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Is Developmental Education Helping Community College Students Persist? A Critical Review of the Literature

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Abstract

There is considerable debate about the effects and benefits of developmental/basic skills/remediation education in college. Proponents argue that it enables poorly prepared high school students to attain the necessary preparation to succeed in college while critics contend that the benefits of remediation are not clear. The main objective of the article is to provide a critical review of the literature on the impact of developmental math on the educational outcomes and persistence of community college students. The authors first describe three types of summative quantitative evaluations. The authors then review a number of studies that have used these techniques to evaluate the impact of developmental math on a number of educational outcomes of community college students nationwide. In the last section, the authors propose the use of regression discontinuity (RD) design as a feasible evaluation tool that institutional researchers at community colleges can use to identify the level (i.e., number of levels below college level courses), subpopulations (i.e., gender, race/ethnicity, and age), and institutions (i.e., multicampus district) that are doing a better job in teaching the developmental courses needed to persist in college.

Keywords

community colleges, remedial math, basic skills, evaluation

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A large proportion of the high school graduates who attend a postsecondary institution take at least one developmental/basic skills/remedial course in either mathematics or English.[1] Between 25% and 40% of first-year students at public 2-year colleges enroll in remedial courses (Parsad & Lewis, 2003; Spann, 2000). However, there is evidence from national longitudinal studies that this percentage might be even higher; according to transcript data, in the early 1980s about 64% of the students who started at a community college were assigned to remedial courses (Wirt et al., 2001). In addition, estimates suggest that by 1995 almost all public 2-year institutions offered remedial education and almost 75% of 4-year colleges offered at least one remedial course (Parsad & Lewis, 2003).

There is considerable debate on the effects and benefits of remediation in college. Proponents argue that it enables poorly prepared high school students to attain the necessary preparation to succeed in college (Lazarick, 1997), while critics contend that the benefits of remediation are not clear (Calcagno & Long, 2008). One of the major criticisms is that remediation is too costly. Estimates of the cost of remediation in community college vary considerably. Rough estimates presented by Breneman and Haarlow (1998) suggest that the annual cost is more than $1 billion for public colleges. However, according to Merisotis and Phipps (2000) this represents less than 1% of their total $115 billion budget. The cost of remediation is also incurred by the students. Recent estimates by Melguizo, Hagedorn, and Cypers (2008) suggest that despite the relatively low tuition and fee costs of community colleges in California, the real cost for students is the substantial amount of time that they spend enrolled before transferring to a 4-year college. Students with deep developmental needs who successfully transfer to a 4-year college spent on average 5 years before transferring and transferred only 1 year's worth of courses. In summary, a substantial number of students arrive to college with deep remediation needs, and the cost of remediation is high not only for the states, districts, and local governments that need to pay at least twice for a course that students should have taken in high school but also for the students who cannot progress toward a baccalaureate degree on time.

The main objective of the article is to provide a critical review of the literature on the impact of basic skills math on the educational outcomes and persistence of community college students.[2] We start by briefly describing three different summative quantitative evaluation techniques (i.e., descriptive, quasi-experimental, and experimental) commonly used to estimate the effect of basic skills math on student success. We then present a review of the evaluations that have used these techniques. The last section describes in detail the benefits and limitations of regression discontinuity (RD) and presents it as a promising evaluation technique for individual colleges and community college districts in the context of one of the recent largest basic skills initiatives in California. In the next section we briefly describe three summative quantitative evaluation techniques. We are aware that there are other qualitative or mixed-methods types of evaluations that are also promising. But for the purposes of this study we will only focus on summative quantitative evaluations.

Descriptive, Quasi-Experimental, and Experimental Design

After a thorough review of the literature we can identify three main types of summative evaluation techniques: descriptive studies, quasi-experimental design, and experimental design. For a thorough review of the statistical techniques for evaluation, see Schneider, Carnoy, Kilpatrick, Schmidt, and Shavelson (2007). In this section we briefly describe them and highlight their main advantages and limitations.

