Measuring the Alignment of High School and Community College Math Assessments

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More than 60% of all community college students are placed into remedial, non-credit bearing courses. Concerns over the lack of articulation across the K-12 and postsecondary educational systems have led to concerns over whether students have had the opportunity to learn and demonstrate the skills required for success in college level classes. To measure the degree to which the expectations across these systems are consistent, the degree of alignment between the examinations at these two levels was explored. The California Community College placement test content was compared to the high school level California Standards Tests in General Mathematics, Algebra 1 and Geometry. Only the General Mathematics was aligned across a substantial number of standards. Taking into consideration past studies, it appears that the major source of misalignment between the two testing systems occurs within the content areas of Integers and Rationals, Trigonometry and Graphing.

Most students want to attend college or some other form of postsecondary training (Rogers, Terriquez, Valladares, & Oaks, 2006), including an increasing number of minority students that have been traditionally underrepresented in higher education. For instance, more than 80% of African American and Latino students begin high school with the ultimate goal of attending college (Kirst & Venezia, 2001). This desire for additional education beyond the high school level reflects a trend of increasing college enrollment, with the National Center for Educational Statistics predicting an increase of 12% in college enrollment from 2005 to 2014 (Snyder, Tan, & Hoffman, 2006). Even for those students who don't plan on participating in post-secondary educational programs, college readiness skills are important, as the skills required by today's economy for entry into the workforce are basically the same as those required for college level work (ACT Inc., 2006). Despite the importance of postsecondary education, there exists a well-documented and pervasive lack of alignment between high school experiences and college expectations (Conley, 2003a; Conley & Venezia, 2003; Kirst, 2004; Kirst & Venezia, 2001; Lundell, Higbee, Hipp, & Copeland, 2004; Venezia, Kirst, & Antonio, 2003). This disjuncture creates barriers to student achievement in the transition from high school to college. These barriers disproportionately affect poor, minority students. As a result, high school students are setting goals of earning college degrees and applying to colleges without the knowledge of how to best prepare to successfully finish the degree program once they are admitted.

The No Child Left Behind Act attempted to mitigate some of these barriers through the use of standards based, high stakes testing to assess the proficiency level of students. These assessments function as messages to teachers and students about what is important to teach and learn (Herman, Webb, & Zuniga, 2007); however, they do not provide feedback to the students on their progress towards college readiness (Lundell, Higbee, Hipp, & Copeland, 2004). Since

the standards on which these exams are predicated determine what is taught in classes, and what is tested has an enormous impact on what is emphasized, investigating the alignment of high school standards tests with community college placement test content is important in understanding the challenges that students encounter as they transition to postsecondary institutions. Exploring this type of testing alignment provides an indication of how well articulated the content that students are exposed to during their precollegiate education is with what colleges expect them to have learned before attempting college level work.

In a recent study of the disconnect between high school and college, the Stanford University Bridge Project, researchers made several suggestions to help improve student success through better articulation between K-12 and postsecondary educational systems. Included in these suggestions was the recommendation that states examine the relationship between high school standards and postsecondary placement examinations (Venezia, Kirst, & Antonio, 2003). This study investigates the relationship between high school and community college placement tests in California. To partially address this questions, the alignment between the California Community College (CCC) placement tests and the California Standards Tests (CST) in mathematics were analyzed. This is an important step in diagnosing areas of misalignment in the transition from high school to college.

Education and Testing in California

California's educational system consists of three distinct higher education systems in addition to the K-12 system of education. These include the University of California System (UC), The California State University System (CSU) and the California Community College System (CCC). The California Postsecondary Education Commission (CPEC) aids in the coordination between these systems and reviews policies that impact all three (UC Office of the President, 2007). The stakeholders in California's educational systems are varied, with many interested parties competing with the government at the local, state and federal levels for influence over policy decisions (Conley, 2003b).

