Are College Rankings an Indicator of Quality Education? Comparing Barron's and TEDS-M

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Abstract Although students at more selective schools generally demonstrate greater academic performance, it is unclear whether the gains from attending an elite postsecondary institution are due to the quality of educational services provided, or merely from peer and/or selection effects. Employing data drawn from the US-TEDS study, we assess the relationship between college selectivity and the mathematics learning of future teachers controlling for previous SAT scores using two different models. In an institution-level analysis, gains in student knowledge are measured by the difference between standardized SAT scores and standardized mathematical content knowledge (MCK) scores. In a multi-level model institutional and student-level data are used to examine the effects of selectivity on MCK scores, including measures of course-taking and prior achievement. In both analyses we find that college selectivity has little relationship with added mathematical knowledge.

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1 Background

A handful of colleges and universities sit as the uncrowned princes of the U.S. system of higher education. With enormous endowments, renowned faculty, and international prestige, there is no question that a comparative handful of institutions—most of them private—stand above the rest. These colleges are highly selective, such as the prestigious Ivy League schools, which have an average acceptance rate of under ten percent.[1] They attract of preponderance of the highest-achieving high school graduates, as evidenced by the average SAT scores of incoming freshman (Hoxby 2009). And, as many of the top schools are private, they tend to be much more expensive to attend: the total charges (including tuition and fees) for in-state four year public colleges in 2010 was $16,000 per year, less than half of that of private non-profits at $37,000 (Baum and Ma 2010).

What is less clear is what these bright students and their families are getting for their money. At first blush this might seem a rather odd question. After all, students at elite institutions of higher education tend to graduate at a higher rate, are more likely to pursue advanced degrees, have more prestigious careers, and earn higher salaries than students at other universities (Carnevale and Rose 2003). The disproportionate rewards accruing to students at top colleges have aroused a great deal of concern due to their underrepresentation of women, minorities, and those from families of modest means.

However, simply because graduates of the best schools do rather well in life tells us little about the quality of education they have received. First, it should be remembered that education is in part a positional good (Hollis 1982): one need not learn a great deal, only more than one's competitors. Higher incomes associated with having gone to a Harvard or Yale are not necessarily an indicator of having received an objectively excellent education, only that their graduates' educations are deemed superior to that obtained by others elsewhere. Second, the very privileged status of those entering the most prestigious schools raises doubts about the rigor of the instruction provided.

The success of those graduating from elite colleges could simply be an instance of selection bias: they attract the best students in part through reputation and price signaling, so it should not be surprising that their alumni do rather well. These postsecondary institutions provide superior social networking advantages and peer effects, real benefits to be sure, but hardly indicators of a strong curriculum. There is every possibility that students at the most selective postsecondary institutions would do just as well having gone somewhere else. These considerations raise the question: is the selectivity of a college necessarily an indicator of the quality of education received?

[1] Calculated from data presented in Dell (2011).

The difficulty to date in judging the quality of higher educational institutions is that the most common metrics are selectivity measures like acceptance rates, input measures such as SAT scores, and outcome measures such as wage and career data. What has been lacking thus far are measures of the *value added* by these schools. In other words, we need a way of determining how much additional knowledge has been gained by students in a given educational program in comparison with other programs.[2]

From the U.S. Teacher Education Study in Mathematics (TEDS), we now have such information. The TEDS yields empirical data on the educational experiences and content knowledge gains of a nationally representative sample of future teachers prepared at a wide variety of institutions. By combining data from the TEDS study with college selectivity measures—specifically the respected Barron's college rankings—it is now possible to estimate the degree to which selective schools provide a superior education, at least in one academic discipline. Other studies, such as that of Arum et al. (2011), examined learning gains across disciplines using generic measures of cognitive ability such as critical thinking that may or may not be appropriate to specific majors. The virtue of the TEDS study is that it focuses on only one—those preparing to become teachers of primary and early secondary mathematics—which permits specific assessments of content acquisition. In this paper we focus on future lower secondary teachers.

2 Study Design & Preliminary Analysis

The data for this research were gathered from two main sources: the Barron's College Admissions Selector Rating, generously provided by Barron's, and the results of the U.S.-TEDS study. By examining the relationship between student academic achievement and content knowledge with college selectivity, we can examine the value added by attending a given institution of higher education. We perform this analysis both at the institutional and student level. If "selectivity" truly does connote a higher quality education, students who attend elite schools should perform much better than students at other schools, *controlling for the students' prior academic achievement*.

