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How Are Community College Students Assessed and Placed in Developmental Math? Grounding Our Understanding in Reality

Examining current assessment and placement policies (A&P) used to assign students to a developmental math sequence in the Los Angeles Community College District, this study finds that faculty and administrators lack the technical expertise and resources necessary to ensure that A&P policies facilitate student success.

Within the past two decades, the effectiveness of developmental education[1] for improving student success has attracted the increased attention of researchers and policymakers. Recent evidence suggests that nationwide approximately 60% of all incoming freshmen enroll in at least one developmental education course (NCPPHE & SREB, 2010). In California, it has been estimated that if the standards employed by the California State University System were to be applied to California's community colleges, roughly eight out of ten entering students would need to enroll in developmental education (NCPPHE & SREB, 2010). An additional concern is that developmental education requires a significant amount of state funding (Melguizo, Hagedorn, & Cypers, 2008; Schneider & Yin, 2011; Strong American Schools, 2008). Facing tight-

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ened budgets, policymakers are trying to identify in a more systematic fashion which approaches to developmental education work.

The increasing amount of attention dedicated to developmental education has produced a large body of research. Nonetheless, current scholarship has largely focused on: 1) calculating student participation rates in remedial education (Attewell, Lavin, Thurston, & Levey, 2006; Horn & Nevill, 2006; Provasnik & Planty, 2008); 2) calculating provision rates of remedial education across postsecondary institutions (Parsad, Lewis, & Greene, 2003); 3) identifying students most likely to enter remediation (Cohen & Brawer, 2008; Kirst & Venezia, 2004); 4) discussing or testing the validity and reliability of placement tests (Brown & Niemi, 2007; Gerlaugh, Thompson, Boylan, & Davis, 2007; Hughes & Scott-Clayton, 2010); 5) calculating the cost of providing remedial education (Melguizo, Hagedorn, & Cypers, 2008; Schneider & Yin, 2011; Strong American Schools, 2008); 6) exploring how developmental education is delivered (McMillan, Parke, & Lanning, 1997; Perin, 2004); and 7) providing guidance on how to assess or assessing the impact of remedial education on student success (Attewell, Lavin, Thurston, & Levey, 2006; Bahr, 2008; Bailey, Jeong, & Cho, 2010; Bettinger & Long, 2009; Boatman, 2012; Boatman & Long, 2010; Calcagno & Long, 2008; Crews & Aragon, 2004; Grubb, 2001; Levin & Calcagno, 2008; Martorell & McFarlin, 2011; Melguizo, Bos, & Prather, 2013; Scott-Clayton & Rodriguez, 2012).

A new thread of research has emerged within recent years, which emphasizes understanding assessment and placement (A&P) policies that assign students to developmental and transfer-level[2] coursework (Bailey, 2009; Bailey, Jeong, & Cho, 2010; Bunch, Endris, Panayotova, Romero, & Llosa, 2011; Perin, 2006; Safran & Visher, 2010; Venezia, Bracco, & Nodine, 2010). This gain in currency can be partly attributed to the fact that A&P have become staple characteristics of the current community college landscape (Gerlaugh, Thompson, Boylan & Davis, 2007).

While current research on community college A&P has given us a general understanding of A&P policies used across two-year institutions, it has failed to provide a focused, more dialogic description of what a specific set of A&P policies look like and why. For the most part, researchers have analyzed specific, discrete characteristics or stages of A&P, i.e. the types of tests used (Gerlaugh, Thompson, Boylan, & Davis, 2007; Hughes & Scott-Clayton, 2010), the validity of the placement instruments (Brown & Niemi, 2007; Gerlaugh, Thompson, Boylan, & Davis, 2007; Hughes & Scott-Clayton, 2010), or the number of students placed into different levels of developmental educa-

tion (Bailey, 2009; Bailey, Jeong, & Cho, 2010; Fong, Melguizo, Bos, & Prather, 2013). Further, the majority of A&P research presents data at the national or state level (Attewell, Lavin, Domina, & Levey, 2006; Bailey, Jeong, & Cho, 2010; Bettinger & Long, 2009; Bunch, et. al, 2011; Collins, 2008; Hodara, Hughes, Karp, Wachen, & Weiss, 2012; Martorell & McFarlin, 2011). As a consequence, we know much less about A&P policies and practices designed at a local level. Capturing a nuanced picture of local A&P may help researchers and policymakers identify specific paths to improve these policies in states with decentralized governance systems.

This study capitalized on these efforts by focusing on a specific group of two-year institutions that belong to a single district and operate under the same governance structure. In departing from current literature, we not only sought to describe A&P policies used across the colleges, but also to distill how A&P policies are designed and implemented, and relate with actual student testing, enrollment and placement in as well as progress through a developmental math sequence. We framed the discussion of our results to provide perspective on how California and other states can improve how community colleges determine developmental education placement.

The study's main objective was to provide a detailed description of math A&P policies in the Los Angeles Community College District (LACCD). We focused on math because a larger proportion of students place into remedial math than remedial reading or English (Bailey, Jeong, & Cho, 2010; Parsad, Lewis, & Greene, 2003). The following questions guided this study:

1. What does an actual set of A&P policies for developmental math look like?
2. What implications do A&P policies have on student testing, as well as placement and enrollment in and progress though a developmental math sequence?
3. What strategies and methods do faculty and administrators use to determine A&P policies for developmental math at their colleges?
4. What conditions facilitate or constrain colleges from improving A&P policies for developmental math?

Unlike current studies of A&P policies (Bailey, Jeong, & Cho, 2010; Hughes & Scott-Clayton, 2010; Perin, 2006), we employed a mixed-methods case study approach to investigate A&P policies, drawing data from college websites, placement criteria documents, student transcripts, and interviews conducted with college faculty and administra-

tors. We used this approach because it allowed us to produce a more complete picture of what local A&P policies look like, how they are designed and implemented, and how they influence student placement and progress. Further, this approach permitted us to uncover how factors like limited resources, high degrees of discretion, and conflicting demands bear on how community colleges design policy.

We divide this article as follows. First, we provide a review of the literature on A&P for developmental education, particularly in community colleges. Second, we provide the context of our study by describing the governance structure and state policies that regulate A&P and the LACCD. Third, we outline the study's data and methods. Fourth, we present the study's findings. Finally, we present our conclusions and discuss the implications recent California legislation has on improving A&P policies.

