Washington State Board of Education: 2008 Graduate Follow-up Study

FINAL REPORT

DUANE B. BAKER, Ed.D.
CANDACE A. GRATAMA, Ed.D.
KARI M. PETERSON, Ph.D.
ELIZABETH BOATRIGHT, Ph.D.

Duane Baker is the founder and president of Baker Evaluation,
Research, and Consulting, Inc (*The* **BERC** *Group*). Dr. Baker has a
broad spectrum of public school educational and program
experience, including serving as a high school classroom teacher,
high school assistant principal, middle school principal, executive
director for curriculum and instruction, and assistant
superintendent. In addition, he has served as an adjunct instructor
in the School of Education at Seattle Pacific University since 1996,
where his emphasis has been Educational Measurement and
Evaluation and Classroom Assessment.

Dr. Baker also serves as the Director of Research for the
Washington School Research Center at Seattle Pacific University.
He also serves as an evaluator for several organizations including
the Bill & Melinda Gates Foundation, Washington Education
Foundation, Washington State Office of Superintendent of Public
Instruction, and others.

Members of *The* **BERC** *Group* have K–20, experiences as teachers,
counselors, psychologists, building administrators, district
administrators, and college professors. The team is currently
working on research and evaluation projects at the national, state,
regional, district, school, classroom, and student levels in over
1000 schools in Washington State and nationally.

Table of Contents

Executive Summary

Students who are ready for college level work are more successful in college than those who are not. However, many students enrolling in college nationally and in Washington State are not ready to take college level course work. The Washington State Board of Education commissioned this research to examine the relationship between high school and college course-taking patterns.

This study examined the course-taking patterns for students of the graduating class of 2008 across Washington State. The sample was drawn from a previous transcript study. Of the original participants (n = 14,875), we were able to match 89% of the records (n = 13,247). Overall, 6,377 students attended a two-year college in Washington State or one of six four-year colleges and universities identified for this study.

Overall results demonstrate large differences in course-taking patterns depending on the type of college students attend. Students who attended four-year colleges or who were dual enrolled took more rigorous courses than students who attended a two-year college. Of the 2008 high school graduates who attended college the year after graduating high school, 45% of students attending a two-year college, 85% of students attending a four-year college, and 82% of students who were dual enrolled met minimum, public four-year Washington college admissions standards set by the HEC Board. There are significant differences between the two-year and the four-year group and the two-year and dual enrollment group across each subject area, with the four-year and dual enrollment groups meeting eligibility requirements in each subject area at higher rates than the two-year group.

A logistic regression analysis was conducted to predict enrollment into a two-year or four-year college. GPA had the highest predictive ability, followed by level of last math class, foreign language requirement met, and the level of the last English class. This indicates that both courses and grades are important in predicting the type of college enrollment.

An analysis of the percent of students taking remedial math and English courses shows that 56.9% of students took a college remedial math or English course in the CTC system. By subject area, 49.7% of students took a remedial math course, 25.6% took a remedial English course, and 18.5% took both a remedial math and a remedial English course. A logistic regression analysis was conducted to better understand the relationship between students enrolling in remedial courses and when they last took English and math, and at what level. For math, the last level that students completed was the strongest predictor of whether a student enrolls in a remedial math course followed by GPA. Findings show that students are less likely to enroll in a remedial math course in college if they have taken Calculus or beyond in high school. For English, GPA was the strongest predictor, followed by the level of English course students attained in high school. In both cases, the last year students took the course was not a statistically significant predictor. This indicates that the level students attain in math and English is more important than when they last take math or English.

Approximately 34% of students who participate in Running Start or College in High School take math during that dual enrollment program; 38% do not take math while in the dual enrollment program; and 27% take math through their high school. Analyzing the type of math students take is difficult because many schools do not specifically code the Running Start course on the transcripts.

There are differences in course-taking patterns based on students declared purpose for enrolling in a community and technical college. Students who plan to transfer to a four-year college after completing their work at a two-year college typically have attained higher levels of math than students who have a workforce goal. Students with a transfer goal are also enrolled in remedial math courses at higher rates. This is expected because transfer students generally have to take more math. Interestingly, there is a trend that as students take more career and technical credits in high school, there is an increasing percentage of students entering the CTC system with a workforce goal. This may mean that students are choosing certain course-taking patterns in high school based on their expectations at the CTC.

The results of this study suggest that there are some important relationships between high school and college course-taking patterns. The current study and existing research provide critical guideposts for improving college and career preparation for Washington students.

- The courses students take in high school are important predictors in the direction students go in college and in their ultimate success. Effective guidance and planning is necessary so students fully understand the courses they need to take in high school for their post-secondary plans.
- The level students attain in English and math is an important predictor in whether students take remedial English and math courses. Adequately preparing and requiring students to reach specific course levels is necessary to ensure students are prepared to engage in college level work and to reduce remediation rates in college.
- Algebra II is the pre-requisite for admission into a four-year college. However, many students who achieve this level of math end up enrolling in a pre-college or remedial math courses. This suggests that there is a misalignment between high school math preparation and college level preparation. Additional studies should be conducted to determine if this is a misalignment between the high school curriculum and college curriculum or if there is an issue with the placement test. This may be a focus of policy investigation in the future.
- Students enrolling with a workforce goal tend to take a greater proportion of career and technical education credits. Education pertaining to the evolving requirements for entering the workforce is important.

Washington State Board of Education: 2008 Graduate Follow-Up Study

FINAL REPORT

INTRODUCTION

This report summarizes findings from a follow-up study of the Washington State Board of Education Transcript Study (Baker, Gratama, Peterson, & Bachtler, 2008). The purpose of this study is to provide the State Board of Education (SBE) information about student course-taking patterns in college by analyzing 2008 high school graduates' course-taking patterns in relation to their enrollment in two-year and four-year colleges the following year. This study also aims to provide information around math and English course-taking patterns in college. The report begins by summarizing the research on course-taking patterns and achievement to place the current findings in the context of previous research. The introductory section is followed by a description of the research design, research findings, and discussion and conclusions.

College Remediation: The Nature of the Problem

According to 2003-2004 ACT Assessment results, only 40% of high school graduates were ready for their first course of college Algebra, and only 68% are ready for college coursework in English (ACT, 2004). Put simply, high school students who are prepared for college-level work are more successful in college than those who are not. Students are aware of this too. Survey data from Washington State schools show many students aspire to attend college but do not believe their high school has prepared them adequately in terms of coursework (Baker, Gratama, Peterson, & Bianchi, 2007). In fact, current college readiness standards (as defined by ACT and Washington State agencies such as the Office of Superintendent of Public Instruction and the State Board of Community and Technical Colleges) are above the statewide minimum math requirements for high school graduation in Washington State (Washington State Board for Community and Technical Colleges, 2009). Statewide, approximately 48% of graduates attending a Community and Technical College (CTC) in the year after they graduate enroll in a remedial math class and 28% enroll in a remedial English class (Washington State Board for Community and Technical Colleges, 2009). Therefore, a student can graduate from high school successfully in Washington State and still not be ready for college, causing significant financial, opportunity, and institutional costs down the road (State Board for Community and Technical Colleges, Office of Superintendent of Public Instruction, and the Higher Education Coordinating Board, 2004; Washington State Board for Community and Technical Colleges, 2009).

On a national level, the ACT estimated in 2005 that approximately $1 billion of institutional funds go toward college remediation, whether it is pre-college course offerings, counseling, or other support programs (Conley, 2007). Similar to Washington State, federal statistics indicate that 40% of admitted and enrolled students take at least one remedial course (National Center for Education Statistics, 2004), reducing dramatically their probability of graduating from college. More than any other subject, college remediation occurs most frequently for math. English speaking ability,

socioeconomic status, and race are also statistically significant predictors of college readiness in Washington State and on a national level (Stern & Pavelchek, 2006; Conley, 2007). Remediation rates and college readiness statistics, however, only reveal the tip of the iceberg. Many colleges and universities permit students to enroll in college-level courses even if they are identified as needing remedial coursework. Placement methods also vary greatly across institutions and are often rudimentary in nature, identifying only those students with the most severe learning needs (Conley, 2007).

Possible Causes and Solutions

According to the State Board of Community and Technical Colleges, the Office of Superintendent of Public Instruction, and the Higher Education Coordinating Board in Washington State, the major causes of college remediation are (a) insufficient or untimely information about preparation requirements, (b) inadequate student preparation and guidance, (c) the wide variety and inconsistency of placement tests, (d) misalignment between college ready curriculum and high school graduation requirements, and (e) the need for better content-based professional development for teachers, particularly in math (State Board for Community and Technical Colleges, Office of Superintendent of Public Instruction, and the Higher Education Coordinating Board, 2004).

An oft-cited solution to the readiness problem is to increase high school graduation standards, provide supplemental supports for struggling students such as those offered in the Transition Math Project and Achieve the Dream programs, and eliminate low-level courses (Bottoms & Feagin, 2003; Baker, Clay, & Gratama, 2005; ACT, 2004; Stern & Pavelchek, 2006; Tierney, Bailey, Constantine, Finkelstein, & Hurd, 2009). Past research reveals that students in states with higher math graduation requirements tend to enroll in higher-level math courses as college freshmen and persist in these courses (Schiller & Muller, 2003). Regardless of state, ethnicity, or socioeconomic status, students who take advanced math and English courses (especially, AP English) are more likely to attend college and earn college degrees (Stern & Pavelchek, 2006; Adelman, 2006). Furthermore, some researchers have claimed that taking an advanced math course in high school is the best predictor for obtaining a college degree (Adelman, 2006; Stern & Pavelchek, 2006; Shettle, et al., 2007). And yet, multilevel regression analysis of 1992 NELS data revealed that high school students' math and science test scores did not vary by high school graduation requirement policy, suggesting that increasing the number of required math and science credits by itself may not be sufficient to improve understanding in these subjects (Teitelbaum, 2003). Possible reasons for this disconfirming evidence, the author admits, could be due to curriculum dilution or insufficient advancement in coursework.