Descriptive Studies

Most of the descriptive or correlational studies usually compare the outcomes of students in basic skills with those who did not take basic skills. Their main limitation (and a reason why they produce inconsistent results) is that the results may be biased because of uncontrolled preexisting differences between students who take remedial courses versus those who do not (Bettinger & Long, 2005). The most common statistical procedures used to identify group differences are: *t* tests, chi-square tests, analysis of variance (ANOVA), and regression analysis. The main limitation of this type of evaluation is that due to preexisting differences and lack of appropriate controls, the estimates are likely to be biased. In addition, it is not possible to make any causal inferences.

Quasi-Experimental Design Studies

The studies that have used quasi-experimental design attempted to control for the preexisting differences between the students who take basic skills courses and those who do not. The most common statistical procedures used are: two-stage regression analysis with instrumental variables (Heckman, 1979) and propensity score matching (PSM) techniques (Dehejia & Wahba, 1999, 2002; Rosenbaum & Rubin, 1983; Winship & Morgan, 1999). The main advantage of two-stage regression analysis is that with an appropriate instrument (i.e., a variable that is related to the explanatory variable but not with the error term), and if properly implemented, this technique can substantially reduce the bias of the estimates. The main advantage of the PSM technique is that as Heckman, LaLonde, and Smith (1999) noted, nonparametric methods, if rigorously applied, force analysts only to compare comparable people. An additional advantage is that cross-section estimates based on matching, like experiments, balance the bias.

Experimental Design

Experimental design or randomized trials are the only design that enables the evaluator to fully control for the preexisting differences between the students (Campbell & Stanley, 1963; Rubin, 1974). The idea is to take a sample of individuals who do not differ significantly in background and academic preparation characteristics and randomly

assign them to the treatment (i.e., basic skill course) or the control (i.e., college-level course). By doing this the evaluator is removing the bias that arises when students with some characteristics that are difficult to control by the evaluator, such as being very persistent or motivated, decides to enroll in the remedial course. The main advantage of randomly assigning students is that it is possible to make causal inferences. One limitation of experimental design in this context is that it defeats the purpose of placement testing.

Similar to randomized control trials, one evaluation technique that also enables the researcher to do causal inferences is regression discontinuity design (Bloom, Michalopoulos, & Hill, 2005; Cook & Campbell, 1979; Lipsey & Garrard, 2007; Schochet, 2006). The primary purpose of this design is to eliminate selection bias. As mentioned earlier, the best remedy to control for the selection of students into programs and therefore to establish causality is randomization. Random assignment of students to different levels of math would make all unobserved and observed factors equal between control (nonremediated/nonparticipants) and treatment (remediated/participants) groups. However, such randomization is not feasible because as mentioned earlier, it would compromise math instruction and would defeat the purpose of placement testing. A regression discontinuity design replaces true random assignment with assignment according to an exogenously determined cutoff score on a continuous predictor variable. Specifically, RD design is the closest nonexperimental research design to a random assignment experiment in which a portion of entering students would be assigned to one level of math and a portion would be assigned to the next higher level. Finally, by focusing on students who score close to the cut point, RD design will most closely resemble a true randomized experiment as the actual underlying difference in the ability of those taking the tests will vary little within the study sample. In other words, many of the students who test below the cut point might have tested above on a different day or different test form and vice versa. Thus, the assignment to different math levels will be determined largely by testing error, not by differences in the actual underlying ability of the students taking the test.

The following section provides examples of the three types of evaluations described previously.