The Changing Landscape of A&P Policies in Community Colleges

An Overview of A&P Policies for Developmental Education

There is no national consensus on what constitutes developmental education (Attewell, Lavin, Thurston, & Levey, 2006; Bailey, 2009; Merisotis & Phipps, 2000), and even less on how students should be assessed or placed into developmental coursework (Hughes & Scott-Clayton, 2010). Some attribute this discord to the historical tensions that have been shown to exist between ensuring access to higher education and maintaining academic standards for college-level work (Goldrick-Rab, 2010; Hughes & Scott-Clayton, 2010). For community colleges this tension is particularly acute since their admission policy has traditionally been open access. A&P policies have thus become key factors in estimating a student's level of preparedness for collegiate-level coursework.

While there is wide agreement between policymakers and practitioners that A&P ought to be mandatory in community colleges (Prince, 2005), the policies used to assign students to developmental coursework vary widely. A recent analysis of state policies on A&P for developmental education showed that only 13 states have legislated the use of a common assessment and common cut scores (Fulton, 2012).

Despite the presence of statewide A&P policies, the majority of these states grant their institutions some level of autonomy. For example, Kentucky and Oklahoma set primary cut scores, but allow institutions to select secondary assessments and cut scores (Fulton, 2012). For this reason, it is important to examine A&P at a local level.

Across the nation, institutions utilize different placement tests to gauge a student's college readiness (Bailey, 2009; Gerlaugh, Thompson, Boylan, & Davis, 2007; Hughes & Scott-Clayton, 2010). Even though the College Board's ACCUPLACER and ACT's COMPASS are instruments most used to place community college students (Hughes & Scott-Clayton, 2010), other less common tests are also employed. For example, Texas and Florida have each developed their own assessment for developmental education placement, and the University of California and California State University systems have jointly designed the Mathematics Diagnostic Testing Project (MDTP) to diagnose a student's performance in several areas of math. Apart from differences in assessment tests, community colleges also use different cut scores to assign students to developmental education sequences of up to four courses (Bailey, 2009).

Growing Movement to Standardize A&P Policies

Although A&P policies differ across community colleges, some researchers argue that the ways in which students are deemed college ready should be revamped because they do not place students fairly (Burdman, 2012). Testing students' readiness for college while they are still in high school is one reform that has received traction in several states, including California and Michigan (Adams, 2011; Howell, Kurlaender, & Grodsky, 2010). Other community colleges use diagnostic features offered by test providers to identify their students' specific learning needs (Burdman, 2012).

Implicitly, these changes represent a wider movement to standardize A&P policies for developmental education. Research on the adoption of a uniform set of A&P standards have shown that it: 1) prepares students for college-level courses, especially underserved populations; 2) improves placement accuracy; 3) helps institutions establish a common benchmark to measure college readiness; 4) facilitates student transfer between two- and four-year institutions; and 5) helps states develop performance measures to assess the effectiveness of developmental education sequences across institutions (NCPPHE & SREB, 2010; Prince, 2005). By contrast, opponents have contended that uniformity will prevent institutions from meeting the needs of their students, increase the cost burden associated with assessment, and, ultimately, enroll more students—typically of color—in developmental education (Prince, 2005).

This movement has had a noticeable presence in California. After two reports suggesting that a uniform set of A&P policies may help community colleges save money and enable students to move between colleges

without having to retest (Consultation Council Task Force on Assessment, 2007; Consultation Council Task Force on Assessment, 2008), California passed A.B.743 in 2011, which establishes a common assessment system for placement for community colleges.[3]

A review of states setting common A&P policies through the *Achieving the Dream* Initiative gave us insight into the challenges and deliberations community colleges face when determining A&P policies. In a study examining the standardization of A&P across three *Achieving the Dream* states, Collins (2008) charted how Virginia, North Carolina, and Connecticut developed common cut score polices as a means to improve student success. Collins (2008) discovered that other concerns about A&P emerged that questioned the facility of setting common cut scores. In their endeavors, state policymakers wrestled with questions like: Do we have a common procedure for placement? Do we have a common definition for who should be assessed? Do we have a uniform set of protocols for testing? How will staff be affected by the change in cut scores? Do we have the data we need to set cut scores accurately? Collins (2008) concluded that policymakers must reach agreement on what it means to be "college-ready" before A&P policies can be effectively standardized.

In another study on 15 community colleges across 6 states, Perin (2006) discovered that community college officials found ways to reduce the number of students placed into developmental education by overriding statewide assessment requirements. She also found that these institutions altered policies when they felt they failed to accurately assess their students' academic abilities. Taken together, Perin's (2006) findings suggest that faithful implementation of common A&P policies may hinge on whether policymakers and policy implementers agree on the goals, targets, and tools of the policies themselves (Honig, 2006).

Assessing the Effectiveness of A&P Policies

A challenge that community colleges face is ensuring that students placed into remediation actually enroll and progress through remedial coursework. Employing data from *Achieving the Dream* and NELS 88, Bailey, Jeong, and Cho (2010) found that less than half of developmental education students actually completed the entire course sequence. They also learned that about three out of ten developmental education students never enrolled, and that less than two-thirds enrolled in the course to which they were assigned. These findings illustrate the complexities of evaluating the effectiveness of developmental education.

Studies using more rigorous methods to determine the impact of community college placement decisions on short- and long-term student

outcomes have produced mostly negative evidence. Using student-level data from different states, researchers on the whole have suggested that being placed into developmental education does not improve a student's chances of obtaining a degree (Bettinger & Long, 2009; Calcagno & Long, 2008; Martorell & McFarlin, 2011; Scott-Clayton & Rodriguez, 2012). There is mixed evidence that developmental education courses increase college persistence (Bettinger & Long, 2009; Scott-Clayton & Rodriguez, 2012). Findings from our evaluation of A&P policies used to assign students to different developmental math levels suggest that marginal students face a lower probability of passing the subsequent course in the sequence (i.e. intermediate algebra) if they placed in a lower level developmental course (i.e. elementary algebra) versus if they were placed in a higher level course (i.e. intermediate algebra); however this penalty diminishes after one year and disappears over time. Our study shows that the effects of A&P policies are not homogeneous because they vary over time and across courses and colleges (Melguizo, Bos, & Prather, 2013).

Assessing the Validity of Placement Tests

While these studies challenge the benefits of developmental education, others have questioned the validity of the placement instruments. Although the ACT and the College Board demonstrate that their placement tests have content validity, both test publishers have failed to provide adequate proof of their predictive validity (Hughes & Scott-Clayton, 2010). Evidence on placement accuracy rates indicates that COMPASS can reasonably predict students who are likely to earn a "B" or higher than those who are at risk for failure (Hughes & Scott-Clayton, 2010). The poor predictive power of COMPASS may be related to a number of factors. For one, Brown and Niemi (2007) discovered poor alignment between content taught in the classroom and tested on placement exams. Second, it may also suggest that factors such as a student's motivation and ability to dedicate to school may be more powerful predictors of student outcomes.