Some specific efforts underway to reduce remediation in Washington State include the Transition Math Project, a statewide initiative jointly funded by the Legislature and the Bill and Melinda Gates Foundation, and proposed revisions to the state's minimum basic admission standards for college freshmen. Ultimately, school leaders need to ensure that families, students, and teachers understand what constitutes a college-ready curriculum and develop a four-year course trajectory with students early in their high school careers (Tierney, Bailey, Constantine, Finkelstein, & Hurd, 2009).

METHODOLOGY

The purpose of this study was to further analyze 2008 graduates' high school transcripts to provide information about high school course-taking patterns in relation to Washington State two-year and four-year college course-taking patterns.

Research Questions

This project is guided by a series of research questions. These questions call for sophisticated coding of transcripts and for descriptive and inferential statistical analysis, using data from the 2008 State Board of Education Transcript Study, the National Student Clearinghouse (NSC), and the State Board for Community and Technical Colleges (SBCTC). The research questions are listed below.

1. What is the difference in high school course-taking patterns between students who enroll in two-year versus four-year colleges (by student ethnicity, gender, two-year, four-year, total)?

2. What course-taking patterns predict enrollment in a two-year and four-year college?

3. What are the math and English course-taking patterns for students in the SBCTC system who took remedial, college level, or no math or English in the year after high school? When did they last take math or English and at what level?

4. What math do students take at the high school and at the community and technical colleges while in a dual enrollment program (Running Start or College in High School)?

5. What is the relationship between students level of math students take in high school and the students' declared purpose for enrolling in a community and technical college in the first year (transfer, workforce – program area of study/career cluster, other purposes)?

6. Of the students who take three or more career and technical education credits in high school, what is their declared purpose for enrolling in a community and technical college in the first year (transfer, workforce – program area of study/career cluster, other purpose)?

Sampling Procedure

For the present study, we recoded transcripts collected from the Washington State Board of Education Transcript Study (Baker, Gratama, Peterson, & Bachtler, 2008). Please refer to that study for a full description of the sampling method.

From the original transcripts, we used the State Student Identification (SSID) number to match high school transcripts to college records. In some cases, the SSID had been removed from the high school transcripts, and it was not possible to match records. From the original study of 100 schools (n = 14,874 transcripts), we were able to match transcripts from 90 schools (n = 13,247 transcripts), representing 89% of the transcripts. The original study included representation from every county in Washington State; the exclusion of 10 schools eliminated six counties from this sample. Table 1 details the participating districts and schools included in this study by county. Table 2 details district and schools that were excluded from the study.

Table 1.
Selected Districts and Schools

County	District	School
Adams	Othello School District	Othello High School
Benton	Kennewick School District	Kamiakin High School
Benton	Richland School District	Rivers Edge High School
Chelan	Cashmere School District	Cashmere High School
Clallam	Quillayute Valley School District	Forks High School
Clark	Vancouver School District	Columbia River High
Clark	Washougal School District	Excelsior High School
Clark	Hockinson School District	Hockinson High School
Clark	La Center School District	La Center High School
Clark	Evergreen School District (Clark)	Legacy High School
Clark	Ridgefield School District	Ridgefield High School
Cowlitz	Castle Rock School District	Castle Rock High School
Cowlitz	Kalama School District	Kalama Jr Sr High
Ferry	Curlew School District	Curlew Elem & High School
Franklin	Pasco School District	Pasco Senior High School
Garfield	Pomeroy School District	Pomeroy Jr Sr High School
Grant	Royal School District	Royal High School
Grant	Warden School District	Warden High School
Grays Harbor	Wishkah Valley School District	Wishkah Valley Elementary/High School
Island	South Whidbey School District	Bayview Alternative School
Jefferson	Quilcene School District	Quilcene High And Elementary
King	Auburn School District	Auburn Mountainview High School
King	Northshore School District	Bothell High School
King	Enumclaw School District	Enumclaw Sr High School
King	Tukwila School District	Foster Senior High School
King	Highline School District	Global Connections High School
King	Federal Way School District	H. S. Truman High School
King	Bellevue School District	International School
King	Issaquah School District	Issaquah High School
King	Lake Washington School District	Lake Washington High
King	Mercer Island School District	Mercer Island High School
King	Snoqualmie Valley School District	Mount Si High School
King	Seattle Public Schools	Rainier Beach High School
King	Renton School District	Renton Senior High School
King	Skykomish School District	Skykomish High School
King	Tahoma School District	Tahoma Senior High School
King	Vashon Island School District	Vashon Island High School
Kitsap	Bainbridge Island School District	Bainbridge High School
Kitsap	Central Kitsap School District	Central Kitsap High School
Kitsap	Bremerton School District	Renaissance Alternative High School
Kittitas	Thorp School District	Thorp Elem & Jr Sr High
Klickitat	Klickitat School District	Klickitat Elem & High

Lewis	Mossyrock School District	Mossyrock Middle & High Schl
Lincoln	Davenport School District	Davenport Senior High School
Mason	North Mason School District	North Mason Senior High School
Okanogan	Brewster School District	Brewster High School
Pend Oreille	Newport School District	Newport High School
Pierce	Bethel School District	Bethel High School
Pierce	Sumner School District	Bonney Lake High School
Pierce	University Place School District	Curtis Senior High
Pierce	Eatonville School District	Eatonville High School
Pierce	Fife School District	Fife High School
Pierce	Peninsula School District	Henderson Bay Alt High School
Pierce	Clover Park School District	Lakes High School
Pierce	Tacoma School District	Mt Tahoma
Pierce	Orting School District	Orting High School
Pierce	Franklin Pierce School District	Washington High School
Pierce	White River School District	White River High School
Pierce	Puyallup School District	EB Walker High School
San Juan	Orcas Island School District	Orcas Island High School
Skagit	Anacortes School District	Anacortes High School
Skagit	Sedro-Woolley School District	Sedro Woolley Senior High School
Skamania	Stevenson-Carson School District	Stevenson High School
Snohomish	Snohomish School District	Aim High School
Snohomish	Everett School District	Everett High School
Snohomish	Granite Falls School District	Granite Falls High School
Snohomish	Lake Stevens School District	Lake Stevens High School
Snohomish	Mukilteo School District	Mariner High School
Snohomish	Marysville School District	Marysville Mountain View High School
Snohomish	Edmonds School District	Mountlake Terrace High School
Snohomish	Sultan School District	Sultan Senior High School
Snohomish	Arlington School District	Weston High School
Spokane	East Valley School District (Spokane)	East Valley High School & Extension
Spokane	Freeman School District	Freeman High School
Spokane	Mead School District	Mead Alternative High School
Spokane	Spokane School District	North Central High School
Spokane	Central Valley School District	University High School
Stevens	Colville School District	Colville Senior High School
Thurston	Olympia School District	Avanti High School
Thurston	Rainier School District	Rainier Senior High School
Thurston	North Thurston Public Schools	River Ridge High School
Thurston	Yelm School District	Yelm High School 12
Wahkiakum	Wahkiakum School District	Wahkiakum High School
Walla Walla	Waitsburg School District	Waitsburg High School
Whatcom	Lynden School District	Lynden High School
Whatcom	Nooksack School District	Nooksack Valley High School
Yakima	Highland School District	Highland High School

Yakima	Yakima School District	Stanton Alternative School
Yakima	Sunnyside School District	Sunnyside High School
Yakima	Toppenish School District	Toppenish High School
Yakima	Wapato School District	Wapato High School

Table 2.

Districts and Schools Excluded from the Study

County	District	School
Asotin	Clarkston School District	Charles Francis Adams High School
Columbia	Dayton School District	Dayton High School
Cowlitz	Woodland School District	Woodland High School
Douglas	Eastmont School District	Eastmont Senior High
King	Riverview School District	Cedarcrest High School
Pacific	Willapa Valley School District	Willapa Valley Jr Sr High
San Juan	Orcas Island School District	Orcas Island High School
Spokane	Deer Park School District	Deer Park High School
Whatcom	Mount Baker School District	Mount Baker Senior High
Whitman	Colfax School District	Colfax High School

We averaged the demographics of the sample to compare them with the demographics of all eligible high schools in the state and from the original study (see Table 3). The sample was deemed to be representative of the state demographics, with a slightly higher percentage of white students represented in the sample and a higher mean enrollment compared to the state.[1]

Table 3.

Demographics of Schools in Sample

	Entire Population* (n = 504)	*Student Sample from Original Study (n = 100)*	*Student Sample for Current Study (n = 90)*
Enrollment	Mean =637 (Range = 5 – 3142)	Mean = 787 (Range = 26 – 3142)	Mean = 809 (Range = 26 – 3142)
Free/Reduced Lunch	35%	34%	35%
Amer Ind/Ala Native	3%	3%	3%
Asian	8%	5%	5%
Black	6%	4%	5%
Hispanic	14%	13%	13%
White	68%	75%	74%

*Note. Entire Population = all eligible high schools in the state.

Transcript Sample

---

[1] Information was obtained from the OSPI website: www.k12.wa.us.

A team of researchers and school counselors recoded 13,247 graduating students' transcripts by hand from the 90 schools (Range = 3 to 454 per school) to answer the additional questions posed by the SBE. This is 21.3% of the total 2008 Washington State high school graduating population (n = 62,041).

