



\$320,000 Kindergarten Teachers

Your kindergarten classroom can leave a lasting impact on your earnings and your quality of life long after circle time is a distant memory.

By Raj Chetty, John N. Friedman, Nathaniel Hilger, Emmanuel Saez, Diane Whitmore Schanzenbach, and Danny Yagan

Could the quality of your kindergarten experience make a difference in your lifetime earnings? Or whether you're married or own a home?

Our study of an experiment that randomly assigned students to different kindergarten classrooms suggests the answers are yes.

In our recent National Bureau of Economic Research working paper (Chetty et al. 2010), we present evidence demonstrating the tremendous importance of early education. Improvements in kindergarten test scores translate into higher lifetime earnings and improvements in a variety of other outcomes, ranging from where people live to whether they're married. We estimate that an above-average kindergarten teacher generates about \$320,000 more in total earnings than a below-average kindergarten teacher for a class of 20 students.

Isolating the impact of quality in the classroom isn't easy. Under normal circumstances, children in better classrooms — that is, classrooms with better teachers, more resources, better-behaved classmates, or other favorable environmental factors — are different in many dimensions. For instance, they may come from wealthier neighborhoods or be better prepared upon kindergarten entry. As a result, students in better classrooms may do better simply because they had advantages to begin with and not because of the class itself. This difficulty plagues most empirical studies in education: How can we separate causation from correlation?

We cut this Gordian knot by using data from a randomized experiment, the gold standard of research. In the experiment we studied, students and teachers were randomly assigned to specific classrooms. As a re-

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sult, there are no systematic differences in background characteristics across the classes, and we can say with confidence that any differences in later outcomes were caused by differences in classrooms.

We analyzed data from Project STAR — the largest and most widely studied education intervention conducted in the United States. STAR was a randomized experiment conducted in 79 Tennessee schools from 1985 to 1989. In STAR, some 11,500 students and their teachers were randomly assigned to attend either a small class with an average of 15 students or a regular-sized class with an average of 22 students. In general, students remained in their randomly assigned classes in grades K-3 until the experiment concluded and all students returned to regular-sized classes in 4th grade. Previous work has shown that small classes increased students' standardized test scores by about 5 percentile rank points in grades K-3. And students who had better teachers also scored higher on tests in grades K-3. But the longer-run effects were less impressive: The lasting benefits from small-class attendance fell to 1 to 2 percentile points in grades 4-8, as did the benefits from having a better teacher.

However, the end goal of education is not merely to increase test scores. We use test scores because we think they're a good proxy for lifetime outcomes. But no one has ever verified this assumption. The goal of our project was to fill this important gap by linking the STAR data to data on adult outcomes.

We find evidence that kindergarten test scores are indeed very good at predicting later outcomes. There is a strong correlation between kindergarten test scores and a wide variety of outcomes in early adulthood (measured between ages 25 and 27). For each 1 percentile point increase in kindergarten test scores, the students' yearly earnings increase by \$130 — or almost 1% of mean earnings. The relationship diminishes only slightly if we account for family background, for instance, as measured by parental income. Kindergarten test scores also predict a wide variety of other positive outcomes. By age 27, children with higher scores are much more likely to have attended college, have retirement savings, be a homeowner, and live in a better neighborhood.

Do test score improvements in early grades improve lifetime outcomes?

So the key question is: Do policies and practices that improve early childhood test scores also lead to better outcomes in adulthood? What are the long-term effects of better teaching and more resources? To answer this question, we leveraged the STAR experiment to measure the adult outcomes of students who were randomly assigned to receive different levels of classroom resources.

To start, we found that being randomly assigned

to a small class improved students' adult outcomes relative to their schoolmates who attended a regular-sized class. Small-class students went on to attend college at higher rates and to do better on a variety of measures such as retirement savings, marriage rates, and quality of their neighborhood of residence. Small-class students do not have statistically different earnings levels at this point (between ages 25 and 27), but that may change over time as their careers develop and they reap the increasing benefits of their higher rates of college attendance.

The larger surprise came from our findings that kindergarten classroom "quality" has a big effect on adult outcomes. Classrooms vary in many ways beyond size in our data: Some have better teachers, some have better peers, some may just have better "classroom chemistry." While we can't measure each of these attributes of the classroom environment directly, we can proxy for class quality using one's classmates test scores. If your classmates are doing well on tests, then it must mean that you're in an effective classroom environment (remember, students were randomly assigned to classrooms, so there are no differences in student abilities across classrooms before the experiment started).