Probably the most commonly-used measure of college selectivity is the Barron's index, published every year in the Barron's Guide to the Most Competitive Colleges (College Division of Barron's Education Series 2006). The index has been used by many researchers studying college selectivity. Barron's has even partnered with the U.S. National Center on Educational Statistics to offer a publicly available longitudinal database. The Barron's College Admissions Selector Rating classifies colleges

[2] The use of the term "value added" is not to be confused with the quite different "value-added models" that are in widespread use as measures of school and teacher quality in U.S. K-12 education.

Table 1 The College Admissions Selector Rating indicates the degree of competitiveness of admission to the college, with examples[a]

Barron's Rating	Examples
Most Competitive (10)	Harvard, Northwestern University, University of North Carolina-Chapel Hill
Highly Competitive^{+} (9)	University of California, Berkeley, University of Illinois
Highly Competitive (8)	Pennsylvania State University, University of Wisconsin
Very Competitive^{+} (7)	Rochester Institute of Technology, University of Maryland
Very Competitive (6)	Michigan State University, Indiana University, Purdue
Competitive^{+} (5)	Illinois State University, University of Colorado—Boulder
Competitive (4)	San Diego State University
Less Competitive (3)	California State University
Non-Competitive (2)	University of Toledo
Special (1)	New England Conservatory of Music

[a]College Division of Barron's Education Series (Ed.). Barron's Profiles of American Colleges: 2007 (27th ed.). Barron's Educational Series, Inc., p. 252, Hauppauge, NY (2006)

into ten categories, with the most selective colleges receiving a rating of 10 and non-competitive schools a rating of 2, with specialty institutions assigned a coding of 1. Table 1 presents the ten categories, with examples.

Sponsored by the International Association for the Evaluation of Educational Achievement (IEA), the same organization that conducts the TIMSS study, the TEDS was conducted as a follow-up to the "Mathematics Teaching in the 21st Century" (MT21) study in multiple countries, including the United States (Schmidt et al. 2011). In the U.S., nine hundred future lower secondary teachers in their final year of preparation at eighty-one postsecondary schools completed a questionnaire about their personal backgrounds, pre-collegiate educational experiences (including SAT math scores[3]), the types of coursework and field experience they received at their preparatory institution, and their beliefs about and attitudes towards teaching mathematics. They also took the lower secondary version of the Future Teacher Mathematical Content Knowledge (MCK) test assessing their knowledge of mathematical topics on key domains. Additional surveys were directed towards institutional administrators and faculty to glean information about the course curriculum and minimum requirements, among other items.

Although the precise metric employed in the Barron's Selector Rating is privileged information, it is quite likely that the SAT scores of incoming freshmen are an important component. In Fig. 1 we present a scatterplot with the standardized SAT score on the x-axis and the 2 through 10 Barron's rating on the y-axis ("special" schools coded 1 are excluded from our analysis because they do not prepare teachers), with each plot representing the mean of each institution.

[3]Some institutions reported only ACT scores, which were transformed into equivalent SAT scores.

