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Expert Report of Hunter Gehlbach

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Introduction and orientation:

I have been retained by counsel to opine on how school districts can use resources to improve the educational results for their students, especially low income students and students with disabilities.¹

Currently, I am the Vice Dean of the School of Education at Johns Hopkins University as well as a Professor of Education. Concurrently, I serve as the Senior Research Advisor for Panorama Education—a Boston-based data analytics company that uses survey data and school record data to help schools ground their decision-making in high quality data. My previous employment has included being an Associate Dean and Associate Professor at the University of California, Santa Barbara and being an Assistant and Associate Professor at Harvard University's Graduate School of Education. I received my Ph.D. from Stanford University's Psychological Studies in Education program. I also have an M.A. in Social Psychology from Stanford as well as School Counseling and School Psychology degrees from the University of Massachusetts-Amherst. I taught high school social studies for two years. More detail can be found on my C.V.

In providing suggested interventions that can improve the educational results for these students, I focus primarily on research at the intersection of two criteria. Specifically, I am interested in studies and interventions that:

- (a) Show larger effect sizes—i.e., produce larger mean differences between groups,
- (b) Have been replicated in some way or show evidence that they are likely to replicate, and/or
- (c) Represent ideas that are intuitively likely to make a difference (even if they do not actually make much difference).

For example, I discuss tutoring and small group instruction because the substantial literature from multiple sources indicates that schools can generate large improvements across a wide array of student outcomes through these strategies. I also discuss teacher professional development—despite the literature suggesting mixed results from these interventions—because many people intuit that infusing teachers with new ideas and techniques during their careers should be especially

¹I have delimited my scope to areas that fall within my expertise—for other topics, such as bilingualism and class size reduction, I defer to other experts who are better equipped to address them.

helpful for students. I do this so that the reader can compare research on interventions shown to produce larger effects with research on interventions that, while intuited to be effective, have been shown to be less effective.

I have organized the report to focus on what might be done at the student, teacher, leadership, and contextual levels.

1. EXTRA STUDENT SUPPORT

One obvious approach to allocating resources would be to direct those resources towards addressing specific student needs. Substantial research has been done on different strategies that fall within this large umbrella: providing tutoring or facilitating small groups where students can learn from peers; ensuring extra support through having an adequate number of school counselors and psychologists on hand; creating opportunities for extra time on learning such as after school programs, extended day, or extended year policies; better addressing students' needs for social-emotional learning; and focusing on early-childhood education.

1.a. Tutoring and Small-Group Intervention

A tremendously robust line of research has examined tutoring and its effects on student achievement and other outcomes. In fact, one well-known study has held tutoring up as the gold standard against which other approaches were compared (Bloom, 1984). However, because one-on-one tutoring is likely cost prohibitive, most tutoring interventions either focus the tutoring sessions in some way (e.g., by delimiting the length of time for tutoring or by concentrating on a particular subject in which the student is struggling) or experiment with the composition of the tutor and tutees.

The success of tutoring is reasonably intuitive. First, tutoring (especially one-on-one) permits tutors to completely adapt their instruction to meet the needs of the student. Well-trained tutors can meet struggling students where they are and move them forward quickly, instead of leaving them to flounder and become frustrated or disillusioned in the regular class. Second, tutors can build close relationships with students, which has the additional benefit of giving them the social reinforcement that many students crave (Inns, Lake, Pellegrini, & Slavin, 2019; Pellegrini, Inns, & Slavin, 2018). Teacher-student relationships (Brinkworth, McIntyre, Juraschek, & Gehlbach, 2018; Gehlbach & Robinson, 2016) and a sense of social belonging (G. L. Cohen & Garcia, 2008; Walton &

Cohen, 2011) show particularly strong associations with academic achievement and a host of positive social and motivational outcomes for students. Thus, the social and academic benefits of tutoring are likely to reinforce one another.

Many of the efforts have used tutoring to focus on students' reading and math in the early grades to help ensure that they get any remedial help they might need so that they do not fall behind across all their subjects of study (Inns et al., 2019). In other words, focusing on foundational subjects like reading and math will not only help students in those two areas but also in subjects like social studies and science that rely on reading and math as core skills. Likewise, intervention in early years, helps students catch up before the gaps in their knowledge and skills expand to the point of becoming insurmountable.