There has traditionally been little cohesion across education systems in California. Postsecondary and K-12 policymakers tend to be centered on their own issues and have been less concerned with what is occurring at other levels. The differing missions, as well as disconnected curricula and assessments are inefficient and fail to provide equal educational opportunities within the state (Bueschel, 2004). However there has been increasing pressure on educational systems to better align expectations within and across systems (Conley, 2005b), and stakeholders from many directions are calling for P-16 reform. In response, the Superintendent of California's K-12 educational system has established a new P-16 council that promises to improve the coordination across levels to improve education for students at all levels. Council goals include addressing achievement gaps and improving the articulation across systems to better prepare students for college (Jung, 2007). Developing a coordinated vision and better communication is an important first step in creating a system that is well articulated and responsive to the educational needs of the individuals in California's ever changing society (Alpert, Alquist, & Strom-Martin, 2002).

Community College System. With over 2.5 million students, the California Community College system forms the largest postsecondary system in the world. Its 109 colleges have a primary mission of providing education to anyone whom can benefit from it. This includes remedial and vocational education in addition to academic courses designed for transfer to four-year programs. The colleges are primarily controlled locally through a system of 72 districts, but are overseen by the Board of Governors of the California Community Colleges (California Community Colleges, 2006; CCC Chancellor's Office, 2007; Kirst & Venezia, 2001; UC Office of the President, 2007).

Access is one of the most important missions of the California Community College System; nevertheless, recently the CCC system has been increasing its attention on other measures of success. In its strategic plan (California Community Colleges, 2006), the CCC system has developed many goals to improve the opportunities of those in the communities it serves, going beyond simply removing access barriers. They are taking steps to promote the college readiness of incoming students, looking at both basic skills programs and placement and assessment policies. Specifically, they are interested in ways that articulation can be improved between the CCC system and its K-12 counterparts. Improving the alignment between K-12 and CCC expectations, in the form of standards, curriculum and assessments, is a particular goal for the California Community College System.

High School Standards and Assessments. K-12 content standards were adopted in California beginning in the late 1990's with the purpose of improving student achievement through making explicit the knowledge and skills that students should acquire for each grade level and course (California State Board of Education, 2007). They were not explicitly designed to prepare students for college and do not necessarily align well with university expectations (Conley, 2005b). The statewide emphasis on these standards and their associated assessments sends signals to teachers about what they should be teaching and have a huge impact on what is taught in classes. Teachers tend to concentrate on those standards that are emphasized on these tests (Herman, Webb, & Zuniga, 2007). This is not necessarily a bad thing, as long as the assessments are measuring progress towards acquiring the necessary skills for college success. However, if these standards and tests are not well aligned with college readiness skills, we are left with a system where high schools are preparing their students to pass standardized assessments as opposed to preparing their students for college success (Conley, 2005b).

Postsecondary Standards and Assessments. Most colleges and universities require students to take placement exams in order to take college level coursework (Perin, 2006). Since universities and community colleges do not have explicit entrance standards these placement tests serve as "de facto" standards for college level work; standards that are set at a higher level than those signaled by high school graduation requirements (Venezia, Kirst, & Antonio, 2003). Community college educators are concerned about the validity of the current placement procedures, with one quarter of the colleges reporting concern about their adequacy (California Community Colleges, 2006). As a consequence of these placement policies, a large proportion of California's students are unable to take credit-bearing courses.