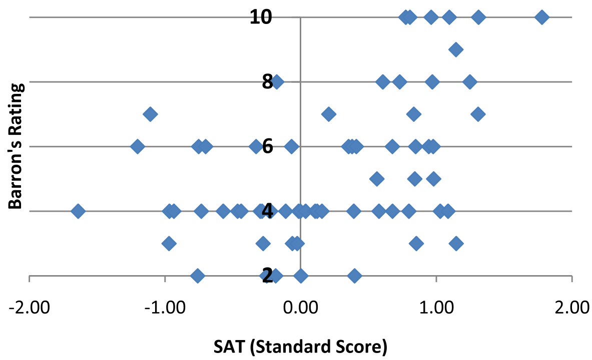

Fig. 1 Barron's selector rating vs. SAT

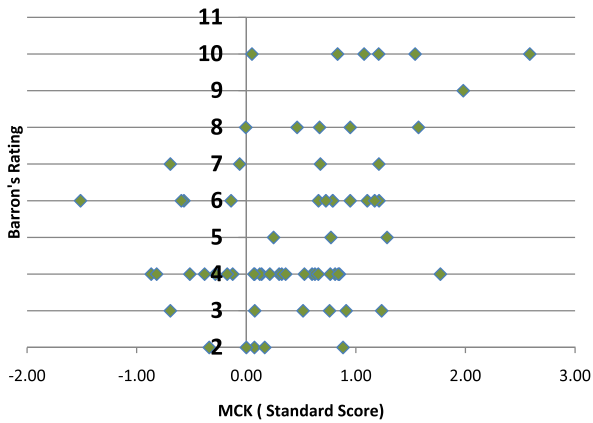

Fig. 2 Barron's selector rating vs. MCK

This spatial representation confirms that there is a relationship between the selectivity of the school according to the Barron's ranking and the quality of the student population, at least among those who intend to become lower secondary mathematics teachers. The relationship is a modest one, however, with a bivariate correlation of 0.48, which could be because the Barron's ranking presumably considers the quality of the entire student body, not just future teachers. It is somewhat surprising that the relationship between institutional ranking and incoming SAT scores isn't higher, given how fierce the competition is for slots at elite colleges.[4]

There is also a relationship between the Barron's ranking and the quality of the student body exiting postsecondary institutions, as measured by the mathematical content knowledge (MCK) of future teachers who are close to graduating from lower secondary teacher preparation programs. This relationship is presented in Fig. 2, with a modest correlation between institutional ranking and performance on the MCK test of 0.40. On the surface these results might lead one to believe that more

[4]One possibility is that those entering teacher preparation programs in less competitive schools have higher SAT scores relative to their institution, while those preparing to become teachers at competitive schools have lower relative SAT scores.

selective schools do in fact produce better-trained future teachers. However, because there is every reason to expect that students who perform well on the SAT would also receive a good score on the MCK, the apparently superior performance of students from prestigious schools might therefore be a case of selection bias.

3 Selectivity and Program Quality

A more accurate measure of the educational rigor of a given program can be found by comparing the performance of an institution's students on the SAT and the TEDS-M MCK. SAT mathematics scores serve as the measure of a student's preparation in mathematics before they enter a teacher preparation program, while the MCK score is a measure of a student's knowledge near the completion of that program. If an institution's students perform relatively better on the MCK than on the SAT, then we can infer that the teacher preparation program added a something to its future teachers' store of mathematical knowledge. However, if student inputs (SAT) and outputs (MCK) are equivalent, then we should question how much added value that program provides.

Figure 3 relates student performance on the MCK to scores on the math portion of the SAT, with both measures standardized so that they are on the same scale. The plots themselves are displayed in nine different shapes representing the nine different levels on the Barron's selectivity scale. Open shapes indicate more selective schools and closed shapes less selective schools. Since both the SAT and MCK are measures of mathematical knowledge, there is a strong correlation between the two (0.78)—students who do well on one test tend to do well on the other test. The forty-five degree line in the center of the figure represents an exact correspondence in the performance of an institution's students on the standardized SAT and MCK—in other words, that on average students demonstrated no *relative* gains in mathematical knowledge during their teacher preparation program. The further above the line an institution is, the greater the relative average learning gains for its students.

As is clear from the graph, the average student at most of the eighty-one institutions in the sample registered learning gains in MCK during their college years.[5] However, there is no clear relationship between the selectivity of the institution and relative improvement on MCK assessments. There are a substantial number of institutions ranked low on the Barron's index which nevertheless are located above the line, and some of the more selective institutions fall below the line, indicating that their students actually performed less well relative to comparable students at other schools after four years of college education.

[5]Part of this increase may be due to differing sample populations. The SAT is normed on the U.S. population, while the MCK is normed internationally. As the U.S. average on the MCK is slightly higher than the average SAT math score, part of the difference in performance between the two exams is based on that higher average. This likely contributes only to a modest proportion of the overall score gain, however.