For example, a widely studied tutoring program, Reading Recovery, showed that children who received one-to-one tutoring performed much better on word recognition: effect size (ES)² = 0.71 (p<.01), on a passage reading test ES = 0.75 (p<.01), on Woodcock Word Attack ES = 0.42 (p<.05), and on Woodcock Passage Comprehension ES = 1.07 (p<.01), for an average of ES = 0.74 (Inns et al., 2019). Even when paraprofessionals (rather than teachers) and small groups (rather than one-on-one) approaches are used, tutoring for reading still produces impressive gains for students in most cases (Slavin, Lake, Davis, & Madden, 2011). In one exception to the above statement, Samson, Hines, and Li (2015) found that teachers outperformed paraprofessionals.

Tutoring in math appears to help student achievement, although the results are less robust than for reading (Carbonneau, Marley, & Selig, 2013). For instance, Slavin, Lake, and Groff (Slavin, Lake, & Groff, 2009) found more modest effect sizes (+0.18) when examining secondary math tutoring.

In terms of who conducts the tutoring, the research on peer/cross-age, online, and volunteer tutoring show less conclusive results (P. A. Cohen, Kulik, & Kulik, 1982; Slavin et al., 2011). Although, in a related finding, classrooms which are structured so that teachers employ small, cooperative group learning produce better learning, social, and motivational outcomes than traditional

² Effect size is a common way to understand the size of the impact of an intervention. It is a function of the difference between the mean of the treatment and control groups as well as the variance within each of those groups. [Table 1](#) of this website offers some excellent ways to intuitively understand this metric. E.g., an effect size of .5 means that there is a 64% chance that a randomly selected person from the treatment group will be higher than a control group counterpart; an ES of 1.0 corresponds to a 76% chance. As a very gross generalization, ES of between .2 and .3 are common in education.

lecture/discussion classrooms and classrooms with competitive orientations (D. W. Johnson & Johnson, 2009). Thus, students can and do learn from each other successfully, but they may need teachers to structure those activities. Moreover, like any educational intervention groupwork needs to be implemented in strategic ways for it to be effective and so teacher training on how to enact these techniques properly may be important for groupwork to be effective (Aronson, 2000; E. G. Cohen & Lotan, 1997).

The bulk of the research signals that how the tutors are trained matters and direct, on-going supervision and feedback for tutors will likely bolster the efficacy of tutoring interventions. Tutor trainings that emphasizes personalization, engagement, and motivation are likely most impactful.

Bottom line: In sum, tutoring is likely to be a tremendously effective strategy for a number of reasons: It can be implemented easily in most schools; certified teachers are not required; and the tutoring can be targeted just to those students who need it (and it can be stopped once a student has recovered to grade-level). Research demonstrates that tutoring in reading and in students' elementary years will probably produce more gains than other tutoring-based interventions, including tutoring in other subjects and tutoring in students' secondary years. Moreover, one tutor to a small group of students can be effective (one-to-one tutoring produces only slightly stronger effects).

1.b. School Counselors

Mental health challenges experienced early in childhood tend to be stable and predictive of negative outcomes later in youth. Early prevention and intervention can alter this negative trajectory (Hill, Coie, Lochman, & Greenberg, 2004; Lochman, 1995). Unfortunately, only a small percentage of students experiencing mental health problems are identified and receive treatment by gatekeepers, such as educators, school psychologists, and school counselors (Briggs-Gowan, Horwitz, Schwab-Stone, Leventhal, & Leaf, 2000). Naturally, mental health issues are not confined to younger students—problems arise throughout all phases of students' (and adults') development. In a study of 8 to 15 year-olds, Merikangas et al. (2010), found that only about half of children in need of mental health services actually receive help. Thus ongoing, effective support is needed to meet this need.

School counselors are a primary, professional support for students when they encounter mental health challenges at school. School counselors tend to focus on resolving conflicts, connecting students to internships or volunteer opportunities,

matching students with an appropriate set of courses, and guiding students at key transition points. By contrast school psychologists' identify and treat mental health and learning issues, primarily for those students who are referred to them.

There is strong evidence that school counselors support student valued academic outcomes such as increased graduation rates, higher grades, and decreased absenteeism.