At the community college level, 60% of all entering students being placed in remedial courses (Kirst, 2004). However, the widespread remediation rates are not just a community college problem. In 2006 the California State University System, which accepts the top one-

third of California's graduating seniors (Commission for the Review of the Master Plan for Higher Education, 1987), placed 37.5% of first-time students in remedial mathematics, despite the fact that the mean GPA of these students was 3.15 ("Fall 2006 final regularly admitted first-time freshmen remediation systemwide"). Remedial rates are especially high among students of minority background; with 65% of African American, 53% of Mexican American and 54% of other Latino students being placed in remedial math courses, compared to only 26% of white students. This indicates that minority students are disproportionately underprepared to pass the placement tests that indicate readiness to take college level math courses. Furthermore, enrolling in these courses does not guarantee that one will be successful; and, success rates for minorities are particularly low. For instance, approximately 60% of African American community college students taking Elementary Algebra do not pass the class. Furthermore, a student who is placed in remedial classes has a lower chance of completing a degree. Students placed in an arithmetic level math courses have only a 10% chance of attempting transfer level math courses (California Community Colleges, 2006).

There are a wide variety of assessments used for placement purposes and most students are unaware of the existence of these exams let alone their content (Bueschel, 2004). One exception is CSU's Early Assessment program; students are given the opportunity to take an augmented form of the K-12 state assessments at the end of their junior year. Students who do well are exempted from taking placement tests, provided they attend a university in the CSU system. In addition, as they obtain their scores in August, they receive diagnostic information on their level of college preparation while there is still time to do something about it (Callan, Finney, Kirst, Usdan, & Venezia, 2006). Unfortunately, this program is unavailable for UC and community college bound students.

Placement tests are designed to measure how likely a student is to do well college level courses. They must not include sources of variability that are irrelevant to the skills being measured. Furthermore, they must appropriately measure whether they have acquired the skills taught in the prerequisite courses (Kane, 2006), which are defined in this study to be the high school level math courses. Otherwise, the test is measuring something other than readiness for a class, it is measuring the given students' opportunity to learn. This raises several questions: Have students truly been given the opportunity to learn and demonstrate the content that they need to know and understand to successfully complete transfer level coursework at the community college? How well aligned are California's high school standards to California Community College expectations? To partially address these questions, the alignment between the California Community College placement tests and the California Standards Tests in mathematics were analyzed.

Alignment

Alignment is a measurement of the relationship between different components of an educational system. Nationally, there appears to be a marked lack of alignment between the K-12 and postsecondary systems. Measuring the alignment that already exists within the system is an important step in addressing the problems that arise from a misaligned system.

In the field of measurement, alignment is often defined as the extent to which expectations, in the form of standards, match the assessments intended to measure them. It is important to distinguish that alignment is a measure of the relationship between the system *components* rather than an attribute of any particular element within the system (N. L. Webb, 2002). Alignment indicates how well the parts of the systems work together to guide student learning and expectations. The *Standards for Educational and Psychological Testing* asserts that measuring alignment is an important tool for finding and reducing testing bias (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999). For instance, test users are cautioned to find evidence for the extent to which the test represents curricular standards.

Consequences of misalignment. A system that is lacking in either horizontal or vertical alignment also lacks clear and consistent signals regarding what is important for students to learn in preparation for postsecondary success. The lack of measures of college readiness and the differing expectations between the secondary and postsecondary education systems lead to confusing messages regarding what were expected of students in college *(Rodriguez, 1995)*. Without the alignment between standards, exams and expectations, students do not receive clear and consistent information regarding their progress toward meeting college readiness expectations (N. M. Webb, Herman, & Webb, 2007). Lack of alignment makes tracking student progress through the system difficult. It makes issues such as poor student performance, achievement gaps, high dropout rates and high remediation rates more difficult to diagnose. Therefore, investigating the alignment among components in the educational system is an important step in addressing the widespread underpreparation of California students for college level work.

It is easier to find breakdowns in an aligned system. Without comprehensive vertical and horizontal alignment between standards and exams, any observed progress, or lack thereof, is difficult to attribute to causes (Martineau, Paek, Keene, & Hirsch, 2007). Learning is more difficult to measure in a misaligned system *(Baker, 2004)*. It is quiet possible that capable students are misplaced into remedial courses because they have not had the opportunity to learn the content they are expected to demonstrate on the placement exams. This generates questions regarding the validity of any placement decisions made upon these potentially misaligned tests.