Kindergarten Test Scores and Early Adulthood

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Using this measure, we found strong statistical evidence that being assigned to a higher-quality classroom in the same school was an important predictor of students' kindergarten test scores. This part was not surprising — some teachers are more effective than others at raising test scores. Similarly, some classes "click" together and have more successful years for a variety of reasons that depend on such idiosyncratic things as personality matches. Although the impact on the current-year's test scores was strong, the effect quickly faded — at least on test scores. From 4th through 8th grades, there was no remaining statistical difference between students who attended different kindergarten classrooms. Studies in the broader literature usually find patterns like this: An excellent teacher or class can have a large effect on test scores in this year or the next, but most of the benefits have faded away within two or three

years. The natural conclusion was, of course, that these effects must be only temporary and are unlikely to make a difference in the long run.

We were surprised, then, to find a strong relationship re-emerge between kindergarten classroom quality and adult wage earnings! Even though the effect of better classes on student standardized test scores quickly faded, being assigned to a higher-quality classroom was an important predictor of students' earnings. Remarkably, we also find substantial improvements on virtually every other measure of success in adulthood that we examined. Students who were randomly assigned to higher-quality kindergarten classrooms were more likely to attend college and attended higher-ranked colleges. They were also more likely to own a house, be saving for retirement, and live in a better neighborhood.

To quantify the size of these effects, we isolate the part of the class quality that is driven by teachers. We estimate that going from a below-average (25th percentile) teacher to an above-average (75th percentile) teacher raises a child's earnings by about 3.5% per year. In present value, that adds up to more than \$10,000 in additional lifetime income on average for each student. When you multiply that by 20 students in each class, the additional lifetime benefits from a single year of high-quality kindergarten teaching is about \$320,000. These are huge stakes at play and underline the importance to the nation of having high-quality classrooms and schools.

The benefits of classroom quality for adult outcomes is not limited to only the kindergarten year. High-quality classrooms in grades 1, 2, or 3 had a similar beneficial impact. We do not have the data to allow us to determine whether classes in grades after 3rd grade have the same effect, nor can we say anything in this study about preschool education. But we think our results point to the importance of the early grades in general and not about kindergarten in particular.

Noncognitive skills: All I really need to know I learned in kindergarten.

The effects of kindergarten on later outcomes are somewhat puzzling: High-quality classrooms have large effects on test scores at first, then fade in later test scores, and finally re-emerge in adulthood. What explains this pattern of fade-out and re-emergence? Our leading theory: improvement in noncognitive or "soft" skills. These are exactly the types of skills highlighted in Robert Fulghum's classic essay, "All I Really Need to Know I Learned in Kindergarten": "play fair," "don't take things that aren't yours," and so on. A growing literature, pioneered by Nobel Laureate James Heckman, has shown that such noncognitive skills have important long-term impacts.

In our data, we see that good teachers and class-

room environments in early childhood improve students' noncognitive skills. Improving some noncognitive skills — such as paying attention in class and persisting at tasks — may result directly in improved standardized test scores. Others — such as whether a student "annoys" other classmates or is critical of the subject matter — have a less direct effect on test scores but are nevertheless an important determinant of success in adulthood. Fourth- and 8th-grade teachers were asked to rate each student on how often they exhibit certain behaviors relating to effort, initiative, and disruption — for example, how often he or she "acts restless, is often unable to sit still." We find that a higher-quality kindergarten classroom leads to better performance along these dimensions as measured in 4th and 8th grades, even though there is no detectable effect on standardized (cognitive) test scores in those same grades. These gains in noncognitive skills are strongly associated with later earnings even though they aren't as strongly predictive of later test scores.

So, why does the legacy of kindergarten re-emerge in adulthood? A good kindergarten teacher must be a good classroom manager in order to raise her students' performance on tests. Good classroom management is likely to impart social and other noncognitive skills. These social skills don't get picked up on later tests — but it pays off for an adult who tends not to "be restless" and "annoy others." So, there is good reason that your excellent kindergarten teacher may be helping you today even though you may not have directly felt her effects in later years of school.

What are the characteristics of good kindergarten classrooms and good kindergarten teachers?

Our findings that kindergarten classrooms and teachers matter a great deal in the long run naturally raises the question of how one can identify the best teachers and classroom environments.