In a review of 153 school counseling interventions involving thousands of students, Whiston, Tai, Rahardja, and Elder (2011) found an average $ES = .30$ for school counseling interventions across a range of cognitive/academic achievement, behavioral, and affective outcomes.

The American School Counselor Association's (ASCA) recommended ratio of 250:1. Delaware's ratio at 436:1 in the 2013-14 academic year is highly discrepant from that ratio (Clinedinst, Koranteng, & Nicola, 2015)³. However, the inequity of the national ratios is also noteworthy. Districts at the 25th income percentile (the poorest schools) report a 642:1 ratio while those at the 75th income percentile (the richest schools) report 292:1 (Gagnon & Mattingly, 2016).

Although there are multiple consequences of higher-than-recommended counselor-to-student ratios, college counseling may have among the most long-lasting effects. As counselors juggle multiple responsibilities with high caseloads, focusing on post-secondary options is often the area that slips through the cracks. In 2014, among schools with counselor-to-student ratios of one-to-400 or more, counselors could only commit 25 percent of their time to college counseling services, as opposed to counselors in well-resourced schools who were able to spend 29 to 38 percent of their time on college counseling. Similarly, schools with larger populations of low-income students, as measured by eligibility for free and reduced-price lunch, tend to spend less time for college counseling services. These counselors often focus instead on scheduling, as well as counseling students individually or in small groups regarding their personal issues. Because college counseling tends to be a highly individualized process—often conducted by counselors meeting individually with students—it is unsurprising that counselors with lighter case-loads can spend more time and resources on college admissions programming. Some added benefits of this personalization may include reviewing student applications prior to submission and coordinating visits to colleges. However, activities may also include structural improvements for the school such as working with school leadership to align curricula with college requirements (Clinedinst et al., 2015).

³ More recent reporting suggests this number is largely unchanged (Eichmann, 2019).

Some research indicates that increasing counselor ratios will improve academic achievement and outcomes, including college enrollment. Carrell and Carrell's (2006) statistical model showed that in Alachua County, Florida, if the counselor-to-student ratio to the ASCA recommendation a 7.4 percent decrease in disciplinary recurrences could be expected. Reducing student-to-counselor ratios to recommended levels also decreased disciplinary occurrences for Black students by 9.4 percent, further reducing disciplinary reoccurrences for Black males by 10.8 percent, and a 9.6 percent decrease in disciplinary recurrences for all students eligible for free or reduced price lunch. Belasco (2013) finds that students, especially those with low-incomes, who visited their school counselor in 10th and 12th grades at a minimum, were more likely to enroll in four-year institutions than students who visited their counselors in one grade only or not at all.

Bottom line: Overall, school counselors can benefit students through a range of different types of counseling interventions that they might conduct and the effect sizes are often impressive. However, it is unclear if the mere presence of counselors in schools is helpful for student outcomes. Rather, the benefits of counselors are likely realized through the interventions that they conduct or facilitate (e.g., by having counselors coach teachers to administer interventions) and counselors' capacities to conduct successful interventions are almost inevitably affected by their caseloads. If counselors are assigned to too many students, it becomes much more challenging to design programming to proactively address issues at a school. High counselor caseloads also appear to have a particularly negative effect on tasks that require individualized attention, such as college counseling for students.

1.c. Extra Time on Learning:

After-School Programs, Extended Day, Extended Year

One way students might easily benefit from additional financial resources is to receive extra time in learning environments. However, the research shows that some types of additional time are effective and other approaches probably are not.

Extending the Day and Extending the School Year

A host of studies have been conducted in an effort to shed light on the intuitively appealing idea that having students spend more time in class (during the school day or by attending school for more days out of the year) will result in greater learning or other student outcomes. Overall, the literature seems to suffer from an inability to make apples-to-apples comparisons as these programs are implemented in a surprising number of different ways. The findings tend to be

mixed. To the extent that there are real effects, they are not particularly strong. For example, Patall et al. (2010) find a small or weak impact of an extended school day on student achievement, although the results may be heterogeneous across grades and socio-economic (SES) groups. McMullen and Rouse (2012) found that when Wake County, NC schools spread their 180 days of instruction throughout the school year, that it had essentially no impact on academic achievement of the average student. Yet, Cooper et al. (2003) found small-to-modest effect sizes of $ES = .06 - .11$. In sum, although there is almost no evidence that extra time on learning or spacing out the school year to mitigate “summer slippage” hurts students, the evidence that it helps them is weak.