Existing Evidence of the Impact of Basic Skills Math on Educational Outcomes of Community College Students

The evidence of descriptive studies is mixed. In the early 1990s a number of evaluations were conducted by the National Center for Developmental Education (Boylan, Bliss, & Bonham, 1994, 1997). Boylan and his colleagues conducted an evaluation of a random sample of 160 2- and 4-year institutions. Within this sample they identified a random sample of students in developmental programs to test the effectiveness of these courses on first semester retention, GPA, and success in subsequent developmental courses. Their results for community college students in developmental mathematics showed that (a) retention rates in math were higher for students when remediation

placement was mandatory and (b) remedial math success rates were higher in programs where counseling was available and in programs engaged in evaluation of the educational outcomes of their students. Following these findings, Boylan (2002) identified 33 best practices for institutions to follow. These became the benchmarks that are currently used in a substantial number of evaluations at the institutional and state levels, including the California Basic Skills Initiative (CBSI). It is important to clarify that even though Boylan chose a random sample of institutions and a random sample of developmental students within these institutions, this is not a randomized control trials experiment because students selected themselves into the remediation courses. This is probably the largest nationwide study performed to date, but it did not attempt to address issues of selection.

In California, James, Morrow, and Perry (2002) compared the retention and success rates of a cohort of first-time freshmen in 1995 tracked for 6 years. They compared students who had been placed in basic skills with non–basic skills students. According to them, 37.7% of the basic skills students stated a goal of degree/certificate or transfer, compared to 31.1% for the non–basic skills students. Of those with stated goals, about 17.4% of basic skills students earned an associate's degree (AA) or certificate in 6 years, compared to 13.1% of the non–basic skills students. Finally, of those with stated goals, about 21% transferred to a 4-year institution in 6 years, compared to 27.5% of the non–basic skills students. These results are not surprising given that students with lower remediation needs were more successful in completing the college-level courses necessary to transfer. The findings of this study clearly illustrate the problem of using two nonanalogous comparison groups.

In terms of the effect of basic skills mathematics programs on student success on college-level mathematics, the results of three studies suggest that taking these courses makes no difference. O'Connor and Morrison (1997) found that developmental mathematics had no effect on students entering more advanced undergraduate mathematics courses. Similarly, Baxter and Smith (1998) found that participation in developmental mathematics courses does not lead to success in college-level mathematics. Waycaster (2001) also found no difference in a longitudinal study in five community colleges in Virginia. He compared the educational outcomes of students who had been placed in remedial math with those who enrolled directly in college-level courses. He found comparable success rates between students who had taken developmental courses and those who had been placed directly in college-level courses.

Finally, Adelman (1999), who tested the impact of taking more remedial courses on college completion, found a negative impact. He used data from the National Center of Education Statistics (NCES) to compare the graduation rates of students who had taken remedial courses versus those who have not and found lower graduation rates for the students who took more remedial courses. The wide disparity in the findings of these studies confirm that descriptive studies present conflicting evidence that makes it really hard to understand the impact of basic skills math on students' educational outcomes.

The evidence of remediation in studies that use more advanced quasi-experimental designs is limited. Attewell, Lavin, Domina, and Levey (2006) used the National Education

Longitudinal Study class of 1992 (NELS:88) to test the effect of remediation on students' educational outcomes. They used propensity score matching to better control for differences in students' observed characteristics. They found no negative effect of remediation on either certificate or AA degree completion, but they found that remediated students were 6% less likely to attain a bachelor's degree. Jepsen (2006) tested the effect of basic skills instruction on a sample of students from 12 community colleges in California. He compared students who had been assigned to basic skills through the conventional assessment process (i.e., placement test in combination with other transcript information) with those who enrolled in a basic skills course below the one assigned in their placement. He found that participation in remedial courses was positively associated with second term enrollment as well as completing transfer-level courses. He found that the positive effects of basic skills instruction were greater for non–traditional age (older) students. In a recent study, Doyle (2009) used student-level data from a 1995-2004 Tennessee sample to estimate the impact of increased academic intensity on community college student transfer. He used matching estimators to overcome the problem of selection of students. The findings revealed that taking 12 or more credit hours increased the probability of transfer by 11% to 15%.