We find that kindergarten teachers with more years of teaching experience are more effective at raising both kindergarten test scores and adult earnings. This may partly be the effect of learning on the job, but it may also reflect the fact that teachers who have taught for a long time are more devoted to the profession or were trained differently. Smaller classes play a role, but many of the most effective classes were regular-sized classes.

But differences along these dimensions only explain a small part of the overall classroom-level variation. Other observable factors — such as teacher education level or the classroom's mix of gender, race, or free-lunch statuses — don't explain the variation in adult outcomes. Unfortunately, most of the overall classroom effect that we detect is unexplained by characteristics that we can observe in our data.



Being assigned to a higher-quality classroom was an important predictor of students' earnings.

That is, we're unable to fully quantify what makes a "high-quality" class in this study. We can document the importance of high-quality classrooms but have a harder time giving recommendations about how to ensure that every student gets to experience one.

We suspect that much of the variation in class quality is driven by teachers and classroom chemistry. Some teachers may be better classroom managers, may relate better to their students, etc. — all things we can't measure in our data. We also don't have information on differences in instructional practices or other aspects of what teachers actually do in the better classrooms. These are important limitations of our work, ones that we're trying to address in follow-up research, because we need policies that can be implemented in order to improve classrooms.

Improvements in standardized tests might mean something different today.

Overall, we find that interventions that improve standardized tests in the current year yield large payoffs in adulthood, even if the effects on the standardized tests themselves fade over time. We think this occurs because children learn multiple types of skills from high-quality teachers and schools. Some of these skills are readily apparent on standardized tests, while others have an important effect directly on adult outcomes.

This equation might change somewhat when tests raise the stakes, as they have recently under No Child Left Behind (NCLB) and other state accountability systems. Other research has found that schools, facing such accountability pressure, sometimes game the system and find ways to inflate standardized test scores without actually increasing learning. These stakes-driven increases in test scores may no longer impart better noncognitive skills. Our research can't speak to this point directly. But if noncognitive skills are the key link to better adult outcomes, we should encourage schools to prioritize these skills no less than they did before NCLB. On the other hand, perhaps NCLB's pressure to improve standardized test scores doesn't affect the earlier grades that we study in our paper since test-based accountability does not start until 3rd grade.

POLICY IMPLICATIONS

In our research on the long-term effects of Project STAR, we found that one's kindergarten teacher and classmates leave a lasting effect long after circle time is a distant memory. Better kindergarten classes not only improve short-run test scores but also can substantially raise lifetime earnings. They also improve a range of other outcomes, such as college attendance, retirement savings, marriage rates, and homeownership. Our measures may even understate

the long-run benefits of a good kindergarten class because earnings gains may further increase as the students age and because we can't measure beneficial impacts on health outcomes or criminal behavior in our data.

At this stage, our work can't definitively point to a particular policy to implement in order to improve early childhood classroom education. While our analysis shows that good teachers generate great value for society, it doesn't tell us how to get more of those great teachers. Paying teachers more may attract more talent to the profession, but it might also have a small impact. Merit pay policies could potentially improve teaching quality but may also

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lead to teaching to the test without gains on the all-important noncognitive dimensions. Nevertheless, we see hope in a broad variety of policies designed to improve the quality of early childhood classes. These range from improving teacher training and mentoring to reducing class size, retaining teachers with high value-added on test scores, and perhaps paying star teachers a higher salary.

While we can't point to specifics yet, we do know now that better early childhood education yields substantial long-run improvements. Children who attend higher-quality schools fare substantially better as adults. In the United States, the current property-tax system of school finance gives higher-income families access to better public schools on average. This system could amplify inequality, as disadvantaged children generally attend lower-quality, resource-constrained schools. Our analysis of the long-term impacts of Project STAR suggests that improving early childhood education in disadvantaged areas may significantly reduce poverty and inequality in the long run. Whatever path a school takes to improving student learning in the early grades, what is clear is that the stakes are too high to ignore the potential benefits of improving early education. **K**

REFERENCE

Chetty, Raj, John N. Friedman, Nathaniel Hilger, Emmanuel Saez, Diane Whitmore Schanzenbach, and Danny Yagan. "How Does Your Kindergarten Classroom Affect Your Earnings? Evidence from Project STAR." *NBER Working Paper 16381*, September 2010.