If the tests are not well-aligned, then the content taught in most high school math classes will be significantly different from what postsecondary institutions expect students to master before beginning college level work. The differential focus between the two levels will create barriers to student achievement by hiding the fact that many students are not making progress to meet college level goals. When tests are well aligned, earlier assessments can be used to benchmark progress towards meeting the requirements of later assessments. In California, an aligned testing system is important if one is to make judgments regarding individual student progress. More specifically, a well-aligned testing system across grade levels, would allow educational personnel to diagnose problems relating to individual students' preparation for college while there is still time to compensate for them. Conversely, should the systems be well-aligned, community college personnel will have the option to utilize past standards scores to make placement decisions more economically and efficiently.

Improving Alignment. Many suggestions have been made regarding the improvement of alignment between high school and college, most of which will not be discussed here. One common recommendations is to ensure that placement exams used in colleges are aligned with the standards used to prepare students for college. Preferably this could be achieved through the implementation of a systemwide set of exams benchmarked on explicit K-16 and university standards *(Kirst, 1998)*. These aligned standards and assessments can improve the quality of signals and incentives provided to students as they prepare for college *(Venezia, Kirst, & Antonio, 2003)*. As a first step in addressing these suggestions, the degree to which college placement tests currently align with high school standards should be explored.

Norman Webb has designed one of the most comprehensive and adaptable models for judging test alignment (Bhola, Impara, & Buckendahl, 2003). Therefore, the current study will utilize the Webb alignment procedure to assess the alignment between community college and high school math assessments. Webb's model assesses alignment in four dimensions: categorical concurrence, depth of knowledge, range of knowledge and balance of coverage. These categories give a comprehensive picture of how well aligned assessments are in content, complexity and breath of coverage across and within standards. (see Brown & Niemi, 2007; N. L. Webb, 1997; N. L. Webb, 1999).

A study conducted by Conley and Brown, examines standardized test items to ascertain the degree of alignment with Knowledge and Skills for University Success (Brown & Conley, 2003) but does not look specifically at California standards or the placement tests which serve as de facto standards for embarking upon college level coursework in California. Brown and Niemi recently conducted a study, assessing the alignment between the aforementioned California Community College placement test content and the Algebra II and Summative High School Mathematics California Standards Tests (Brown & Niemi, 2007). These standards tests, however, are taken by only 18% of the best academically prepared California high school students. Community colleges, in contrast, are designed to provide a college education to every student who can benefit, not just the best-prepared students.

No previously conducted study measures the alignment between the community college entrance expectations and the tests taken by the majority of California students. The California Standards Tests in General Mathematics, Algebra I and Geometry are cumulatively taken by 81.2% of high school students, therefore, it is both important and informative to investigate the alignment between the standards associated with these tests and the "de facto" standards defined by the college placement tests. This investigation has not been previously performed. This study, combined with the work of Brown and Niemi, will provide a clear picture of how well the community college expectations are aligned with the California Standards Tests taken by 99.2% of California students. This will help us to better understand how well high school students are prepared to successfully pass placement exams in mathematics and enroll in college level mathematics courses. This knowledge can then be utilized to explore solutions at the K-12 and higher education levels, helping to move us towards a future where all students are given an equal opportunity to reach their potential.

Methodology

How well aligned are the mandatory tests taken by California high school students with the entrance expectations of California Community Colleges? This study is designed to investigate the degree of alignment between high school and college expectations, in order to provide data on the degree to which California's high school mathematics standards prepare students to successfully pass placement exams in mathematics and to succeed in college level courses. We will investigate the alignment between the community college entrance standards, defined as the placement test content and the K-12 content standards in mathematics, as operationalized by the end of course tests. The investigation will concentrate on the alignment of CCC placement test content with the California Standards Tests in General Mathematics, Algebra I and Geometry.