Assessing How Colleges Design and Implement A&P Policies

The effectiveness of A&P policies also rests with community college faculty and administrators who determine their design and implementation. Understanding what challenges they face in crafting A&P policies that work is one way to locate reform. In a case study of faculty and administrators from three community colleges, Safran and Visher (2010) found that few organizational structures exist that allow colleges to carefully examine A&P policies. Betts, Hahn, and Zau (2011) also

suggested that when faculty are equipped with diagnostic information, they can better direct students to more appropriate course levels and determine where students need academic assistance.

From this literature review, we identify two gaps in current scholarship on collegiate A&P policies. First, today's research fails to fully explore the differences that exist in A&P policies across our nation's community colleges. As a result, researchers have an incomplete understanding of how community college students are assigned to developmental education. We have very few examples of actual sets of A&P policies. Second, studies highlighting the challenges community colleges face in assigning students to developmental education have not conducted a detailed examination of A&P policies used within a single college district. Consequently, we know little about how colleges determine A&P policies and how those policies affect student enrollment, placement, and progress in their developmental education sequence.

Context and Study Site

The California Community College System and Governance Structure

A Profile of The California Community College System. The California Community College System is the largest postsecondary education system in the nation (CCCCO, 2011a). It is composed of 72 districts and 112 community colleges, enrolling over 2.8 million mostly part-time students (CCCCO, 2011a; Sengupta & Jepsen, 2006). In contrast to Florida, California community colleges operate under a decentralized governance structure, and, as a result, are largely overseen by locally elected boards of trustees (Melguizo & Kosiewicz, 2013)[4].

High Degrees of Discretion in Determining A&P Policy. California's community colleges have a significant degree of autonomy in determining A&P policies. Although colleges are required to assess their students, they determine how students are assessed and who should receive an exemption. In the most recent published version of the CCCCO's Matriculation Handbook (2011b), interviews, standardized tests, attitude surveys, as well as high school and college transcripts are some ways colleges can determine assignment to developmental coursework. Colleges that choose to employ standardized tests must select an instrument from a list of those that have been approved by the California Community College Chancellor's Office. Otherwise, colleges must prove that the instrument has content validity. State approved instruments for math assessment include: College Board's ACCUPLACER/Companion test, ACT's COMPASS, and UC/CSU's MDTP (CCCCO, 2011b). Col-

leges may also utilize "informed assessment," which allows students to choose the placement level they feel best matches their academic abilities. Further, each community college also has latitude to set cut scores to place students based on their test performance. As a result of the 1991 MALDEF suit against the CCCCO, community colleges across California are obligated by law to consider measures other than the student's assessment score when determining their placement into developmental or transfer-level courses. Known as "multiple measures," these measures capture other cognitive and affective student characteristics. Acceptable multiple measures include: standardized placement tests, writing samples, performance-based assessments, surveys and questionnaires, past educational experience, among other measures (CCCCO, 2011b).

The Los Angeles Community College District

The LACCD is one the largest community college districts in California and made up of nine colleges that serve the greater Los Angeles area. LACCD's community colleges enroll a widely diverse group of 250,000 full- and part-time students, the majority of whom consider themselves students of color. Based on data used for this study, roughly 50% of the district's students were Latino, and one-fifth classified as African American. Roughly two out of five LACCD students reported that their native language was not English.

Because LACCD colleges serve their communities, they attract different types of students. While a number of colleges primarily teach Latino students, one in particular matriculates a large African American population. Another college enrolls a significant proportion of immigrant students. LACCD colleges also offer different certificate programs, which are tied largely to local industry. For example, one college specializes in film and media studies, and another offers certification programs in nursing.

Despite these differences, approximately 50% of LACCD students were placed into a developmental math course between summer of 2005 and spring 2007 even though most of them bear a high school degree. Today, the percent of students placed into developmental math is likely over 60. Since 2010, California requires students to pass intermediate algebra to receive an Associate's degree, one math level higher than elementary algebra, the previous degree requirement. Across LACCD's nine community colleges, each has developed their own A&P policies. In the LACCD, the developmental math sequence begins with arithmetic, and is followed by pre-algebra, elementary algebra, and intermediate algebra.

Methodology

We employed a case study approach for our study because we believed that community colleges that comprise LACCD, which serves mostly nontraditional, and ethnic and racial minority students, may provide an opportunity for us to learn how other large, urban, minority-serving colleges and districts implement developmental education A&P policies.

A particular strength of this approach is the use of multiple sources of data (Stake, 1995). For this study, we drew on qualitative and quantitative data from websites, transcripts, and administrative documents produced by the district, and employed quantitative and qualitative methods to collect and analyze them.

Transcript Data and Analysis

Transcript data used for this study were based on three cohorts of developmental math students, who were assessed during the 2005–06 school year (five years of data), the 2006–07 school year (four years of data), and the 2007–08 school year (three years of data).[5] For each student, we obtained: 1) their placement test scores and multiple measure points which combined resulted in their final placement; 2) their demographic characteristics; and 3) their enrollment data prior and subsequent to being placed in math. Through these data, we identified the subtests used for their placement, their math placement level, whether they ever enrolled in a math class after being placed, how far they progressed through the math sequence, and whether they received multiple measure points. We followed students through the 2009–2010 academic year since the lowest-placed students should have completed the A.A. math requirement by that time. Examining student outcomes within six years is the standard timeframe used by the U.S. Department of Education to measure graduation rates; if we had data for six years our results may have been less conservative. We analyzed roughly 80,000 student transcripts.

Content Data and Analysis

To conduct our content analysis, we drew on two sources of data: 2005–2007 placement criteria and a student background questionnaire that was used to gather information on a student's academic history and goals. We analyzed each college's placement criteria to identify if, and to what degree, cut scores used to place students in math varied across LACCD colleges. We also analyzed each college's student background

questionnaire to identify the multiple measures each college used for placement. Specifically, we were able to determine how many points students were awarded for each multiple measure and what each multiple measure attempted to assess. This analysis also helped us to identify the number of students who were placed into a higher-level math course because of multiple measures.

Interview Data and Analysis

In the spring and summer of 2011, we conducted twenty-five interviews with administrators and faculty across all nine community colleges to gain insight into how they design and implement their A&P policies[6]. Interviews were conducted with matriculation coordinators and student services personnel, institutional researchers, and math chairs since, according to district officials, they play influential roles in the design and implementation of math placement policies[7]. By interviewing multiple stakeholders, we were able to reliably detect patterns that transcended differences between colleges as well as administrators and faculty members; we were also able to identify patterns unique to administrators, faculty, and each institution.