Of the 13,247 students in the sample 46.9% were male, 51.4% were female, and 1.7% did not report gender. The ethnic distribution aligns more closely to the state demographics. Table 4 details the demographics of the students compared to the state.

Table 4.
Demographics of Students in Sample

	Entire Population (n = 1,031,846)	Sample by School (n = 13,247)
Amer Ind/Ala Native	2.7%	1.2%
Asian	8.4%	6.6%
Black	5.5%	3.6%
Hispanic	14.7%	11.0%
White	66.2%	65.5%
Other	--	0.6%
Not Reported	--	11.5%

College Attendance

Finally, because the purpose of this study was to link high school transcripts to college transcripts, we identified students who attended college the year after graduating from high school. College enrollment and persistence data were obtained from the National Student Clearinghouse for all schools identified in the State Board of Education Transcript Study. We submitted information collected from the transcripts, including lists of the names, birth dates, year of graduation, and high school attended, among other data, to NSC to be matched with the college reported enrollments from 2008 across the nation. The research team then compiled and analyzed the yearly enrollment records to determine college enrollment rates for all study participants and compared these rates to Washington State rates.

"College direct" students are defined as high school graduates who attended either a two- or four-year college any time in the academic year immediately following their high school graduation. The college direct rates for SBE study participants and Washington State are presented in Figure 1. The results show a similar percentage of students identified for this study attended college as compared to Washington State.

College Direct: SBE Study Graduates

■ SBE Graduates   ■ WA State Graduates

Percent

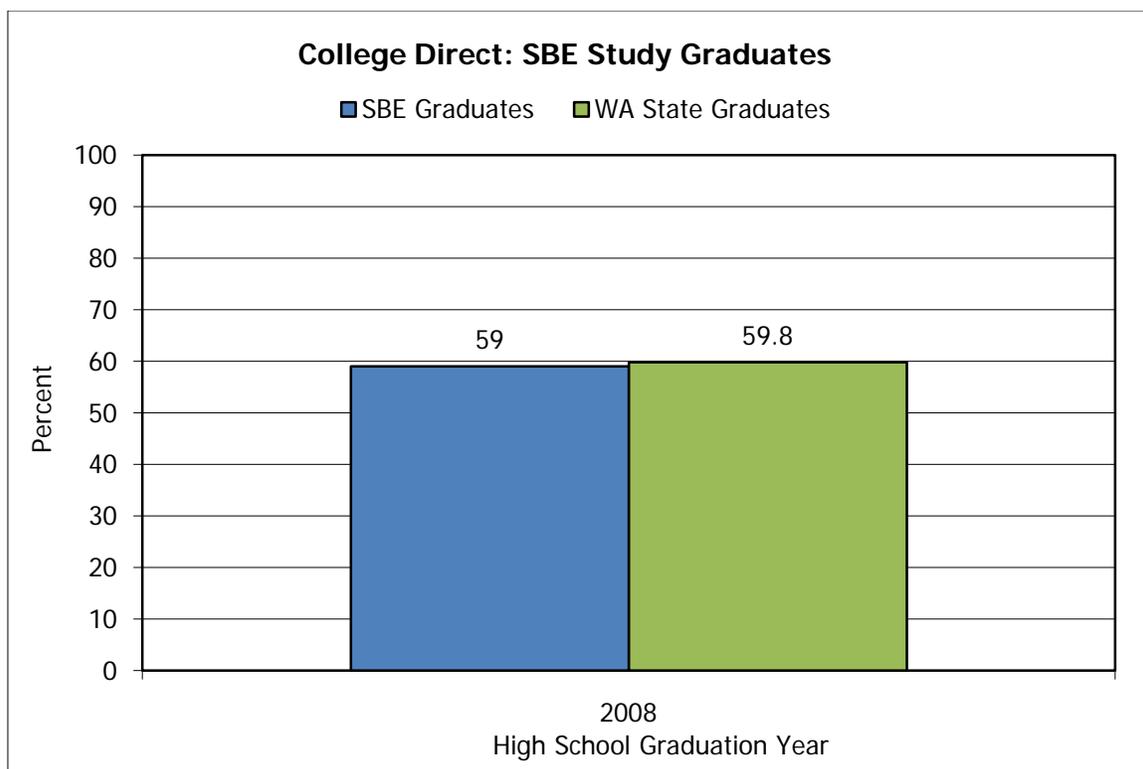| | 2008 |
| 59 | 59.8 |

High School Graduation Year

Figure 1. **Percent "College Direct" 2008**

Figure 2 shows the percentage of college direct students attending two- and four-year colleges the first year after graduating high school. These data indicate a similar percentage of students attend a two-year college within the sample and compared to Washington State.
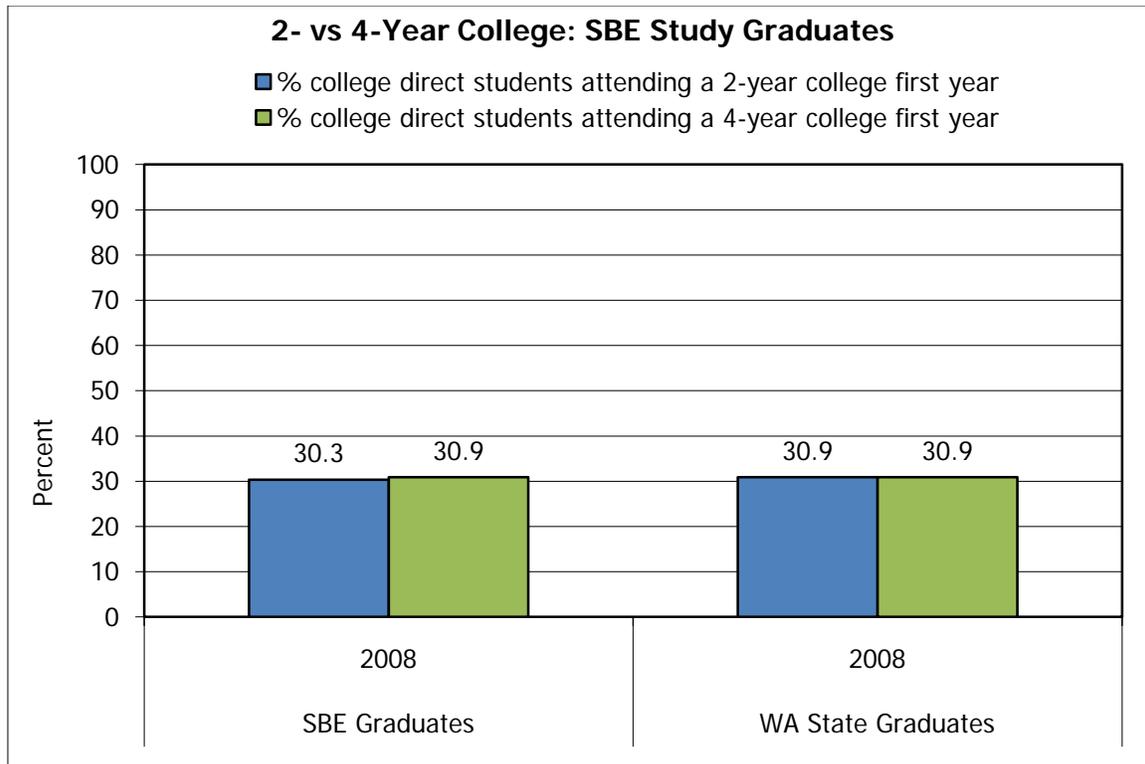
2- vs 4-Year College: SBE Study Graduates

■ % college direct students attending a 2-year college first year
■ % college direct students attending a 4-year college first year

	SBE Graduates 2008		WA State Graduates 2008	
	30.3	30.9	30.9	30.9

Figure 2. **Percentage of "College Direct" Graduates Attending 2-year or 4–year Colleges after Graduating High School – 2008**

The results from the National Student Clearinghouse are also comparable to the data obtained from the SBCTC and Education Data Center. Table 5 shows the overall percentage of students attending colleges in Washington State as identified by the SBCTC, the overall percentage of students attending the six colleges/universities in Washington State (Central Washington University, Eastern Washington University, Evergreen State College, University of Washington, Washington State University, and Western Washington University) as identified by the Education Data Center, and students who were dual enrolled. In this sample, we were able to link high school course-taking patterns to college course-taking patterns.

Table 5.
Percent of Students Attending College

	Sample (n = 13,247)
Washington State Two-Year Colleges	29.6%
Washington State Four-Year Colleges (six total)	16.5%
Dual Enrollment	2.1%

Table 6 details the demographics of the students by type of college enrollment. Overall, more females compared to males enroll in college, and more Asian students enroll in college compared to other racial/ethnic groups.

Table 6.
Demographics by Type of College Enrollment

	Washington Two-Year Colleges	*Washington Four-Year Colleges (six only)*	*Dual Enrollment*
Total	(n = 3918)	(n = 2186)	(n = 273)
Female	30.4%	17.0%	2.6%
Male	28.8%	16.1%	1.5%
Amer Ind/Ala Native	22.2%	15.0%	1.3%
Asian	32.9%	23.1%	2.6%
Black	29.0%	13.1%	2.3%
Hispanic	27.3%	8.5%	1.8%
White	29.5%	17.8%	2.2%

Data Gathering and Analysis

After recoding the transcripts, we added the SSID and a random identification number to the database. We used the SSID to obtain enrollment records and course-taking patterns from the State Board of Community and Technical Colleges (SBCTC) for two-year colleges. We obtained four-year enrollment records from the Education Data Center for six four-year colleges in Washington State (Central Washington University, Eastern Washington University, Evergreen State College, University of Washington, Washington State University, and Western Washington University). After obtaining data-sharing agreements with the six four-year colleges/universities, we worked with the six registrars to gather additional course-taking pattern data. Once all the data was matched, we removed the SSID and used the random identification number.