Alignment Rating Process

A content analysis was previously conducted, by Brown and Niemi, to determine the core objectives that are assessed by the most commonly utilized placement tests in the California Community College System (Brown & Niemi, 2007). The mathematics twelve core objectives identified in this analysis were compared to the California Standards Tests assessing knowledge in General Mathematics, Algebra I and Geometry, using raters to determine matching across content and cognitive complexity.

Participants

Consistent with past alignment studies, 9 subject matter experts from California high schools and colleges were recruited to serve as raters for this alignment study. Each rater had direct experience with the California Content Standards in mathematics and/or the content in remedial or entry-level college math classes and was either high school or postsecondary educators in mathematics. The alignment exercises occurred within the context of a one-day alignment workshop. All raters received an honorarium of $250 for their participation.

Activities

The alignment workshop began with a training session. First, the raters were introduced to the purposes of the study and important definitions, including the concepts of categorical concurrence and depth of knowledge. Second, raters were introduced to the 5-point scale being used to quantify depth of knowledge. Raters practiced assigning depth of knowledge levels to sample, training items. They participated in a discussion regarding their reasons for assigning each item the level to help them develop a shared understanding of these levels.

Once the training was completed, the raters participated in two rating activities that were later used to determine the alignment between the CCC placement test content and the California Standards Tests. First, each rater independently assigned a Depth of Knowledge rating to each of the CST test elements on a 1-5 scale using Marzano's taxonomy (see Marzano, 2001; Marzano & Kendall, 2007). Next, each rater compared the content of the high school assessment elements

with the California Community College placement exam content to determine if and where matches occur, creating a matrix of CCC objectives by CST items. Analyses were performed by standard for each rater and then averaged to determine the results.

Alignment Criteria

Categorical Concurrence. Categorical concurrence (CC) is a measure of how well two assessments are matched in content. This measure illustrates the degree to which the placement exam content and high school standards assess the same content. It quantifies the degree to which the mandatory high school assessments assess the same content as the assessments used for community college placement. A test item and an objective show categorical concurrence if they assess the same topic. Raters assign each test item to one or more objectives, or to no match. A standard meets the benchmark for categorical concurrence if at least six assessment items are mapped into the grouping of objectives for that standard.

Depth of Knowledge Consistency. Depth of knowledge (DOK) measures cognitive complexity on a 1 - 5 scale using Marzano's definitions of levels of cognition. These include Retrieval, Comprehension, Analysis, Knowledge Utilization and Metacognitive Processes. The DOK component measures the degree to which the placement exam content and high school tests assess matched content to a similar degree of complexity, quantified by a value from 0 to 1.0. This will be used assess the degree to which California high school tests measure content at higher or lower levels of complexity compared to community college placement exams. An item matches an objective on depth of knowledge if it has been assigned a complexity rating equal to or greater than the associated objective. The depth of knowledge criteria is determined to have been met if at least half of the items matched to a given standard are tested at a level of complexity at or above that of the standard.

Range of Knowledge. Range of knowledge (ROK) refers to the number of objectives tested by items mapped into a given standard. This measure indicates whether the span of knowledge measured by high school standards tests and community college placement exams are comparable, with a range of 0 to 1.0. The higher the percent of objectives assessed, the higher the range of knowledge value assigned to that test. The minimum criterion is that at least half of the objectives within the standard have at least one question mapped to them. This is reflected in a desired value for range of knowledge greater than 0.5.

Balance of Representation. The DOK and ROK criteria allow an exam to have a large number of questions clustered around a few objectives. In order to determine if the questions are evenly spread among the various objectives within a standard, the balance of representation index is computed. Balance of representation (BR) refers to the distribution of assessment items among the various objectives. A specific assessment is high in balance of representation if the assessment items are distributed evenly across the given objectives. The desired level of balance is .70 or higher.

