloomer, David Prince, and Loretta Seppanen of the Washington State Board for Community and Technical Colleges for the productive research partnership through which this guide was developed. We would also like to thank Rick Voorhees and Trudy Bers for helpful comments on a review draft and Doug Slater for able editorial assistance.

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