Each in-depth interview was used to elicit information on four broad subject areas: 1) the selection of the assessment instrument; 2) the process of setting and evaluating cut scores; 3) the process of selecting and evaluating multiple measures; and 4) the conditions that constrained faculty and administrators from improving A&P policies for math. We chose these broad areas to fill in gaps in existing literature as well as to recognize the considerable latitude faculty and administrators are granted to design A&P policies.

All interviews were conducted in person using the same protocol and research staff. Interviews were limited to 45–60 minutes in length as a way to avoid interviewer fatigue, and to ensure greater integrity of our data. With permission from interviewees, we digitally recorded interviews for transcription. Otherwise, interviews were recorded in writing. All interviews were transcribed.

We analyzed data collected from our interviews using thematic analytic methods advocated by Boyatzis (1998). To ensure we remained close to the data, team members reviewed interview transcripts several times and engaged in collective discussions about what the data conveyed (Lincoln & Guba, 1985). We also presented our findings to a group of math chairs, matriculation coordinators, and institutional researchers to ensure that our interpretations were valid and resonated with their experiences and perceptions (Creswell, 2006).

Findings

Use of Placement Instruments

Between 2005 and 2007, five out of nine LACCD colleges used ACCUPLACER, two used COMPASS, and two used the MDTP to assess and place their students in math. Since 2007, two colleges abandoned MDTP for ACCUPLACER, and another college returned to MDTP after having used it previously. At some colleges, the English department's dissatisfaction with their own placement instrument precipitated the switch to ACCUPLACER or COMPASS while at other colleges efforts to reduce testing costs, decrease testing time, and facilitate quicker placement motivated the adoption of ACCUPLACER or COMPASS. However, among these factors, quicker placement was the most quoted reason among administrators as well as faculty. This suggests that placement efficiency is consequential for the majority of colleges.

For the most part, faculty felt indifferent toward commercial placement tests validated by the state. The math department chair in College A captured faculty sentiment by stating: "I think that looking for a better placement test is like looking for the Holy Grail!" Yet a few chairs suggested that their placement test did a good job at sorting students by their math ability. One math department chair came to this conclusion based on the small percentage of students who successfully challenged their placement: "Less than half, which leads me to believe that the placement instrument is actually appropriate. I get the sense that it's doing its job" (interview, Math department chair College D). Although faculty expressed different sentiments about the ability of placement tests to effectively sort students into the right course, each grounded their feelings in perception rather than empirical evidence.

Computer-Adaptive Placement Tests: ACCUPLACER and COMPASS. ACCUPLACER and COMPASS are computer-adaptive placement tests that employ an internal algorithm—or branching mechanism—to estimate the student's placement score. Both tests are composed of subtests that vary in academic content and rigor. Students start the exam with questions from a particular subtest; the subtest with which students begin is typically determined by the college or the information students provide on the background questionnaire. Based on the number of questions a student answers correctly on the first subtest, the branching mechanism may move that student to different subtests. Because both placement tests can refer students to different subtests within one sitting to improve placement accuracy, colleges that use ACCUPLACER and COMPASS eliminate the risk of "no shows"—students who are referred

to a later administration of a different subtest, but never show up to take it. Although ACCUPLACER and COMPASS may refer students to multiple subtests, both tests place students based on their last recorded subtest score. When students complete their test, they receive notification of the course in which they are allowed to enroll. Since each subtest is sold as an individual unit, colleges may strive to place students with only one subtest.

Matriculation coordinators and directors of institutional researchers, in particular, cite the seamlessness between testing and placement as a major reason for switching to a computer-adaptive placement instrument. As one vice president of student services stated:

> If you have 50 students testing [with paper and pencil test] in one day, you may not have time to get it corrected, get your cut scores and your raw scores to the cut scores, and get placement. So it could be a day, maybe two, before a student might know what they assessed into, with math class, with English class, what reading class. ACCUPLACER would tell you after they finish. (interview, vice president of student services, College B)

Diagnostic Test: MDTP. The MDTP is a diagnostic test that assesses a student's abilities in specific math content areas. On the one hand, MDTP is similar to ACCUPLACER and COMPASS in that it consists of alternative subtests varying in content and rigor. Students who take the MDTP test also begin the assessment process by answering questions from one subtest and can be subsequently referred to another subtest, depending on their performance. On the other hand, MDTP is unique in comparison with its computer-adaptive counterparts in that it allows administrators to set subscores identifying a student's strengths and weaknesses on questions constituting each subtest. Since the MDTP is not computer-adaptive, each subtest lengthens the amount of time students need to complete the assessment process. Further, the MDTP is administered with paper and pencil and answer sheets are generally scanned in a batch process[8]. Walk-ins are thus more difficult to accommodate and students must wait at least a few hours before receiving a placement or referral to another subtest. Based on data from MDTP colleges, relatively few can take a second subtest on the same day and only one in five who must come back a second day for another session ever do.

Finally, though reporting diagnostics is seen as a key advantage of MDTP over other placement instruments, few faculty provided details about how they would use them to improve overall remedial math instruction. As a director of institutional research put it:

> The problem is that even when we had MDTP with the diagnostic capability, it wasn't used. So that if you have that diagnostic information, if it's not shared with the faculty, and if the faculty doesn't have strategies for dealing with it, it doesn't help. (interview, former director of institutional research, College A)

While ACCUPLACER and COMPASS offer diagnostic tools, colleges must pay an additional fee to use them, which seems to discourage their use.

Setting and Validating Cut Scores, Determining Multiple Measures

Placement into a math class is based on a student's test score and points awarded through multiple measures. At LACCD, administrators and faculty cannot manually determine students' final placement since scores are calculated by a common data system. Each college determines which cut scores and multiple measures they use to place students in math. In practice, colleges use cut scores to determine a student's initial placement and then add multiple measures to determine their final placement.

College math departments are charged with setting cut scores largely because it is felt across campus that faculty know best how to gauge a student's math skills and abilities. Directors of institutional research and matriculation coordinators take an auxiliary role providing data and conducting analysis to facilitate the process of setting cut scores. A statement made by a director of institutional research in College G captures this reality well: "And I have no vote. I'm just there to facilitate" (interview).

Faculty have utilized various methods to determine where to set cut scores. The most common methods includes taking the placement test while pretending to be a student whose knowledge and skills fit a specific math class, and examining cut scores used by other colleges. Other methods include using the cut score guidelines published by research institutes and examining results from disproportionate impact studies. Faculty members using ACCUPLACER failed to mention referring to guidelines published by the College Board to set cut scores.