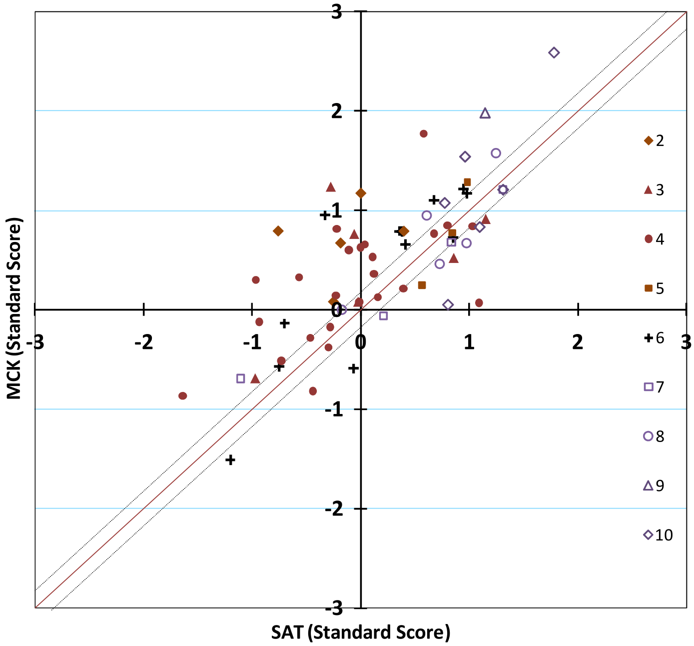

Fig. 3 SAT vs. MCK by Barron's ranking

The quadrant in which the institution is plotted also reveals information about the quality of the students attending each type of college or university. Those institutions in the top right quadrant recruit high-quality students who also do well on the MCK, with those above the line posting increases in relative performance. Although the highest-performing institutions are relatively selective, there are nearly as many lower-ranked schools that also recruit bright students who exhibiting greater relative performance on the MCK.

Given their selectivity, why aren't the average SAT scores at selective schools not all grouped in the upper right quadrant? And why isn't there a stronger relationship between selectivity and SAT scores? Although we can only speculate, it is possible that, of those interested in becoming teachers, the "best and brightest" students as measured by SAT scores are not attracted to more selective schools. Given their great expense, students instead choose to attend less selective state public schools. State schools are designed with state teaching credentials in mind, which might not be the case for private schools.

Additionally, the salary for teachers is low compared with that in other professions that have comparable educations. As a consequence it might make little sense from a strict cost-benefit perspective to obtain a very expensive degree from a private institution. As this study is focused only on future lower secondary mathematics teachers, the results should not be analogized to other disciplines, or to any class of universities as a whole. There is every possibility that the Barron's rankings are more

Table 2 Quality indicator by simplified Barron's selector categories

	Level 1: Less Selective	Level 2: Selective	Level 3: Very Selective	Level 4: Most Selective
Above Quality Baseline	16	41	32	11
On/Below Quality Baseline	19	39	32	10

(Cells indicate number of institutions in each category)

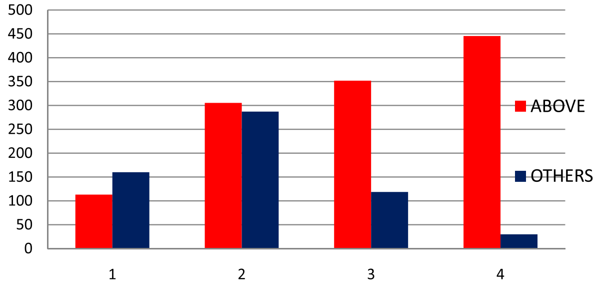

Fig. 4 Required course hours in mathematics by Barron's selector categories

strongly correlated to SAT scores for the whole student body, or that different programs at elite schools might demonstrate larger increases in relative performance.

Because of the small number of institutions in the sample and to reduce the number of interaction terms, we collapsed the competitiveness ratings into four broader categories: Level 4 Most Selective (Most Competitive and Highly Competitive +), Level 3 Very Selective (Highly Competitive, Very Competitive +, and Very Competitive), Level 2 Selective (Competitive + and Competitive), and Level 1 Less Selective (Less Competitive and Non-Competitive). Table 2 presents a simplified representation of Fig. 3 indicating the percentage of institutions in each category, with "above" referring to institutions whose average performance is greater than the baseline, which suggests that students attending those institutions have increased their relative knowledge of mathematics, and "on/below" referring to those institutions whose students have experienced no increase or have even fallen behind their peers at other institutions.

If we define a "high-quality" teacher preparation program as one whose students score more highly than their entrance examination scores would predict (and "low-quality" as those whose relative performance is lower), then it becomes clear that there is *very little relationship between the college selectivity and program quality*, at least in the field of lower secondary mathematics education. At each level of selectivity, a roughly equal proportion of institutions are above the baseline as on or below it.