The analyses include both descriptive and inferential statistics to describe general course-taking patterns, to determine differences in course-taking patterns for two-year and four-year enrollment, to analyze college remediation rates, and to determine the relationship between students course-taking patterns in high school and their declared purpose for enrolling in a community and technical college in the first year after graduating from high school.

RESEARCH FINDINGS

The following sections provide the results for this study. The results are organized around the original research questions identified in the Request for Proposal.

Research Question #1: What is the difference in high school course-taking patterns between students who enroll in two-year versus four-year colleges (by student ethnicity, gender, two-year; four-year; total)?

Overall results demonstrate large differences in course-taking patterns depending on the type of college students attend. Students who attended four-year colleges or who were dual enrolled took more rigorous courses than students who attended a two-year college. Of the 2008 high school graduates who attended college the year after graduating high school, 45% of students attending a two-year college, 85% of students attending a four-year college, and 82% of students who were dual enrolled (attending both a two-year and four-year college) met the minimum, public four-year Washington college admissions standards set by the HEC Board (see Figure 3). An analysis of variance (ANOVA) with subgroup (Two-Year, Four-Year, and Dual Enrollment) as the independent variables and meeting college eligibility as the dependent variable was conducted to examine group differences. The analysis revealed no statistically significant difference in college eligibility between the four-year and dual enrollment groups. However, statistically significant differences in college eligibility did exist among the other groups ($F = 588.48$; $p < .001$).
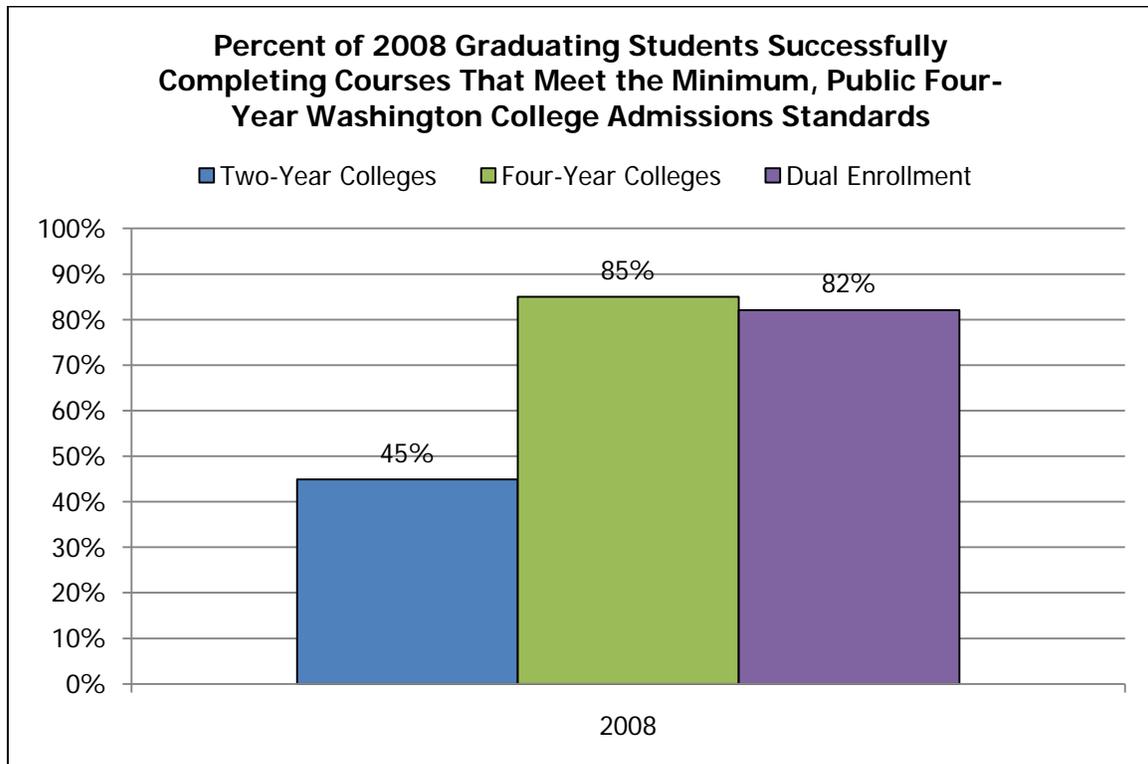

Figure 3. **Percent of 2008 Graduating Students Successfully Completing Courses That Meet the Minimum, Public Four-Year Washington College Admissions Standards**

To determine if there are differences by subject area and the type of college students attend, six ANOVAs were conducted, one for each subject area. The dependent variable in each analysis was the percentage of students meeting college eligibility requirements in that subject area, and the independent variable was the group. The overall results for each ANOVA were significant (Fs = 34.33 to 458.79; $p < .001$). Post hoc results show no statistically significant differences in any subject area for the four-year college or dual enrollment groups. Across each subject area, 95% or more of the students met college eligibility requirements for the four-year and dual enrollment groups. Post hoc results show a statistically significant difference between the two-year college and four-year college and between the two-year college and dual enrollment groups for each subject area (p < .001). These findings are expected, given that students enrolled in a four-year college are expected to meet these minimum requirements and students who are enrolled in a two-year college are not necessarily expected to take these courses (see Figure 4).
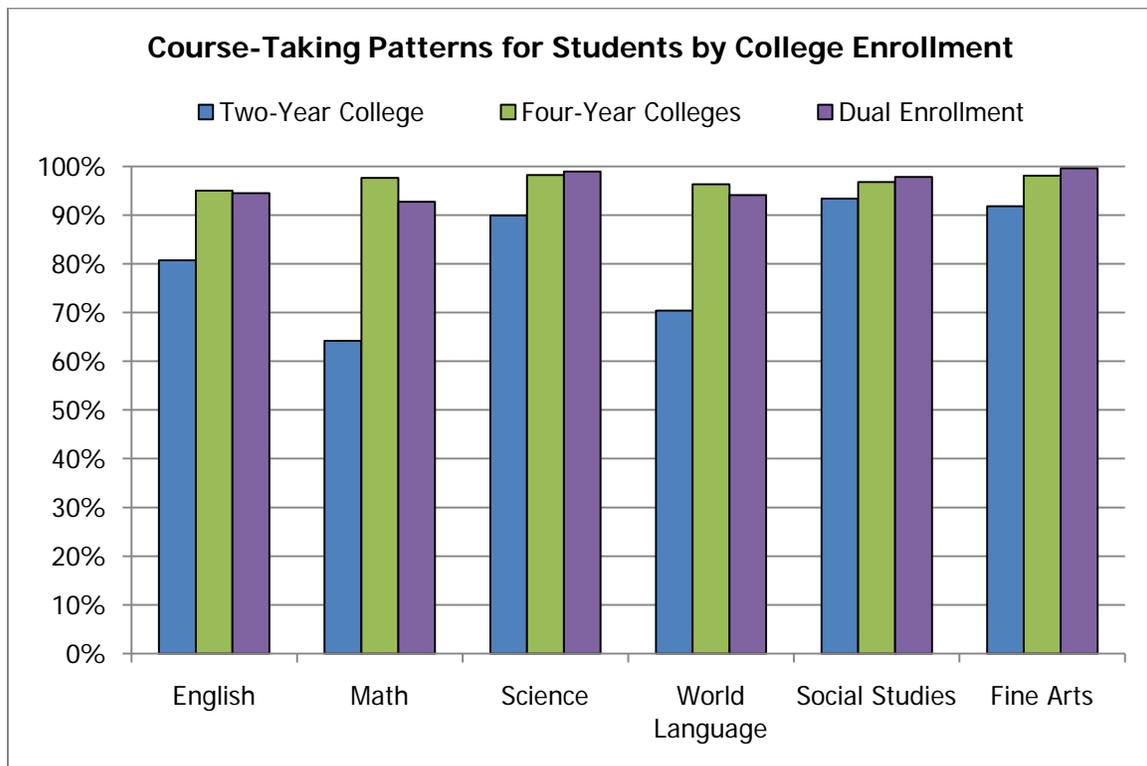

Figure 4. **Course-Taking Patterns for Students by College Enrollment**

Table 7 shows the percentage of students meeting all college eligibility requirements disaggregated by gender and ethnicity for the type of college attended. Across all groups, Asian/Pacific Islander students meet college eligibility at higher rates compared to other ethnic/racial groups. Generally, fewer Native American students met college eligibility requirements across all groups.

Table 7.
Course Taking Patterns by Gender and Ethnicity

	Females	Males	African American	Asian/Pacific Islander	Native American	Hispanic	White
Two-Year	47.8%	41.5%	33.1%	51.9%	33.7%	41.9%	44.6%
Four-Year	84.8%	85.0%	85.2%	89.9%	73.4%	84.7%	89.5%
Dual Enrollment	77.8%	89.5%	72.7%	100%	73.1%	--	81.6%

Additional analyses were conducted on the highest level and last year of math and English taken at both the SBCTC system and four-year college/university. The results show that students attending four-year colleges typically complete a higher level of math and take math into their senior year at greater rates than students who attend two-year colleges (see Tables 8 and 9). These findings are similar for English (see Tables 10 and 11). However, in English the majority of students take English in their senior year.