Math faculty also reported that the process of setting and validating cut scores involves much trial and error. Faculty stated that they have the difficult task of setting cut scores in a way that minimizes errors in placement. In other words they have to minimize the number of students who should have been placed in a course but were not, against the number of students who should not have been placed in a course but were.

The director of institutional research in College B characterized setting and validating cut scores as conducting an experiment for each course (interview). Faculty cited a student's skills and previous knowledge also determine their success, making it extremely challenging to determine proper student placement in math classes. For some faculty, setting appropriate cut scores was not a top priority in terms of improving developmental education. One math faculty member put it this way:

> I'll say that for me that's a secondary concern. The primary concern is for us to make sure that our courses are teaching appropriate content; so one of the issues that, I guess we're starting to work on, that there is this big overlap of topics in elementary and intermediate algebra. (interview, math department chair, College H)

In general, faculty and administrators did not periodically review cut scores. It was only when faculty were dissatisfied with the quality of their students were cut scores examined. As one institutional researcher illustrated:

> They weren't happy with the cut scores obviously, that's why we had started the process, because they were getting a lot of students who weren't prepared or weren't able to complete the class. (interview, former director of institutional research, College C)

A review of placement criteria reveals that math cut scores vary substantially by college, despite the fact that some colleges benchmark cut scores against other colleges and teach essentially the same math curriculum. Table 1 shows cut scores used to place students who took the ACCUPLACER arithmetic test, one of three ACCUPLACER's subtests. From this data we learned that a student who took that test in College C and obtained a score of 35 would have been placed four levels below transfer. That same student would have been placed five levels below transfer at College B. We saw these same patterns for colleges using COMPASS and the MDTP. Differences in cut scores become less visible in the transfer-level subtests, irrespective of the placement instrument used. We suspect that these similarities may be grounded in the fact that transfer-level math courses are articulated to California's public universities and, thus, course standards are more uniform.

Faculty do not use a common method to measure the effectiveness of their cut scores on placing students in the appropriate math class. Methods typically examine perceptional data from student surveys and faculty surveys, anecdotal data, as well as quantitative data on student

TABLE 1
Cut Scores for Math Placement Based on ACCUPLACER Arithmetic Test

Placement Level	Cut Scores				
	College A	College B	College C	College D	College E
Five levels below transfer	< = 16	0	< = 21	< = 21	0
Four levels below transfer	< = 34	< = 64	< = 34	< = 59	< = 45.5
Three levels below transfer	< = 64	< = 81	< = 64	< = 99	< = 72.5
Two levels below transfer	0	0	0	< = 112	0
One level below transfer	0	0	0	> = 113	0
Higher referral	> = 65	> = 82	> = 65	0	> = 73.5

Note. Scores for each ACCUPLACER subtest range from 0–120. Data presented in this table are restricted to five colleges that used ACCUPLACER to assign students to developmental education between 2005 and 2007.

grades and completion rates. Roughly half of the colleges report comparing success rates between students who placed directly into a course versus those who acquired the prerequisite by passing the antecedent course. In sum, these evaluation techniques prevent faculty and administrators from determining the degree to which cut scores or student characteristics facilitate success or failure in the developmental math sequence.

On average, the student background questionnaire requires students to answer 20 questions, a restricted number of which are treated as multiple measures.[9] The multiple measure questions most frequently used ask students about the highest math level they passed in high school, the total number of years they took high school math, and the last time they took a math course. The least frequently used multiple-measure questions investigate the type of high school math courses students took, the amount of effort and time students intend to devote to studying math and doing math homework, and their students high school G.P.A. Stepping back, most questions counting as multiple measures assess a student's self-perception of their cognitive rather than noncognitive abilities.

Colleges vary in the number of multiple measures they use for placement, as well as the number of points they award through multiple measures. While one college used two multiple measures, another used six. Points awarded through multiple measures ranged from –2 to 5, suggesting that multiple measures at face value could hurt or benefit

students, particularly those whose test scores are located around a cut point. On the whole, faculty members could not explicate why they used certain multiple measures or why they assigned them little weight in determining placement. Many math chairs expressed that decisions about multiple measures were made before they became faculty.

Almost universally, matriculation coordinators, institutional researchers and faculty regarded multiple measures as insignificant and treated them as a matter of a legal compliance. Consider the following statement made by a math department chair:

> I don't really look at those. I know they're part of it and I know we have to do this. I personally am not an advocate of this necessarily . . . When we were going through all this, it really only amounts to a couple of points on the overall score so I thought, 'Let it go.'" (interview, math department chair, College B)

Despite the fact that faculty perceived multiple measures as inconsequential, research related to this project suggests that they in fact increase access to higher-level math courses without diminishing a student's chances of passing their first math class or the number of credit they accumulate (Ngo & Kwon, 2013; Ngo, Kwon, Melguizo, Bos, & Prather, 2013).

Consequences of A&P Policies on Testing and Placement in Math

We found that the majority of students across the nine colleges placed students in the two lowest levels of the developmental math course sequence (Figure 1).

Nearly two-thirds of students who assessed at one of the five ACCUPLACER colleges placed three levels below transfer or lower. Disaggregating the data by college, we found an inconsistent set of placement distributions across colleges (Figure 2). This is likely a consequence of the wide variation in cut scores. College D placed roughly 53% of its students four levels below transfer, whereas College I placed only 2% at that level. In some instances these variations can be interpreted as efforts to accommodate the curriculum to substantially different distributions of student math ability across the colleges. Although faculty reported wanting to teach classes with students of similar academic abilities, they disagreed on what types of placement policies can group academically similar students together. Some faculty advocated for retaining institutionally determined cut scores that accounted for unique characteristics of their student population; others said they support efforts to set common cut scores. As one math chair put it:

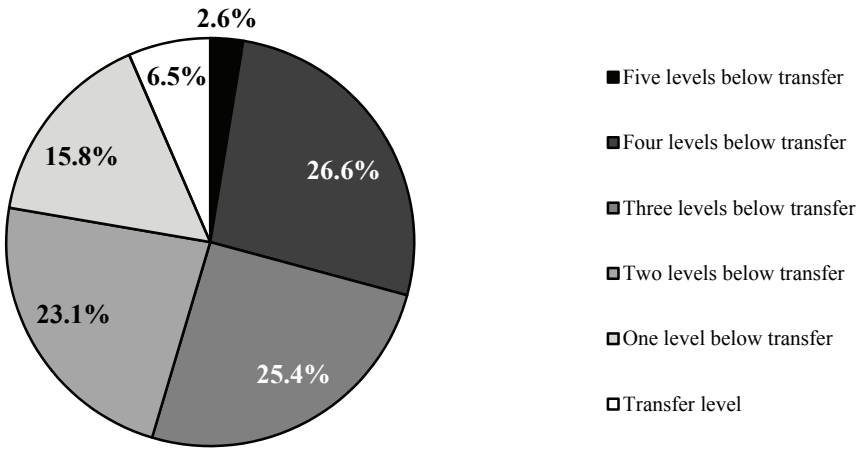

FIGURE 1. Placement by mathematics level, cohorts 2005–2007.