Findings and Recommendations

Analysis

Each rater's examination of CST test elements creates an individual matrix of CCC objectives by CST items. This matrix provides information about content match and DOK level. Each matrix was analyzed separately to determine the resultant values for Categorical Concurrence, Depth of Knowledge, Range of Knowledge and Balance of Representation. These results were then averaged to determine the results by standard and by assessment. Rater reliability was analyzed using the generalizability-coefficient.

Categorical Concurrence. Categorical concurrence is analyzed on a per standard basis, with six assessment items mapping into the objectives for that standard indicating that categorical concurrence has been achieved. The General Mathematics test met the categorical concurrence criteria in most categories including a near match in Algebraic expressions and Operations and Applications and Other Algebra topics, which averaged 5.67 and 5.56 respectively. Categorical concurrence was not achieved for Integers and Rationals, Functions, Trigonometry or Graphing. The Algebra 1 standards test only achieved categorical concurrence in the area of Algebraic Expressions and Operations and Equations, Inequalities and Word problems exclusively. The Geometry test met the categorical concurrence criteria in the area of Geometry only.

Depth of Knowledge consistency. The Depth of Knowledge (DOK) criterion is determined to have been met if at least half of the items matched to a given standard are tested at a level of complexity at or above that of the standard. Range of Knowledge is analyzed similarly. The minimum criterion is that at least half of the objectives within the standard have at least one question mapped to them. Standards with a small number of matches can easily meet the DOK and ROK criteria; but, the results are not necessarily meaningful. For instance, if there is only one content match within a standard, then either 100% or 0% of the items match test the content at the desired level of complexity. Of course, in this case, there are not enough items testing the standard to determine that it is being adequately measured. Therefore, we will only explore the DOK and ROK level of standards that have met the Categorical Concurrence criteria. The calculations for all standards are available in the appendix.

For all three tests, the standards that achieved Categorical Concurrence far exceeded the DOK criteria. The only exception was with the standard of Applications and Interpreting Tables/Graphs, which only weakly satisfied the DOK criteria for the General mathematics test. This indicates that where high school tests are assessing the same content as community college tests, they generally do so at a cognitive level at least as great as that of the community college placement tests.

Range of Knowledge. Range of Knowledge, however, was achieved to a much lesser degree. Within the general Mathematics tests, Equations, Inequalities, and Word Problems met this criteria only weakly, while Algebraic Expressions and Operations as well as Applications and Other Algebra Topics failed to meet this criteria even minimally. For the Algebra 1 test, Algebraic Expressions and Operations met the required ROK criteria. Additionally, Equations, Inequalities, and Word Problems only weakly met the criteria. The Geometry test exceeded the

minimum requirement in its singular matched standard of Geometry. The fact that several of the standards failed to meet the minimum ROK requirements suggests that many of the standards that meet the benchmark for Categorical Concurrence do so because many high school test elements map onto only a few community college objectives within that standard.

Balance of Representation. Balance of representation is analyzed differently than the other three alignment values and is benchmarked at a higher proportion of .70. For all three tests, every standard that met the criteria for Categorical Concurrence far exceeded this minimum standard. This is partially explained by the fact that the community college objectives rarely matched more than one or two high school test elements.

Reliability. Due to the fact that this study employs multiple raters, the reliability of the ratings was assessed for rater agreement. This was done utilizing the generalizability coefficient (see Brennan, 2001; Mushquash & O'Connor, 2006; Shavelson & Webb, 1991, 2006; Shavelson, Webb, & Rowley, 1989), a measure of reliability that, unlike the reliability coefficient of classical test theory, distinguishes between systematic and unsystematic sources of variability. This coefficient provides an estimate of the consistency between raters. Both the General Mathematics and Geometry tests showed a strong degree of rater consistency. The General Mathematics test had a relative G-coefficient of .80 and an absolute G- coefficient of .79 and the Geometry test had ratings of .75 and .74 respectively. The Algebra 1 test showed slightly less consistency with relative and absolute G- coefficients both calculated at .60.