An analysis of institutional data drawn from the US-TEDS study suggests that there are important differences between "high-quality" and "low-quality" teacher education programs, independent from institutional selectivity. In previous work (Schmidt et al. 2002, 2011), we have argued that a rigorous mathematics curriculum is essential for learning mathematics for both students *and* future teachers. As indicated in Fig. 4, high-quality teacher education programs—those whose stu-

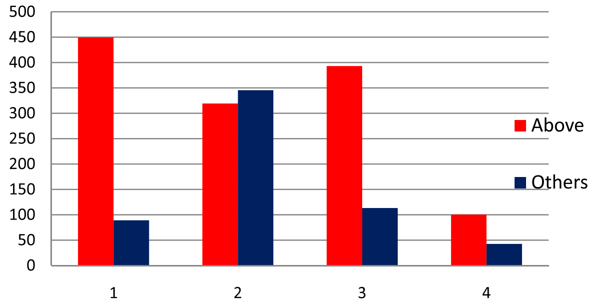

Fig. 5 Required course hours in general studies by Barron's selector categories

dents MCK scores are much greater than their SAT math scores—share a common emphasis on mathematics coursework. Although the proportion of required math courses increases with college selectivity, the difference between high-quality and low-quality selective institutions in the number of math courses is particularly pronounced. The main dividing line in program quality is *not* school selectivity. There also appears to be a tendency for higher-quality but low selectivity institutions to focus more on general studies course requirements, while high-quality and high-selectivity institutions emphasize mathematics classes (see Fig. 5).

The last stage of our examination of the relationship between college selectivity and college quality in lower secondary mathematics teacher preparation programs is a more rigorous statistical analysis using multi-level modeling techniques. The data is drawn from the US-TEDS institutional and student survey and includes both individual level variables measuring previous academic coursework (high school mathematics coursework and score on the SAT) and postsecondary training, as well as program-level indicators of course requirements, selectivity, and mean SAT scores (see Table 3). The dependent variable is the student's score on the MCK. The interaction terms are formed from two categorical variables: the simplified Barron's ranking of selectivity and whether the teacher preparation program was classified above or on/below the line of equal input and output.

High-selectivity institutions whose students perform above the baseline serve as the reference category. If selectivity is a proxy for quality, then we should expect school selectivity to relate to individual-level achievement (although it is clear from Fig. 3 that not all selective schools are "high-quality" in terms of improved relative performance). Alternatively, a strong impact from specific institutional features (such as coursework requirements) or average school outcomes (defined as being above or below the baseline) would imply that the design of the teacher program is related to student knowledge gains, i.e. that curriculum matters. Finally, stronger effects due to student characteristics (the average SAT score) would suggest that students who know relatively more entering teacher preparation programs gain relatively more knowledge by the time they graduate.

The results of the multi-level model are presented in Table 3. Predictably, individual student background is strongly associated with performance on the MCK, with students taking more advanced high school mathematics courses and with higher SAT scores earning better MCK results. This is an individual level relationship

Table 3 Predicting MCK by selection & course indicators

Source	Est	(se)	$p<$
Intercept	193.54	57.28	0.001
Future Teacher Level[a]			
Highest Mathematics Course Taken in High School	11.87	1.97	<0.0001
College Entrance Mathematics Score	0.14	0.02	<0.0001
Advanced Mathematics OTL Exposure	5.31	1.27	<0.0001
Program Level			
College Entrance Mathematics Score	0.53	0.09	<0.0001
Number of Required Math Course Hours	0.04	0.01	0.0119
Advanced Mathematics OTL Exposure	12.63	4.82	0.0101
Less Selective & At/Below Baseline	−41.60	17.54	0.0196
Less Selective & Above Baseline	−10.32	18.15	0.5711
Selective & At/Below Baseline	−43.83	15.48	0.0056
Selective & Above Baseline	−21.61	16.94	0.205
Very Selective & At/Below Baseline	−49.27	14.72	0.0011
Very Selective & Above Baseline	−30.15	15.47	0.054
Most Selective & At/Below Baseline	−47.73	19.5	0.0161
Most Selective & Above Baseline	Reference category		

[a]Variables centered on program means

which holds across all institutions. Most relevant for the present study, the only variables that fail to achieve statistical significance are the interactive terms for selective, high quality institutions (those that are on average above the baseline). Students attending institutions whose future teachers on average experienced relative knowledge gains in mathematics did no better if they went to a selective school, controlling for other factors. Similarly, future teachers at low-quality institutions did about the same no matter how selective their institution, performing forty to fifty points worse on the MCK than those at high-quality, high-selectivity schools, again controlling for other factors.