> I would love for us to be able to establish district-wide cut scores. And I'd like for us to be able to use success data in courses. You know, aggregate all the data we have. We know what your cut score was including the multiple measure. What your score is that said you placed into—you know, there's a range right if you place between—I don't know what the number is but like 52 to 67 you're in Math 115 right? What are the ranges? I don't buy the argument that the students at College J are so much different than the students at College G or College B or anywhere else in the district. Math is sort of math. (interview, math department chair, College D)

Another consequence of cut score disparities is the diversity of subtests students take for placement. Figure 3 shows the type of ACCUPLACER subtests used to place students in College A, by each course constituting the developmental math sequence. We found that roughly four out of five students placed two levels below transfer took only the Elementary Algebra subtest, 17% took the Elementary Algebra and College-Level Math subtests, and only 2% took the Elementary Algebra and Arithmetic tests. Because students can take multiple subtests as a result of an automatic or manual branching mechanism, faculty must predict how changing one cut score will move students of various academic abilities across multiple subtests.

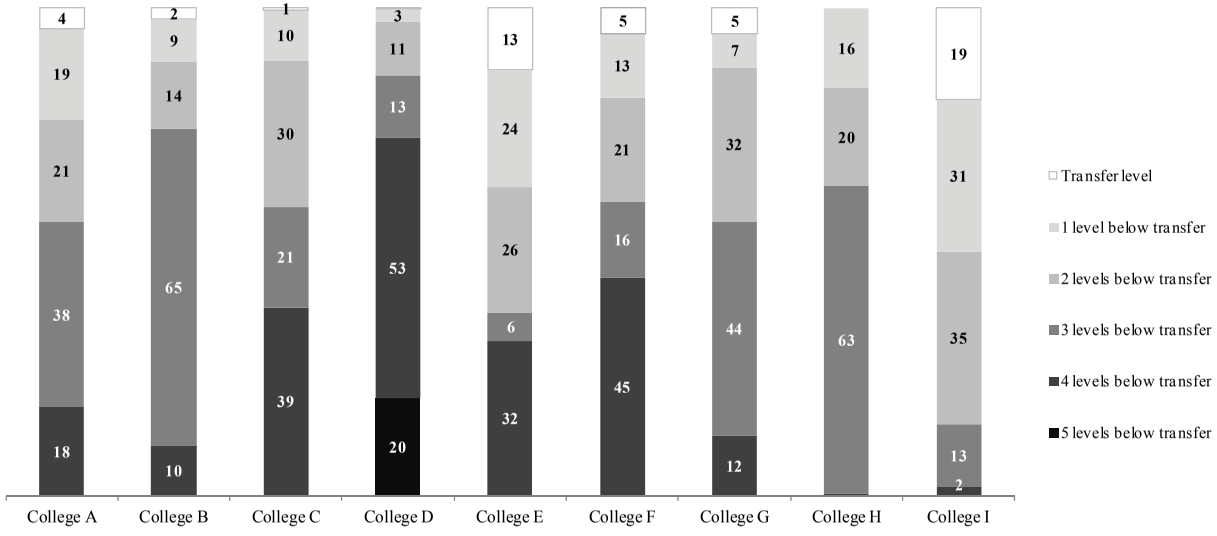

FIGURE 2. Distribution of placements in math for first-time assessed students (in %), cohorts 2005–2007.

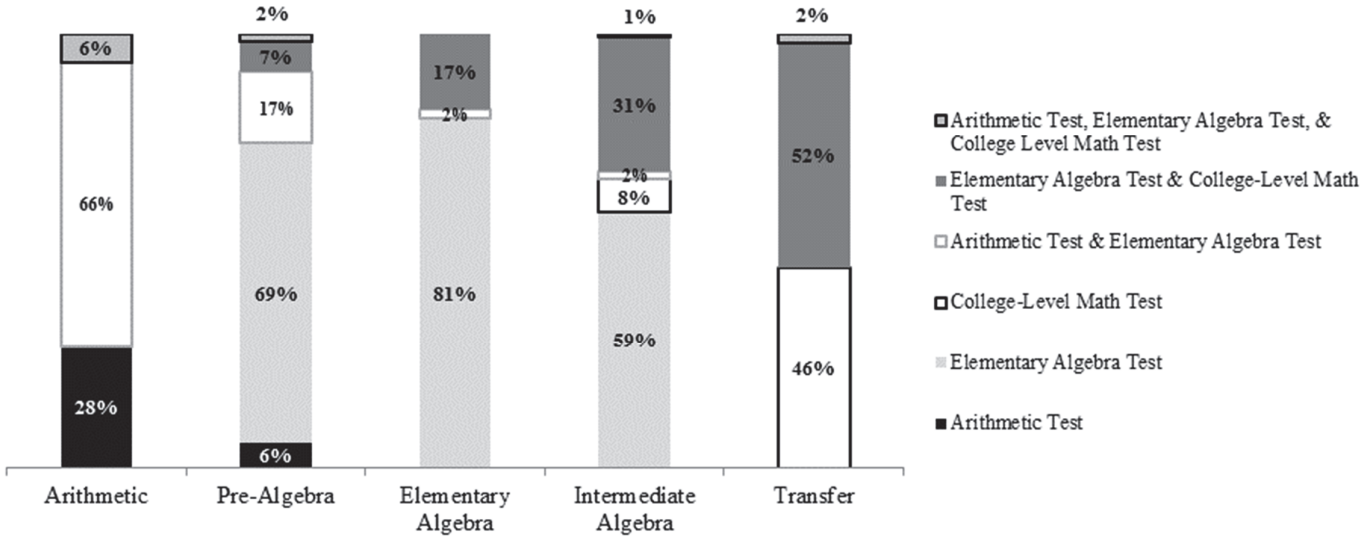

FIGURE 3. Distribution of math placement levels by ACCUPLACER subtests (in %): College A, cohorts 2005–2007.