Even though these studies used advanced statistical methods to control for heterogeneity in students' observed characteristics, the results could still be biased because the groups might have differed in terms of unobserved characteristics such as motivation or aptitude. There have been only a handful of studies that have used quasi-experimental techniques to explicitly control for the selection problem. Lavin, Alba, and Silberstein (1981) exploited a change in the admission policies at the City University of New York (CUNY) to test the effect of remediation on educational outcomes. They found that success in remedial courses increased persistence to the following academic year by 7% to 8%. In addition, success in basic skills courses increased the probability of transfer to a 4-year institution by 2% to 3%.

Bettinger and Long (2004) found negative effects of remediation on the outcomes of students at nonselective 4-year colleges and universities in Ohio. To account for selection bias, they used a variation in remediation placement policies across institutions and distance from high school to college as instruments for placement in remediation. The results suggested that placement into remediation increases the likelihood of dropout or transfer to lower level courses. In a subsequent study, Bettinger and Long (2005) used data from the Ohio Board of Regents (OBR) to explore the effects of remediation on a 1998-2003 sample of first-time community college students. They found that students in remediation performed as well as similar individuals who did not enroll in remedial courses. They also found that math remediation appeared to improve some of the students' outcomes. Despite differences in the findings reported previously, it is important to note that the populations of these studies were different. Therefore, the differences between the studies in New York City and Ohio might be reflecting that CUNY was doing a better job than 4-year nonselective institutions and community colleges in Ohio in providing basic skills.

Finally, Abou-Sayf (2008) reported the findings of a one-semester experiment at Kapiolani Community College in Honolulu, Hawaii. Instructors in the college decided to voluntarily waive the mathematics and English prerequisites from 12 courses in the community college in fall 2006. The study compared the enrollment rates, GPA, and persistence rates of these students with an analogous group in fall 2005. The findings suggest that waiving of the mathematics prerequisites led to an increase in enrollment in the target courses. According to the author, an unexpected finding was that there was no difference in the performance of the students. These findings suggest that there is no evidence that the enforcement of prerequisites leads to improved performance. However, the author argues that the lack of difference might be explained by changes in the grading practices of the voluntary instructors.

Regression Discontinuity

As described previously, it is not possible to evaluate basic skills doing a randomized control trial since it would defeat the purpose of placement. The technique that enables the researcher to make causal inferences is RD design. In recent years a handful of studies have used this evaluation technique to evaluate basic skills in individual colleges and statewide systems. Lesik (2006) used regression discontinuity design to estimate the effect of a developmental mathematics program on student success in college-level mathematics for a sample of students in a single 4-year college in the Northeast. Her results suggest that participating in a developmental program significantly increases the odds of passing a college-level course on the first try.

Two recent studies that analyzed state-level data from Florida and Texas using regression discontinuity design did not find a positive impact of remediation in passing college-level courses and degree attainment. Scholars (Calcagno, 2007; Calcagno & Long, 2008) used a unique data set from the Florida department of education to test the effect of basic skills instruction on college course passing rates and transfer rates of community college students. These studies used a large sample of 140,000 students. They found a positive effect of remediation on the likelihood of enrolling in the following fall term for students on the margin of passing the cutoff. However, no significant differences were found in terms of passing first college-level courses, associate's degree completion, or transfer rates. Martorell and McFarlin (2007) analyzed a large sample of community college and 4-year college students in Texas using regression discontinuity design in the early 1990s. They found limited evidence of a positive effect of remedial math on persistence and educational outcomes. They also concluded that aside from weak evidence that remediation improves the grades received in college-level math courses, there was little evidence that students benefit from remediation. In summary, the results of the two recent state-level evaluations suggest major problems with the current state of basic skills in Florida and Texas.