Overall Test Alignment. The California Standards Tests explored here are not well-aligned with the California Community College placement test content. Most of the alignment that did occur was found within the General Mathematics Test. In fact, neither the Algebra 1 nor the Geometry test showed Categorical Concurrence with any standard that was not also addressed by the General Mathematics Test as well. The only exception to this is the standard of Algebraic Expressions and Operations that averaged 5.67 matches with the General Mathematics Test, versus the 16.67 average hits that occurred in the Algebra 1 test. Furthermore, only in this category, Algebraic Expressions and Operations, did any of the standards that failed to meet the Range of Knowledge criteria for the General Mathematics Tests meet the minimum requirements in either the Algebra 1 or Geometry Tests.

This analysis identified four categories, or one-third of the CCC placement standards, that failed to achieve a sufficient content match. These identified standards are Integers and Rationals, Functions, Trigonometry, and Graphing. According to the Brown and Niemi study, the augmented forms of the Summative High School and Algebra II standards tests also fail to meet the minimum criteria in three of these four identified categories, Integers and Rationals, Trigonometry and Graphing. The General Mathematics test, however, did demonstrate a content match in several of the categories that are essentially excluded from the augmented CSTs, Whole Numbers and Fractions, Decimals and Percents, Applications and Interpreting Tables/Graphs and Operations with Exponents. Overall, when the results of these two studies are considered together, it becomes apparent that 25% of the core objectives being assessed by the California Community College placement exams are not emphasized in the California high school assessment systems.

Conclusions

Overall, the mathematics tests taken by the majority of California high school students are not aligned with the content of the California Community College placement tests in four major areas: Integers and Rationals, Functions, Trigonometry and Graphing. Therefore, only 75% of the core objectives utilized to make course placement decisions are based upon content that is emphasized in the high school curriculum. This misalignment could be resolved in two ways. First, the high school standards and curriculum could be adjusted to better align with postsecondary expectations. Second, the community college placement policies could be revised to better measure the content that students are exposed to during their precollegiate education. This leads to several recommendations for both the K-12 and Community College systems of how to improve the articulation between high school and postsecondary institutions.

Recommendations

First, the California Community College System should consider explicitly defining their expectations for college level coursework. Incoming college freshmen would also benefit from a systemwide placement policy so that both students and teachers at the high school level are clear as to what individuals are expected to know and demonstrate to be placed into college level classes. A new systemwide placement test predicated on the high school standards, with a well-publicized blueprint would also help to clarify the expectations of students in preparing for college. Once the testing systems are better aligned, the California Department of Education should begin to include college readiness indicators as part of its California Standards Tests' reporting procedures. This would allow schools, teachers, parents and students to become aware of any deficiencies students may have while there is still time to address them.

Next, the California Community College system may want to consider the feasibility of utilizing data from the augmented form of the California Standards Tests for student placement, given that these exams are already being used for this purpose by the California State University system. Furthermore, they may want to consider working with the department of education to develop an augmented form of General Mathematics CST that includes the CCC placement standards currently not being assessed. This is important since the majority of community college bound students do not take the Algebra II or Summative High School math tests. In this way, all students would have an opportunity to take a math test that could be used to make placement decisions. In addition, the potential for utilizing these and other CST scores for placement decisions should be explored through following a sample of high school graduates and determining how well their high school standards scores predict future math success. Furthermore, it could be useful to replicate this study with the California High School Exit Exam (CAHSEE) to explore the possibility of utilizing student scores on the CAHSEE to determine placement decisions for students who have not completed the math sequence through Algebra II.

Finally, all states should ensure that their high school level standards prepare students for postsecondary success. In the next revision of the California Content Standards, it is important for the K-12 educational system to take steps to ensure that these standards reflect the college readiness standards. Once the higher education system ensures that their expectations are made explicit, the K-12 standards can be predicated on these expectations.