Determining where cut scores should be located is the first step that faculty must complete to refine their placement process. Next, faculty must understand how multiple measures affect placement decisions. From our data, we found that of the total number of students assessed in ACCUPLACER colleges during the 2005–2006 academic year ($N \approx$ 17,800), only 1,028 students were awarded multiple measure points that moved them into a higher math level. That is, only 6% of all assessed students benefitted from multiple measures. Disaggregating that statistic by college and course level, we found that multiple measures can significantly impact a student's placement in some instances (Table 2). In College D, roughly 25% of students were placed three levels below transfer instead of four levels below transfer as a result of multiple measures. These students represented nearly 24% of all students placed three levels below transfer at this college. We found similar evidence in College C. While these statistics illustrate the largest impacts multiple measures had on moving students to a higher math level, we also found smaller impacts at other colleges, where 0 to 9% of students benefitted from multiple measures.

These findings contradict a common belief shared by math faculty that multiple measures are irrelevant to placement because they are worth only a few points. The little importance attributed to multiple measures may partially explain why they do not explore their validity in predicting student success. Nevertheless, some faculty had definitive views on what constituted ideal multiple measures, with roughly half reporting motivation and "life factors" as the best noncognitive measures to predict student success. Yet, faculty stated that they had little knowledge about how to estimate the relationship between multiple measures and student success. As one math faculty member explained:

> I don't know how to measure those things, and when I think about something like measuring motivation what comes to mind is I can see that a person is persistent, but that to me doesn't give me any feel for whether or not that will translate into effort in the classroom. (interview, math faculty, College H)

Consequences of A&P Policies on Enrollment in and Progress Through the Math Sequence

We found that approximately 10% of all students who were assessed did not attend at least one class in college; yet as the placement level increases this figure becomes smaller (Table 3). Whereas approximately 20% of students placed five levels below transfer-level math did not enroll in college within a year of assessment, only 6% of students placed

TABLE 2
Impact of Multiple Measures on Final Placement in Developmental Education: College C and College D

	Number of students initially placed into different levels of math sequence based exclusively on their test score	Percent of students moved from their initial placement level to a higher placement level due to multiple measures points	Percent of total number of students who placed into developmental math course as a result of multiple measure points
College C			
Five levels below transfer	1,644	17.8	--
Four levels below transfer	4,445	0.9	6.2
Three levels below transfer	1,151	1.2	3.6
Two levels below transfer	555	1.1	2.5
One level below transfer	149	0.0	3.9
Transfer level	19	--	0.0
Total	7,963	4.4	
College D			
Four levels below transfer	564	6.7	--
Three levels below transfer	162	24.7	23.8
Two levels below transfer	1,044	2.3	3.8
One level below transfer	1,983	0.4	1.2
Transfer level	523	--	1.3
Total	4,276	2.5	

TABLE 3

Post Assessment Enrollment Outcomes by Math Placement Level (in %); First-time Assessed Student Cohorts: 2005–2007

	Math Placement Level						
	5 levels below transfer	4 levels below transfer	3 levels below transfer	2 levels below transfer	1 level below transfer	Transfer level	Total
No enrollment within a year of assessment	19.2	15.0	10.5	7.6	5.5	5.0	10.1
Enrolled in other classes but not in math	21.4	18.0	15.4	13.7	11.8	13.9	15.2
Never enrolled in math	44.2	34.9	27.1	22.3	18.1	19.7	26.6
N	1,826	21,648	20,333	18,734	12,416	4,632	79,229

one level below transfer made the same decision. A similar pattern appeared when we focused on the relationship between placement and enrollment in math. We found that roughly 45% of students placed five levels below transfer never enrolled in a math course compared with 18% of students placed one level below transfer. Approximately 27% of all students assessed in math never enrolled in math. On the whole, our results convey a positive relationship between placement level and enrollment in college and math.

In addition, a student's progress through the math sequence increased considerably with a student's initial level of math enrollment. Figure 4 illustrates that only 2% of students whose first math class was arithmetic (e.g. four levels below transfer) successfully completed a transfer-level math course, whereas 70% of students whose first math class was a transfer-level math passed a similar level class over a three-year period. Only 28% of all students whose first math course was arithmetic completed it successfully. That figure increases to 35% for pre-algebra students, 36% for elementary algebra students, 42% for intermediate algebra students, and 70% for transfer-level math students.

Following Bailey, Jeong, and Cho (2010), these statistics may mean that students enrolled in lower math levels encounter factors that make it more difficult to succeed in developmental math than students enrolled in higher math levels. However, Fong, Melguizo, Bos, and Prather (2013) caution that this type of interpretation is based on the assumption that all community college students intend to transfer to a four-year institution and thus must complete the developmental math sequence. These authors suggest that a more accurate, nuanced interpretation of student progression ought to consider student's goals and whether they persisted in the course past the deadline for withdrawal.

Conclusions

Consistent with Safran and Visher (2010), we found that community college faculty and administrators are charged with the complex and difficult task of designing, implementing, and evaluating A&P policies for developmental education with little technical capacity. Using the LACCD as an illustrative case, we learned that colleges lack the resources and information necessary to decipher how each component constituting A&P policies works to facilitate or impede students from progressing in the developmental education sequence. In general, faculty and administrators possess little knowledge about which test works most effectively to place students, how to rigorously evaluate cut scores, and which multiple measures can adequately address short-