Table 8.
Highest Level of High School Math Taken by Students Attending SBCTC and Four-Year Colleges/Universities

	Algebra	Geometry	Algebra 2	Pre-Calculus	Calculus or Beyond
Two-Year	9.8%	17.3%	41.0%	22.0%	9.9%
Four-Year	0%	2.4%	21.8%	32.6%	43.3%
Dual Enrollment	1.5%	2.2%	29.3%	38.1%	28.9%

Table 9.
Last Year of High School Math Taken by Students Attending SBCTC and Four-Year Colleges/Universities

	Freshmen	Sophomore	Junior	Senior
Two-Year	0.4%	7.7%	27.9%	63.9%
Four-Year	0%	2.1%	17.5%	80.6%
Dual Enrollment	0.4%	3.7%	21.6%	74.4%

Table 10.
Highest Level of High School English Attained for Students Attending SBCTC and Four-Year Colleges/Universities

	Below Standard	Standard	Above Standard
Two-Year	5.0%	72.9%	22.1%
Four-Year	1.4%	51.3%	47.3%
Dual Enrollment	0.4%	56.4%	43.2%

Table 11.

Highest Level of High School Math Attained for Students Attending SBCTC and Four-Year Colleges / Universities

	Freshmen	Sophomore	Junior	Senior
Two-Year	0%	0.4%	5.5%	94.1%
Four-Year	0%	0%	2.8%	97.1%
Dual Enrollment	0%	0%	4.4%	95.6%

Research Question #2: What course-taking patterns predict enrollment in a two-year and four-year college?

A logistic regression analysis was conducted to predict type of college enrollment (2-year college vs. 4-year college) for 6039 students using each student's high school Grade Point Average (GPA) and course taking patterns. The predictor variables for this analysis were GPA, level of last math class (pre-algebra, algebra, geometry, algebra 2, pre-calculus, calculus, beyond calculus), level of last English class (below standard, standard, above standard), and foreign language requirement met (yes or no).[2] A test of the full model against a constant only model was statistically significant, indicating that the predictors, as a set, reliably distinguished between 2-year and 4-year college enrollees (*chi square* = 2250.21, $p <$ .001 with $df =$ 4). Prediction success overall was 77%. The prediction success for 2-year enrollment was higher at 84% compared to 4-year enrollment at 63%. It is possible that prediction success for 4-year enrollment is less because even though a student may have the GPA and courses to enroll in a 4-year college they may decide to attend a 2-year college instead. In contrast, students who do not have the GPA or courses to enroll in a 4-year college can only go to a 2-year college.

All of the independent variables made a significant contribution to prediction of enrollment with the highest predictive ability being GPA followed by level of last math class, foreign language requirement met, and level of last English class. Table 12 displays the regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for the odds ratios for all four predictor variables. This table shows that GPA has the largest odds ratio, so when GPA is raised by one unit, the odds ratio is 5.36 times as large and therefore students are 5.36 times more likely to go to a 4-year college, given that all of the other variables in the model are held constant.

---

[2] Researchers also analyzed more complicated models containing more predictor variables (such as meeting social studies, science, and fine arts requirements), but these models yielded very similar prediction success to the simpler model presented above.

Table 12.

Results of Logistic Regression Analysis of College Enrollment as a Function of High School GPA and Course Taking Patterns

Variable	B	Wald Test (z-ratio)	Odds Ratio	95% Confidence Interval for Odds Ratio	
				Lower	Upper
GPA	1.68	434.12*	5.36	4.57	6.27
Math Level	.48	222.97*	1.62	1.52	1.73
Foreign Language Requirement Met	-1.32	100.15*	.27	.21	.35
English Level	.34	27.65*	1.41	1.24	1.60
Constant	-8.83	1011.23			

*$p < .001$

Research Question #3: What are the math and English course-taking patterns for students in the SBCTC system who took remedial, college level, or no math or English in the year after high school? When did they last take math or English in high school and at what level?

In total, 56.9% of students took a remedial English or math course within the SBCTC system the first year following high school. Table 13 shows the percentage of students taking remedial, college level, or no math or English.

Table 13.

Percent of Students Who Took Remedial, College Level, or No Math or English in SBCTC

	Remedial	College Level	None
English	25.6%	39.9%	34.4%
Math	49.7%	18.2%	32.0%

Table 14 shows the remedial course-taking results by University. These results are reported separately because of reporting differences. While these numbers are generally low, it is worth noting that for students who were dual enrolled in the SBCTC system and a four-year college/university, approximately 6.6% enrolled in a remedial English course and 31.9% enrolled in a remedial math course.

Table 14.

Percent of Students Who Took Remedial Math or English Courses in the Four-Year Universities

	Central Washington University	Eastern Washington University	Evergreen State College	University of Washington	Washington State University	Western Washington University
English	18.4%	0.3%	Not Reported	1.0%	0.5%	0.3%
Math	14.8%	2.6%	Not Reported	1.6%	0.5%	2.6%

Additional analyses were conducted to better understand the relationship between high school course-taking patterns and course-taking patterns in the first year of college in the SBCTC system. Figure 5 shows that the percentage of students entering college level math increases as students attain higher levels of high school math. These results show that students taking Calculus or beyond are more likely to enroll in a college level math courses, whereas students at all the levels below Calculus are more likely to take a remedial math course. It is noted that there is an increase in students not taking math when they hit the Calculus and beyond category, and it is possible that students have already received college credit in math.
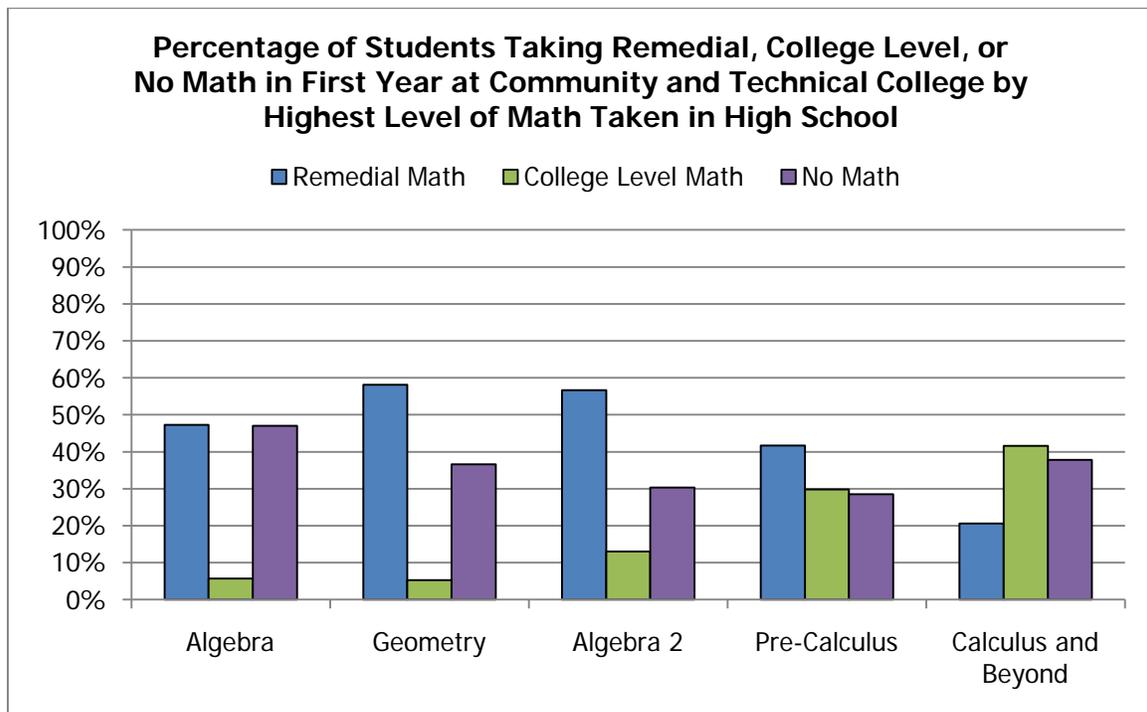

Figure 5. **Percentage of Students Taking Remedial, College Level, or No Math in the First Year at a Community and Technical College by Highest Level of Math in High School**

Figure 6 also shows that the last year students take math is also important. All groups take remedial math at higher rates no matter what year in high school they take their last math class. However, there is a trend, and the longer they continue to take math, the more likely they will enroll in college level math. In addition, students who take math into their senior year of high school are less likely to take no math their first year of college.
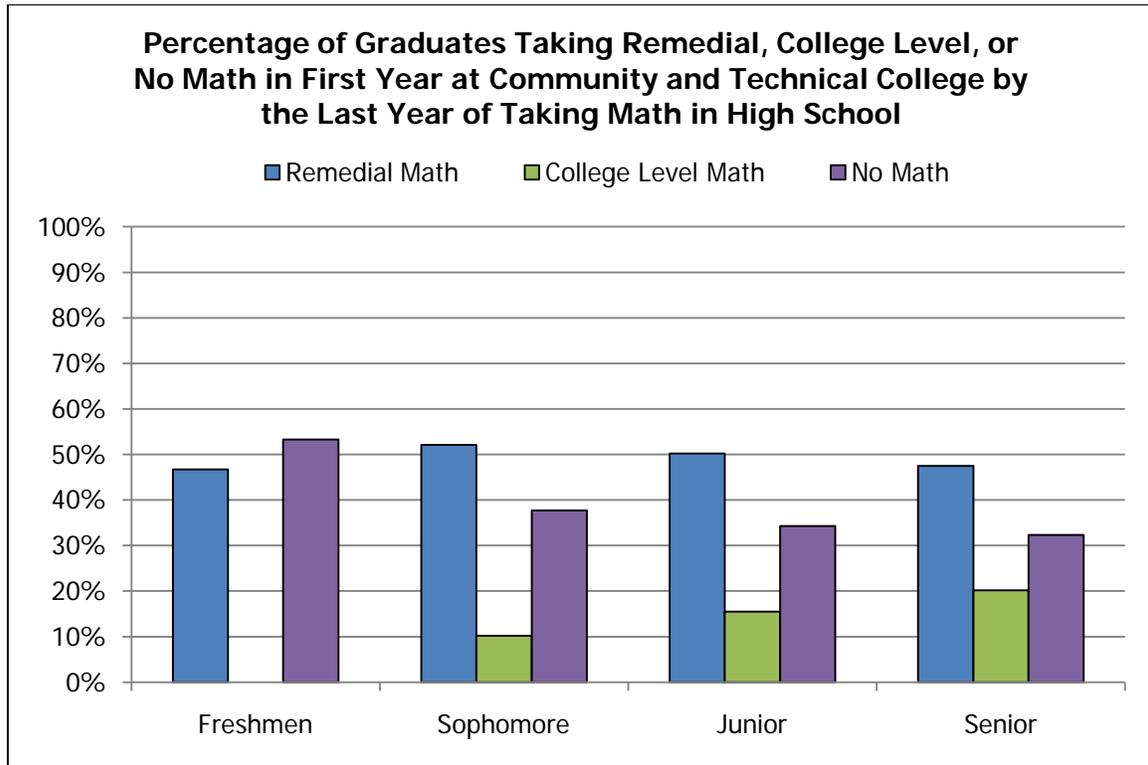
Percentage of Graduates Taking Remedial, College Level, or No Math in First Year at Community and Technical College by the Last Year of Taking Math in High School