Each of the other institutional characteristics had a statistically significant and positive relation with student MCK scores. Students at institutions with higher average SAT scores tended to receive a higher MCK score. The curriculum of the teacher preparation program was also associated with better outcomes on the MCK, with both required number of course hours in mathematics and the average hours in advanced mathematics courses taken by future teachers demonstrating a statistically significant relationship. Students with more coursework also tended to have higher scores.

One key outcome of our analysis is that institutional and program-level factors appear to play a greater role than individual-level characteristics. Although they are statistically significant, the coefficients for student-level SAT performance and number of advanced math courses are substantially smaller than the coefficients representing the institutional mean for SAT or advanced math coursework. The association with MCK scores was more than twice as great for the institutional average in the number of advanced courses than individual student behavior (12.63 vs. 5.31), while coefficients for mean SAT scores were more than triple that of individual student scores on the math section of the SAT (0.54 vs. 0.14). We can only speculate precisely how institutional average SAT scores influence individual MCK scores, for example through peer effects or the ability to devote more time and resources to advanced preparation. More clear is that curriculum and institutional design is strongly related to how well future teachers are grounded in mathematics.

4 Conclusions

The top schools in the U.S. hold their status for a reason, not least of which is that students and faculty compete fiercely to become part of them. However, rankings such as those generated by U.S. News & World Report or Barron's tell us more about the reputations of those schools than about their ability to deliver a high-quality education. Any easy attributions about the worth of a postsecondary institution are confounded by the problem of selection bias.

In the instance of teacher education this problem is particularly severe, with consequences both for prospective teachers and for the educational system as a whole. Starting teachers in the United States make approximately 80 % of per capita income, much less than similarly educated professions. Attending an expensive private institution makes little sense unless it comes with a commensurate reward. Our study suggests that in many cases those interested in teaching mathematics might be better served by attending less expensive, less exclusive public institutions. More importantly, the greater importance placed upon teacher quality by policymakers makes it imperative to identify the best models of teacher preparation, most especially in mathematics. Our analysis makes it clear that we will not be able to find those models simply by examining the course requirements at Ivy League institutions. We will need to do the careful work of examining a broad range of institutions, with close attention paid not to what sort of students attend a program but what sort of teachers they are when they graduate.

References

Arum, R., Roksa, J., & Cho, E. (2011). *Improving undergraduate learning: findings and policy recommendations from the SSRC-CLA longitudinal project*. Brooklyn: Social Science Research Council.

Baum, S., & Ma, J. (2010). *Trends in college pricing 2010*. New York: College Board.

Carnevale, A. P., & Rose, S. J. (2003). *Socioeconomic status, race/ethnicity, and selective college admissions*. New York: The Century Foundation.

College Division of Barron's Education Series (Ed.) (2006). *Barron's profiles of American colleges: 2007* (27th ed.). Hauppauge: Barron's Educational Series, Inc.

Dell, K. (2011). *2011 college admission rates: the toughest season ever. The daily beast*. http://www.thedailybeast.com/articles/2011/02/24/2011-college-admission-rates-rankings-for-30-schools.html. Accessed 28 September 2011.

Hollis, M. (1982). Education as a positional good. *Journal of Philosophy of Education*, *16*(2), 235–244.

Hoxby, C. M. (2009). The changing selectivity of American colleges. *Journal of Economic Perspectives*, *23*(4), 95–118.

Schmidt, W. H., Blömeke, S., Tatto, M. T., Hsieh, F.-J., Cogan, L. S., Houang, R. T., & Schwille, J. (2011). *Teacher education matters: a study of middle school mathematics teacher preparation in six countries*. New York: Teachers College Press.

Schmidt, W., Houang, R., & Cogan, L. (2002). A coherent curriculum: the case of mathematics. *American Educator*, *26*(2), 1–18.