However, these results are probably masking course-, subpopulation-, and institutional-level differences. In other words, some community colleges might be doing a better job in the provision of the basic skills courses that are just below the college-level courses than the courses that are the high school prerequisites. In terms of group differences, some subpopulations, like the older students in the Jepsen (2006) study, might be benefitting more than traditional age students. Some community colleges might be doing a better overall job in their basic skills sequences that is reflected in greater student success in either passing to the next level, passing a college-level course, or transferring to a 4-year college. In the next section, we describe the promises and limitations of this evaluation technique.

Regression Discontinuity Promises and Limitations

One of the main advantages of regression discontinuity is that it is an intuitive technique that is easily understood by a lay audience, and it enables the evaluator to make causal inferences. This is a useful technique for institutional researchers at the institutional, district, and state levels because they have access to large longitudinal samples of students that guarantee the statistical power necessary to implement the evaluation. If properly implemented, this evaluation has the potential of identifying specific colleges that are doing a good job in providing basic skills. This is a technique that also enables the researcher to look at different outcomes of interest. For example, a college might be doing a good job with basic skills in terms of success in the subsequent college-level course, but the college might still have dismal transfer rates. This is a very important piece of information because it will enable the college to focus efforts and direct resources toward enhancing the college-level courses. Similarly, RD design with sufficient sample sizes enables the researcher to look for differences by gender, race/ethnicity, or age. Once again, being able to identify the populations that are facing greater challenges is a very useful policy tool.

Despite the advantages of this technique, there are many obstacles to its implementation. The first is the issue of compliance: Do students who are assigned to remediation follow the recommendation? Even though this is a significant concern for this design there are some variants of RD (i.e., fuzzy regression) design that address this problem. Second, if colleges enable students to retake a placement test, this compromises the validity of the design, constituting a major threat to validity because it changes the assignment process. Savvier and more motivated students will probably end up in the higher level courses, thus biasing the estimates of the evaluation.

Discussion and Recommendations

The review of the literature suggests that current evidence on the state of basic skills math in the United States is contradictory and mixed at best. There is evidence that this is a large and probably growing problem that is costly for the states (Breneman & Haarlow, 1998), as well as the students and their families (Melguizo et al., 2008).

In the next part we briefly describe the California Basic Skills Initiative and how RD is a promising evaluation technique for colleges, districts, and the state.

California is currently undergoing a major statewide initiative to strengthen the delivery of basic skills courses.[3] The CBSI was a result of three major events. First, the California Community College Board of Governors (BOG) adopted a new strategic plan in 2006 with basic skills as a key component to achieve student success. Second, the BOG approved statewide minimum English and mathematics graduation requirements for associate's degrees for all students entering in fall 2009. Third, the academic senate for California Community Colleges (CCC) and the state instructional and student service officers presented the CBSI to the CCC chancellor. The total funds allocated to support the initiative in the past 3 years are approximately $100 million (California Legislative Analyst Office, 2008).

The CBSI is definitely the largest statewide initiative to address this growing problem. This is an unprecedented effort that is providing substantial state administrative support as well as additional funding for all the community colleges in California. We believe that RD can be a very useful tool to be employed to evaluate this initiative. As described previously, it can be used by individual colleges to identify course levels and student populations who benefitted from changes in the courses that resulted from the initiative. It can also be used by the districts to make comparisons between institutions. Finally, at the state level, regression discontinuity design could be used as an ex post evaluation tool of the whole CBSI initiative. Given the substantial amount of resources invested under one of the most difficult economic times for the state economy, it would be important to test whether the institutional support and resources provided by the California chancellor's office translated into student success in basic skills.

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Notes

1. We use the definition of *basic skills education* used in California community colleges. They use this term to refer to courses that are two or more levels below transfer and include English as a Second Language (ESL) courses. We use the terms *basic skills* and *developmental* and *remedial education* interchangeably.

2. For a more detailed review of the literature, see: Boylan and Saxon (1999), O'Hear and MacDonald (1995, 1996), and Research and Planning Group of California Community Colleges (2005).
3. For a thorough description of the initiative, see Illowsky (2008) as well as the Web page of the California community college chancellor.

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