■ Remedial Math   ■ College Level Math   ■ No Math

Figure 6. **Percentage of Students Taking Remedial, College Level, or No Math in the First Year at a Community and Technical College by Highest Level of Math in High School**

Figure 7 demonstrates that level of English is also important in determining whether a student takes a remedial English course. Very few students who take an Above Standard English course take a remedial English course in college. However, many of these students do not take English in their first year of college, and it may be that some of these students received college credit for English while in high school.
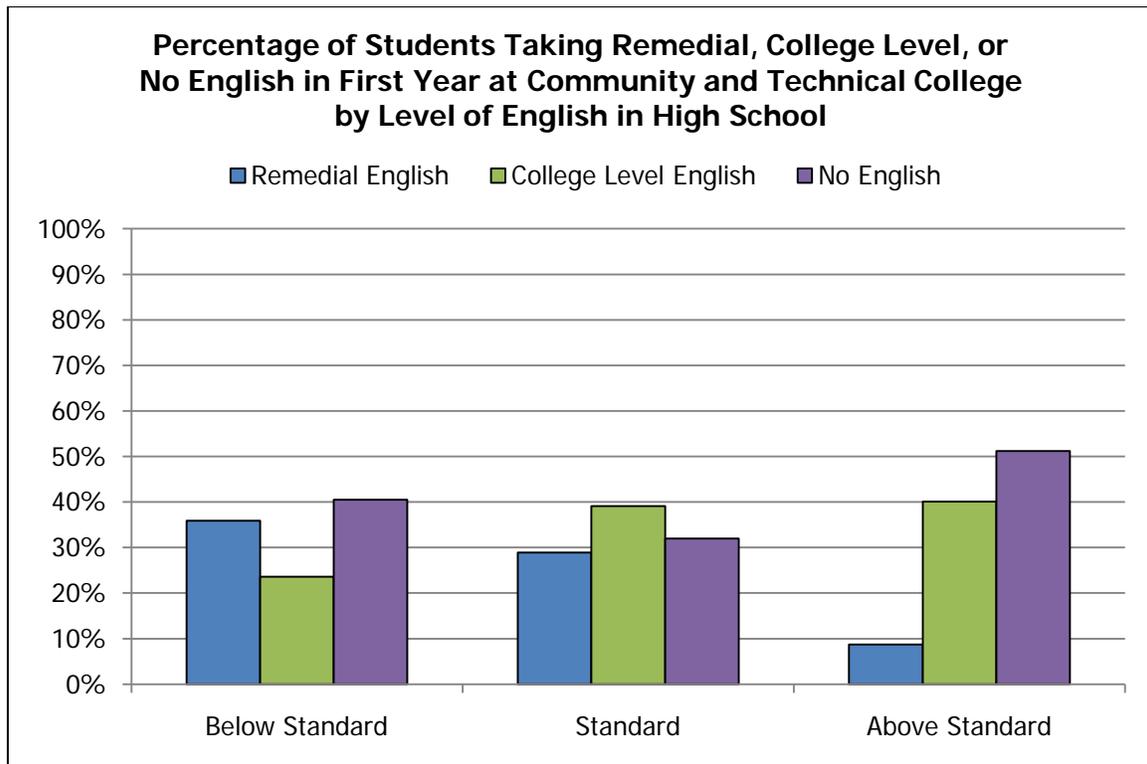

Figure 7. **Percentage of Students Taking Remedial, College Level, or No Math in the First Year at a Community and Technical College by Highest Level of English in High School**

Researchers conducted two logistic regressions to predict enrollment in a college remediation course (math and/or English) using each student's high school level of last math or English class and their Grade Point Average (GPA).[3] For the regression predicting enrollment in a remedial math course, a test of the full model against a constant only model was statistically significant, indicating that the predictors, as a set, reliably distinguished between students who enrolled in remedial math compared to those who did not (*chi square* = 424.54, *p* < .001 with *df* = 2). Prediction success overall was 76%. The prediction success for enrolling in a remedial math course was much higher at 95% compared to not enrolling at 24%. It is possible that prediction success for not enrolling is less because even though a student may have the GPA and courses to enroll in a higher level course they may decide to enroll in a remedial course instead. For the regression predicting enrollment in a remedial English course, a test of the full model against a constant only model was statistically

---

[3] Researchers also analyzed models containing the predictor variables of year last math course taken (for math logistic regression) or last year English course taken (for English logistic regression), but these predictor variables were not statistically significant and were dropped from the final model.

significant, indicating that the predictors, as a set, reliably distinguished between students who enrolled in remedial English compared to those who did not (*chi square* = 210.91, *p* < .001 with *df* = 2). Prediction success overall was 64%. The prediction success for not enrolling in a remedial English course was much higher at 86% compared to enrolling at 28%. It is possible that prediction success for not enrolling is less because even though a student may have the GPA and courses to enroll in a higher-level course they may decide to enroll in a remedial course instead.

In both logistic regressions all of the independent variables made a significant contribution to prediction of remedial course enrollment with the highest predictive ability for enrolling in remedial math being level of last math class followed by GPA and the highest predictive ability for enrolling in remedial English being GPA followed by level of last English class. Table 15 displays the regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for the odds ratios for all predictor variables in both regression equations.

Table 15. Results of Logistic Regressions of Remedial Course Enrollment as a Function of High School GPA and Course Taking Patterns

Variable	B	Wald Test (z-ratio)	Odds Ratio	95% Confidence Interval for Odds Ratio	
				Lower	Upper
MATH					
Math Level	-.71	211.64*	.49	.45	.54
GPA	-.58	35.77*	.56	.46	.68
Constant	5.82	352.30			
ENGLISH					
English Level	-.89	73.13*	.41	.34	.51
GPA	-.72	84.68*	.49	.42	.57
Constant	3.44	142.00			

*$*p < .001$

Research Question #4: What math do students take at the high school and at the community and technical colleges while in a dual enrollment program (Running Start or College in High School)?

Approximately 17.1% of students who eventually enrolled in a two-year or four-year college earned credits through a dual enrollment program in high school (e.g., Running Start, College in High School). Of the students who earned credits through a dual enrollment program, 38.2% did not take math while in a dual enrollment program, 34.4% took math through Running Start/College in High School, and 27.4 took math at the high school (see Figure 8).

It is difficult to determine the actual level of math students take while in a dual enrollment because of the wide variation of course titles on the transcripts. For example, some courses are very specific (e.g. RS Math 107) whereas others are very general (e.g. RS Math or CC Math).
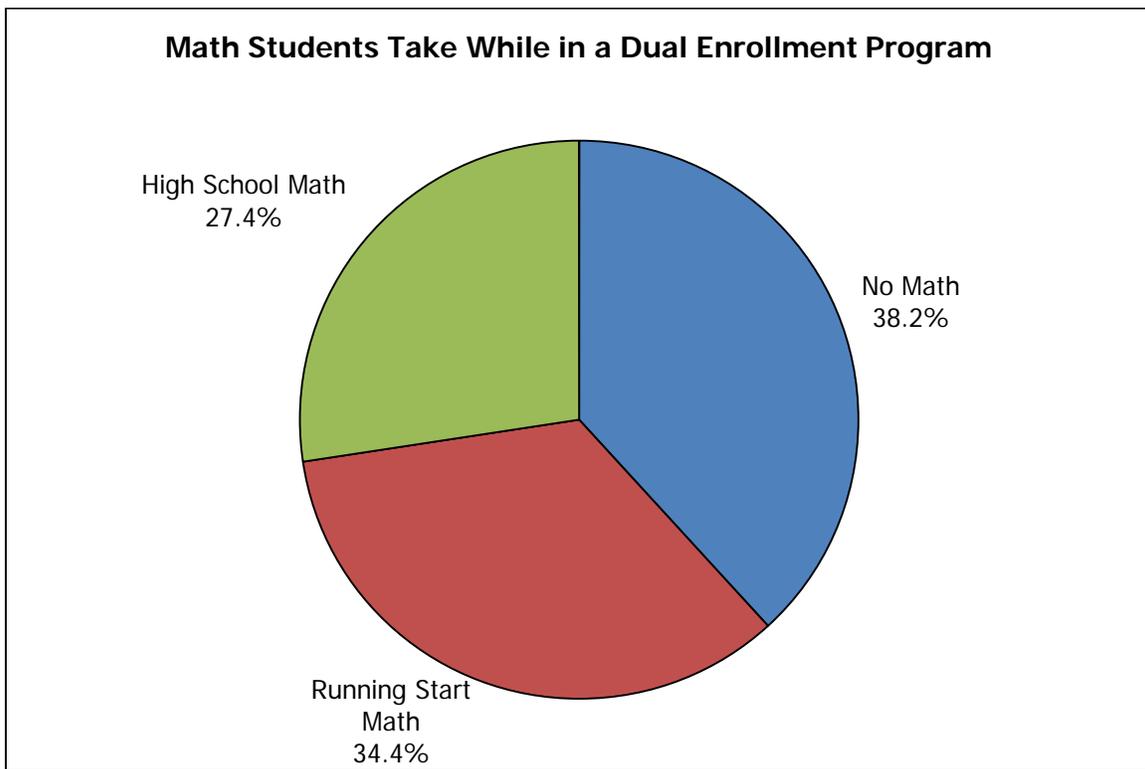

Figure 8. **Math Students Take While in a Dual Enrollment Program**

Research Question #5: What is the relationship between the level of math students take in high school and the students declared purpose for enrolling in a community and technical college in the first year (transfer, workforce – program area of study/career cluster, other purpose)?