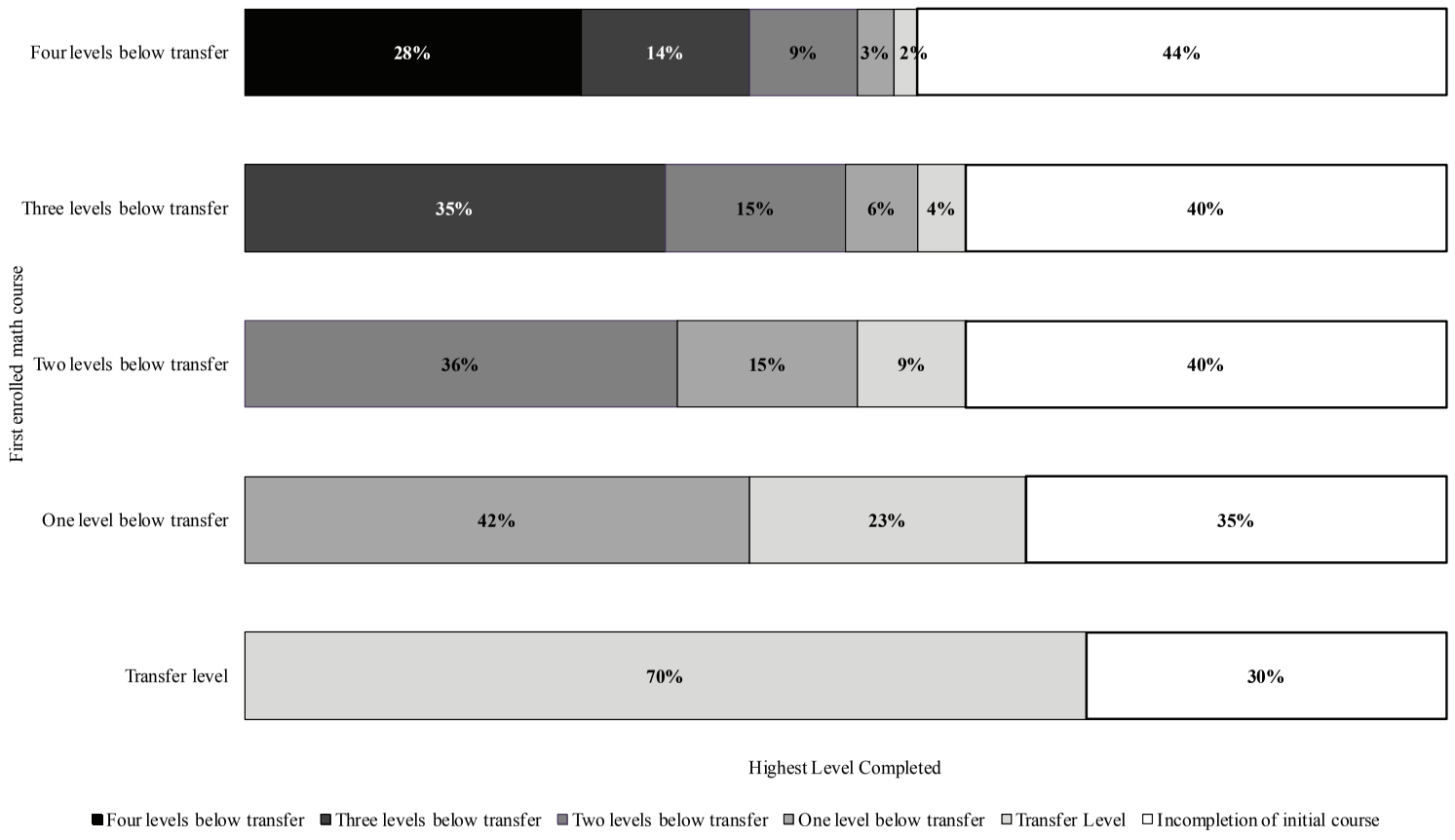

FIGURE 4. Highest level of successful math completion after three years of enrollment by first enrolled math course, cohorts 2005–2007.

comings inherent in current placement tests. The lack of state oversight also compromises how well institutional A&P policies sort students into academically appropriate courses. While we cannot say with accuracy that the manner in which colleges design A&P policies negatively impacts student success in college, the fact that students of similar ability levels place into different level courses at different colleges should be considered a cause for concern for researchers, policymakers, and practitioners.

In 2011, California passed Assembly Bill 743 as a first step to increase the effectiveness and efficiency of community college A&P policies. Supported by the Community College League of California, the Faculty Association of California Community Colleges, and numerous community colleges and districts, this bill requires the State to develop a common assessment system to determine if students are ready for college-level English and math. Under this provision, students will be allowed to transfer their test results to other colleges, reducing institutional costs associated with retesting. A.B. 743 also mandates the development of a statewide data warehouse, which will store information used to place students into developmental and college-level courses. Data collected by the state include student-level assessment results from placement tests and K–12 standardized tests (e.g. California Standards Tests—the CSTs, The California High School Exit Exam—the CAHSEE, and the Early Assessment Program—the EAP) as well as test cut scores. Use of these data by community college stakeholders has the potential to align tests with the Common Core[10] college readiness standards, which have been adopted by the state's department of education, and hold institutions to account for decisions they make about the multiple elements that make up A&P policies. Finally, the bill specifies that community colleges must design a website where students can access practice tests, information about assessment and rates of remediation by college, and a pretest application that allows students to take stock of their current level of preparation for college.

Since this initiative took effect in January of 2012, community colleges and higher education researchers have begun to work with school districts and state officials to develop a placement regime that increases student success in developmental education. For example, Long Beach City College recently established a partnership with the Long Beach Unified School District to collect and employ high school transcript data to assign their community college students to developmental English and math (Fain, 2013). Jaffe (2012) explored the extent to which the CAHSEE predicted a student's readiness for college-level coursework. Recent studies suggest that high school transcript and standardized test

data can sharpen the accuracy of placement results that stem from currently used placement tests (Jaffe, 2012; Long Beach College Promise, 2013).

While A.B. 743 contains policy components necessary to better identify which students really need developmental education to succeed in college, the success of this legislation will hinge on California's ability to guarantee institutional buy-in and cooperation. Absent sufficient funding, a strong constituency of institutional-level data users, and timely data collection and reporting will also likely undermine the effectiveness of A.B. 743 on improving A&P policies for developmental education. Our work has brought to light the complexities that emerge when granting community colleges discretion to design their own A&P policies without enough technical and financial support. Unless faculty, college administrators, and state officials work together to improve the current system, students will continue to take a substantial amount of time and in some cases progress at dismal rates towards completing the math prerequisites for an associate's degree or transfer.

Notes

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[1] The terms basic skills, developmental, remedial and preparatory math education are frequently used interchangeably. Our preferred terms are either developmental or preparatory math.

[2] We avoid using the term college-level because developmental courses can count towards an Associate's Degree, which is a college degree. We use "transfer-level" instead because these courses count towards a bachelor's degree.

[3] It is important to note that data used for this study stem from a period that preceded passage of A.B. 743. Because this bill has not been fully implemented due to budget constraints, community colleges still have a high degree of discretion in determining which students are assigned to developmental education.

[4] For a detailed description of the frameworks governing community colleges, please read Murphy, Neiman, & Hasbrouck (2012).

[5] Students enrolled in professional academies, concurrently matriculated in high school, and older than 65 were excluded from our analysis.

[6] Even though we conducted interviews in 2011, we asked stakeholders about A&P

policies used to assign students to developmental math between 2005 and 2007. Interviewees absent during this period were instructed to discuss current A&P policies.

[7] Disaggregated, we interviewed eight institutional researchers, nine math chairs, six matriculation coordinators, one vice president of student affairs, and one dean of student success. Only at three colleges could we not interview all three key players.

[8] Between 2005 and 2007, the computerized version of the MDTP was unavailable, therefore colleges using MDTP used the paper-and-pencil version.

[9] An example of a question used as a multiple measure: "What is the highest level of math that you have completed, with a grade of a grade of 'C' or higher"?

[10] The Common Core State Standards is an initiative to institutionalize nationwide curriculum standards in the areas of literacy and mathematics instruction.

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