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APPENDIX

Tables and Figures:

TABLE 1
Rater Reliability.

Reliability Ratings (DOK)		
CST Subject Area	Relative G-Coefficient(ρ)	Absolute G-Coefficient(ϕ)
General Mathematics	.80	.79
Algebra 1	.60	.60
Geometry	.75	.74

TABLE 2

Alignment values for General Mathematics.

Alignment Ratings for General Mathematics				
CCC Math Placement Test Content	Categorical Concurrence	Depth of Knowledge	Range of Knowledge	Balance of Representation
Whole Numbers and Fractions	16.89	52.51%	58.33%	90.72%
Decimals and Percents	13.33	62.34%	65.28%	90.62%
Applications and interpreting tables/graphs	12.67	45.75%	50.79%	84.74%
Integers and Rationals	3.11	81.48%	48.15%	97.69%
Algebraic Expressions and Operations	5.67	70.85%	27.34%	86.31%
Operations with exponents	6.67	63.99%	54.17%	86.71%
Equations, Inequalities, and Word Problems	6.44	61.07%	42.42%	90.61%
Functions	2.33	100.00%	25.40%	89.05%
Trigonometry	0.00	N/A	N/A	N/A
Geometry	11.22	71.12%	56.94%	94.05%
Graphing	3.44	97.78%	18.06%	81.53%
Applications and Other Algebra Topics	5.56	86.86%	21.67%	85.97%
Criterion value for alignment:	*≥6*	*≥50%*	*≥50%*	*≥ 70%*

TABLE 3
Alignment values for Algebra.

Alignment Ratings for Algebra 1				
CCC Math Placement Test Content	Categorical Concurrence	Depth of Knowledge	Range of Knowledge	Balance of Representation
Whole Numbers and Fractions	4.67	46.49%	23.75%	94.73%
Decimals and Percents	0.78	33.33%	14.58%	100.00%
Applications and interpreting tables/graphs	4.33	65.54%	20.41%	84.39%
Integers and Rationals	1.78	78.13%	31.25%	98.44%
Algebraic Expressions and Operations	16.67	89.64%	68.06%	87.15%
Operations with exponents	2.78	41.67%	52.08%	100.00%
Equations, Inequalities, and Word Problems	8.00	81.45%	49.49%	86.49%
Functions	2.78	91.27%	20.99%	89.71%
Trigonometry	0.00	N/A	N/A	N/A
Geometry	0.33	100.00%	18.75%	100.00%
Graphing	4.78	76.93%	27.08%	94.14%
Applications and Other Algebra Topics	0.11	100.00%	6.67%	100.00%
Criterion value for alignment:	*≥6*	*≥50%*	*≥50%*	*≥ 70%*

TABLE 4
Alignment values Geometry.

Alignment Ratings for Geometry				
CCC Math Placement Test Content	Categorical Concurrence	Depth of Knowledge	Range of Knowledge	Balance of Representation
Whole Numbers and Fractions	0.00	N/A	N/A	N/A
Decimals and Percents	0.00	N/A	N/A	N/A
Applications and interpreting tables/graphs	1.78	68.33%	9.52%	72.50%
Integers and Rationals	0.00	N/A	N/A	N/A
Algebraic Expressions and Operations	0.33	33.33%	6.25%	66.67%
Operations with exponents	0.00	N/A	N/A	N/A
Equations, Inequalities, and Word Problems	0.44	66.67%	12.12%	100.00%
Functions	0.11	100.00%	11.11%	100.00%
Trigonometry	4.22	89.63%	38.89%	88.13%
Geometry	18.56	82.98%	70.14%	87.38%
Graphing	0.89	100.00%	25.00%	100.00%
Applications and Other Algebra Topics	4.78	91.08%	16.19%	79.26%
Criterion value for alignment:	*≥6*	*≥50%*	*≥50%*	*≥ 70%*