Figure 9 shows students declared purpose for enrolling in a community and technical college in the first year of college. The results show that the majority of students (66.8%) intend to transfer to a four-year college upon completing their work in the community and technical college. Approximately 28% of the students plan to enter the workforce upon finishing a degree at the community and technical college. Examples of workforce training, include registered nursing, welding technician, and firefighter. Fewer students (5.2%) enrolled for other purposes, including basic skills training.
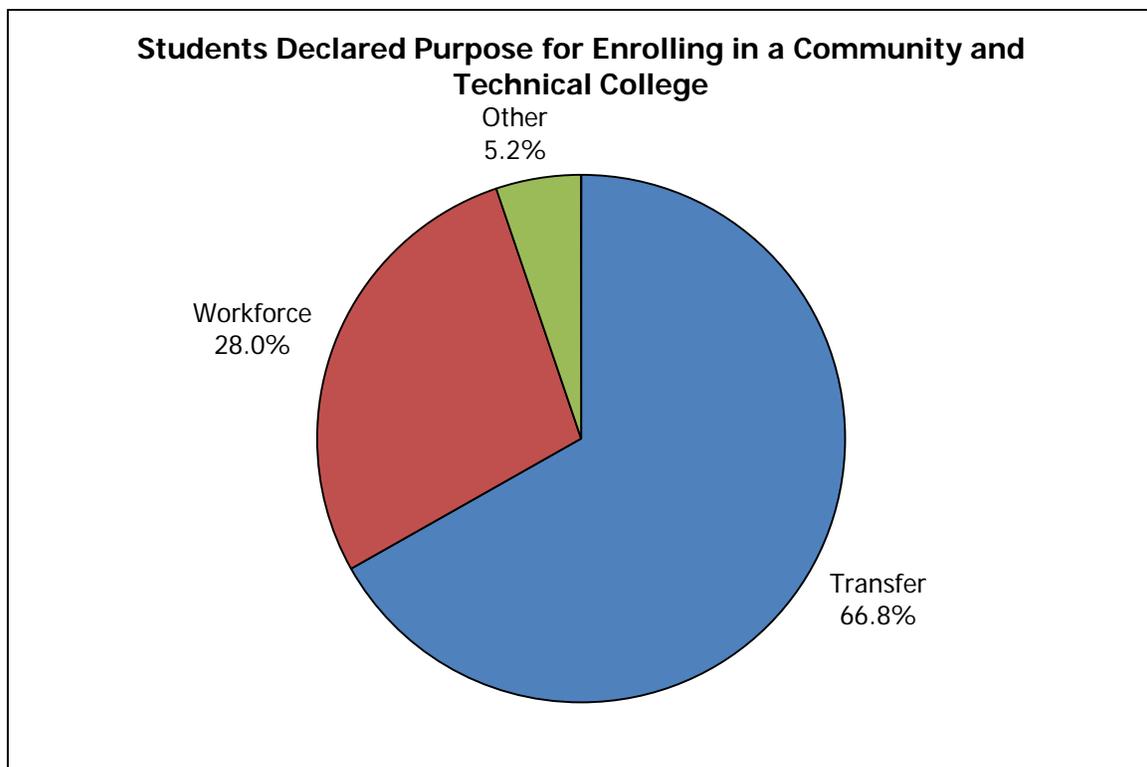

Figure 9. **Students Declared Purpose for Enrolling in a Community and Technical College**

Students enrolled in CTC with a transfer goal typically achieve a higher level of high school math than students enrolled with a workforce goal (see Table 16). These results are in the expected direction given that transfer students typically have higher math requirements than workforce students. A higher percentage of transfer students enroll in remedial math courses compared to workforce students. This would be expected given that there are more transfer students (see Table 17).

Table 16.
Highest Level of High School Math Attained by CTC Enrollment Goal

	Algebra	*Geometry*	*Algebra 2*	*Pre-Calculus*	*Calculus or Beyond*
Transfer Goal	6.8%	14.3%	40.7%	25.7%	12.6%
Workforce Goal	14.8%	21.0%	39.9%	17.5%	6.8%

Table 17.
Pre-College Course Enrollments by CTC Enrollment Goal

	% Taking Pre-College Math
Transfer Goal	52.6%
Workforce Goal	44.5%

Research Question #6: Of the students who take three or more career and technical education credits in high school, what is their declared purpose for enrolling in a community and technical college in the first year (transfer, workforce – program area of study/career cluster, other purpose)?

Figure 10 shows the percentage of students taking three or more career and technical education (CTE) credits in high school and their declared purpose for enrolling in a community and technical college. Compared to the overall declared purpose for enrolling (see Figure 9), a slightly greater proportion of students taking three or more career and technical college credits identified "workforce" as their purpose for enrolling in the CTC. In contrast, a smaller proportion of students taking three or more career and technical education credits in high school identified "transfer" as their purpose for enrolling in the CTC.
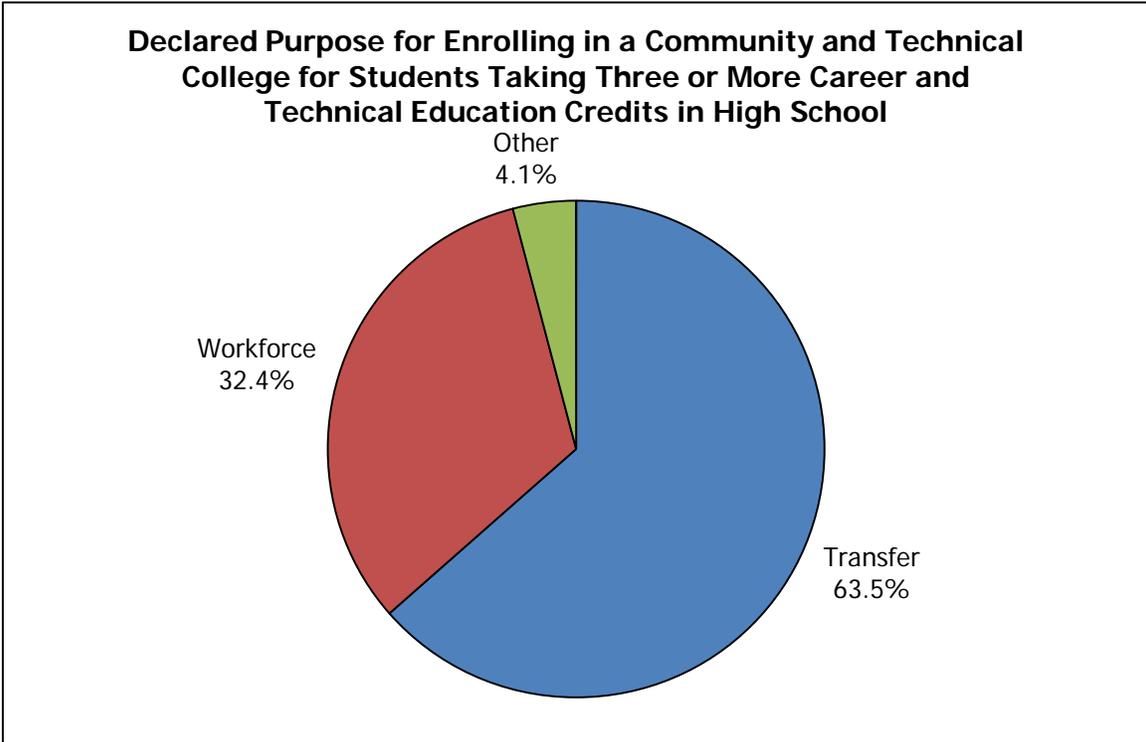
Declared Purpose for Enrolling in a Community and Technical College for Students Taking Three or More Career and Technical Education Credits in High School

- Other 4.1%
- Workforce 32.4%
- Transfer 63.5%

Figure 10. **Declared Purpose for Enrolling in a Community and Technical College for Students Taking Three or More Career and Technical Education Credits in High School**

Further analyses show that as students earn more CTE credits in high school, an increasing proportion of students declare "workforce" as their purpose for entering a CTC (see Figure 11). Conversely, as students earn more CTE credits in high school, a decreasing proportion of students declare "transfer" as their purpose for entering a CTC.
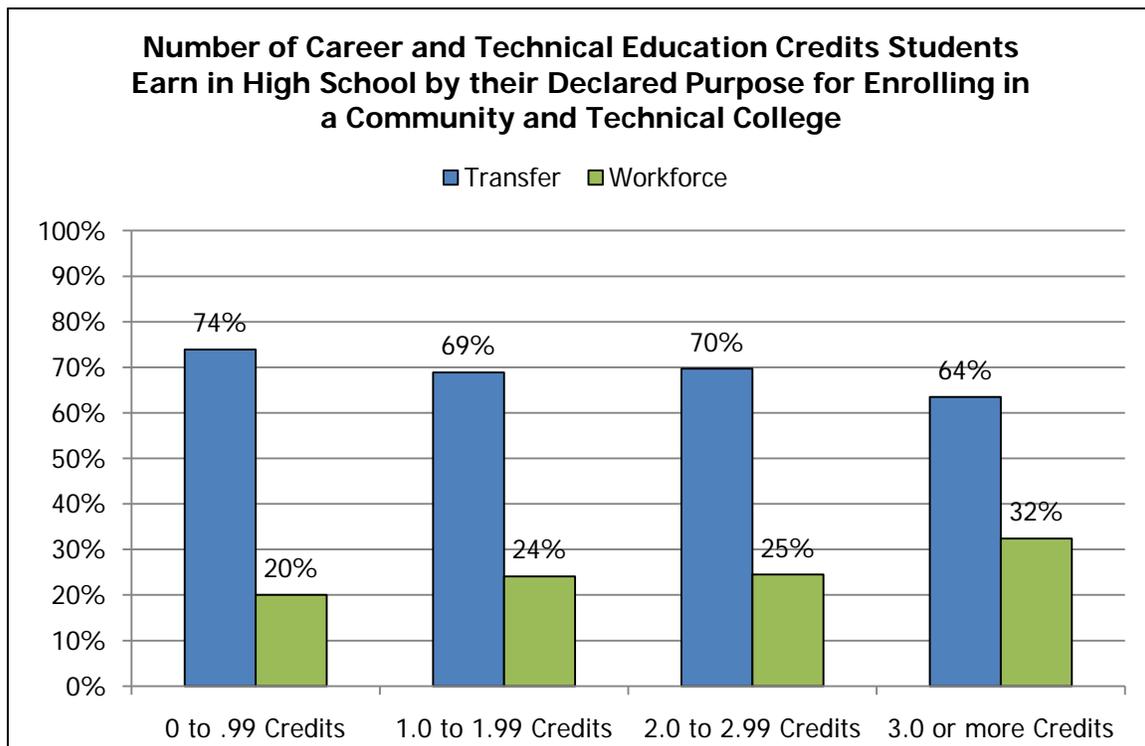
Number of Career and Technical Education Credits Students Earn in High School by their Declared Purpose for Enrolling in a Community and Technical College

■ Transfer ■ Workforce

Credits	Transfer	Workforce
0 to .99 Credits	74%	20%
1.0 to 1.99 Credits	69%	24%
2.0 to 2.99 Credits	70%	25%
3.0 or more Credits	64%	32%

Figure 11. **Number of Career and Technical Education Credits Student Earn in High School by their Declared Purpose for Enrolling in a Community and Technical College**

Conclusion/Discussion

Students who are ready for college level work are more successful in college than those who are not. However, many students enrolling in college nationally and in Washington State are not ready to take college level course work. The Washington State Board of Education commissioned this research to examine the relationship between high school and college course-taking patterns.

This study examined the course-taking patterns for students of the graduating class of 2008 across Washington State. The sample was drawn from a previous transcript study. Of the original participants (n = 14,875), we were able to match 89% of the records (n = 13,247). Overall, 6,377 students attended a two-year college in Washington State or one of six four-year colleges and universities identified for this study.

Overall results demonstrate large differences in course-taking patterns depending on the type of college students attend. Students who attended four-year colleges or who were dual enrolled took more rigorous courses than students who attended a two-year college. Of the 2008 high school graduates who attended college the year after graduating high school, 45% of students attending a two-year college, 85% of students attending a four-year college, and 82% of students who were dual enrolled met minimum, public four-year Washington college admissions standards set by the HEC Board. There are significant differences between the two-year and the four-year group and the two-year and dual enrollment group across each subject area, with the four-year and dual enrollment groups meeting eligibility requirements in each subject area at higher rates than the two-year group.

A logistic regression analysis was conducted to predict enrollment into a two-year or four-year college. GPA had the highest predictive ability, followed by level of last math class, foreign language requirement met, and the level of the last English class. This indicates that both courses and grades are important in predicting the type of college enrollment.

An analysis of the percent of students taking remedial math and English courses shows that 56.9% of students took a college remedial math or English course in the CTC system. By subject area, 49.7% of students took a remedial math course, 25.6% took a remedial English course, and 18.5% took both a remedial math and a remedial English course. A logistic regression analysis was conducted to better understand the relationship between students enrolling in remedial courses and when they last took English and math, and at what level. For math, the last level that students completed was the strongest predictor of whether a student enrolls in a remedial math course followed by GPA. Findings show that students are less likely to enroll in a remedial math course in college if they have taken Calculus or beyond in high school. For English, GPA was the strongest predictor, followed by the level of English course students attained in high school. In both cases, the last year students took the course was not a statistically significant predictor. This indicates that the level students attain in math and English is more important than when they last take math or English.

Approximately 34% of students who participate in Running Start or College in High School take math during that dual enrollment program; 38% do not take math while in the dual enrollment program; and 27% take math through their high school. Analyzing the type of math students take is difficult because many schools do not specifically code the Running Start course on the transcripts.

There are differences in course-taking patterns based on students declared purpose for enrolling in a community and technical college. Students who plan to transfer to a four-year college after completing their work at a two-year college typically have attained higher levels of math than students who have a workforce goal. Students with a transfer goal are also enrolled in remedial math courses at higher rates. This is expected because transfer students generally have to take more math. Interestingly, there is a trend that as students take more career and technical credits in high school, there is an increasing percentage of students entering the CTC system with a workforce goal. This may mean that students are choosing certain course-taking patterns in high school based on their expectations at the CTC.

The results of this study suggest that there are some important relationships between high school and college course-taking patterns. The current study and existing research provide critical guideposts for improving college and career preparation for Washington students.

- The courses students take in high school are important predictors in the direction students go in college and in their ultimate success. Effective guidance and planning is necessary so students fully understand the courses they need to take in high school for their post-secondary plans.
- The level students attain in English and math is an important predictor in whether students take remedial English and math courses. Adequately preparing and requiring students to reach specific course levels is necessary to ensure students are prepared to engage in college level work and to reduce remediation rates in college.
- Algebra II is the pre-requisite for admission into a four-year college. However, many students who achieve this level of math end up enrolling in a pre-college or remedial math courses. This suggests that there is a misalignment between high school math preparation and college level preparation. Additional studies should be conducted to determine if this is a misalignment between the high school curriculum and college curriculum or if there is an issue with the placement test. This may be a focus of policy investigation in the future.
- Students enrolling with a workforce goal tend to take a greater proportion of career and technical education credits. Education pertaining to the evolving requirements for entering the workforce is important.

REFERENCES

Abraham, A. A., & Creech, J. D. (2000). *Reducing remedial education: What progress are states making?* Atlanta, GA: Southern Regional Education Board.

ACT. (2004). *Crisis at the core: Preparing all students for college and work. Executive Summary.* Iowa City, IA: ACT, Inc.

Adelman, C. (2006). *Revisiting the toolbox: Paths to degree completion from high school through college.* Washington, D.C.: U.S. Department of Education.

Baker, D. B., Clay, J. N., & Gratama, C. A. (2005). *The essence of college readiness: Implications for students, parents, schools, and researchers.* Bothell, WA: The BERC Group.

Baker, D. B., Gratama, C. A., Peterson, K. M., & Bachtler, S. D. (2008). *Washington State Board of Education transcript study.* Bothell, WA: The BERC Group.

Baker, D. B., Gratama, C. A., Peterson, K. M., & Bianchi, G. (2007). *Education in Washington state: Emerging issues and needs.* Bothell, WA: The BERC Group, Inc.

Bottoms, G., & Feagin, C. (2003). *Improving achievement is about focus and completing the right courses.* Atlanta, GA: Southern Regional Education Board.

Conley, D. T. (2007). *Redefining college readiness.* Eugene, OR: Educational Policy Improvement Center.

National Center for Education Statistics. (2004). *Conditions of education 2004.* Washington, D.C.: U.S. Department of Education.

Shettle, C., S, R., J, M., Perkins, R., Nord, C., Teodorovic, J., et al. (2007). *The nation's report card: America's high school graduates.* Washington, D.C.: U.S. Department of Education, National Center for Education Statistics.

State Board for Community and Technical Colleges, Office of the Superintendent for Public Instruction, and the Higher Education Coordinating Board. (2004). *Pre-college (remedial) course taking in Washington postsecondary education: Causes and solutions.* Olympia, WA.

Stern, P., & Pavelchek, D. (2006). *Who's prepared for college work? Conventional wisdom confirmed and myths debunked.* Olympia, WA: Washington State University, Social & Economic Sciences Research Center, Puget Sound Division.

Teitelbaum, P. (2003). The influence of high school graduation requirement policy in mathematics and science on student course-taking patterns and achievement. *Educational Evaluation and Policy Analysis , 25* (1), 35-57.

Tierney, W. G., Bailey, T., Constantine, J., Finkelstein, N., & Hurd, N. F. (2009). *Helping students navigate the path to college: What high schools can do: A practical guide.* Washington, D.C.: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education.

Washington State Board for Community and Technical Colleges. (2009). *Role of pre-college (developmental and remedial) education for recent high school graduates attending Washington community and technical colleges.* Olympia, WA: Washington State Board for Community and Technical Colleges.

The BERC Group, Inc.
22232 17th Ave SE, Suite 303
Bothell, WA 98021
Phone: 425-486-3100

Web: www.bercgroup.com