After School Programs

After-school programs vary greatly in their quality and corresponding impact on an array of student outcomes. While some programs function similarly to a daycare, others offer intensive homework support, arts enrichment and physical activity. Quality of after-school care is highly associated with a child’s race and family income (Cain & Hofferth, 1989; Vandell & Corasaniti, 1988). These variations can affect (negatively or positively) students’ academic engagement, personal well-being, and delinquency (Posner & Vandell, 1994).

Durlack and Weissberg’s (2007) review of 73 programs indicates that participation in after school programs generally have positive effects on students’ feelings and attitudes, behavior, and academic achievement with ES ranging from .10 to .34. Effects are consistently stronger when programs are “sequential, active, focused, and explicit.”

Other studies (e.g., Morrison, Storino, Robertson, Weissglass, & Dondero, 2000; Tucker, Chennault, Brady, & Fraser, 1995) have found that after-school academic tutoring or homework assistance may help *prevent a decline* in performance that is evidenced by many at-risk youth. Morrison et al. (2000) studied 350 at-risk students, half of whom participated in an after-school program that provided homework assistance, tutoring, and cultural enrichment activities. A year later, students in the program had maintained initial levels of school bonding and teacher ratings of student behavior, while a matched cohort of students who did not participate in the program showed decreases on these measures over the same period. Tucker et al. (1995) evaluated an afterschool tutoring program serving low-income African American students. After 2 years, participants did not show significant increases in grades, but students who were not in the program showed a significant grade decrease. Together, these studies indicate that after-

school academic support may play a protective role by helping to prevent a loss of school engagement even if it doesn't result in higher levels of functioning (Cosden, Morrison, Gutierrez, & Brown, 2004).

Bottom line: Investing in longer school days, longer school years, or more evenly distributed school years seems less likely to yield clear benefits to students. Because it may well have other unintended consequences (e.g., teacher burnout) that have not been studied, this approach seems risky. Afterschool programming for students seems like a wiser investment provided that the programming is intentional and high-quality.

1.d. Social, Motivational, and Self-Regulatory Aspects of Learning

Social-emotional learning (SEL) has become a broad catch-all phrase to describe a varied set of mindsets, skills, attitudes, and dispositions which are relevant to learning. At this broad level, these characteristics have been associated with positive student outcomes with high effect sizes. For example, across scores of studies Durlak, Weissberg, Dymnicki, Taylor, and Schellinger (2011) found that students exposed to SEL curricula had better social and emotional skills, attitudes, behavior, and academic performance. However, these programs focus on developing different student characteristics, and they are not equally effective. Farahmand et al.'s (2011) review indicated substantially fewer effective programs for low-income, urban youth.

I focus on the impact of interventions that focus on three domains—social connection, motivation, and self-regulation—each of which correspond to students' fundamental psychological needs that must be met before learning can occur. This focus should better illuminate exactly which types of interventions might yield what types of results.

Social Connection

Ensuring that students have strong social bonds at their school takes multiple forms: teacher student relationships, a sense of belonging, healthy classroom climates, and so forth.

The relationships that students have with their teachers are strongly associated with numerous student outcomes, including students' academic achievement (ES = .1 to .3) as well as their engagement (ES = .2 to .5), in research that has looked at average effects across multiple studies (Cornelius-White, 2007; Roorda, Koomen, Split, & Oort, 2011). However, recent research showing that

teachers' perceptions (rather than students' perceptions) of the teacher-student relationship may be the more important predictor of students' grades (Brinkworth et al., 2018). Findings like this imply that these associations may have been under-predicted in previous studies that only measure half the relationship (i.e., measuring only the student's perspective or only the teacher's perspective).

Peer relationships and students sense of belonging are important predictors of students' achievement, engagement, motivation, and prosocial behaviors (Wentzel, 1991; Wentzel, Battle, Russell, & Looney, 2010). Moreover, these relationships may mitigate dropping out of school—particularly for at-risk youth (Hausmann, Schofield, & Woods, 2007). Among the most compelling research to suggest how peer relationships and sense of belonging might be improved are the aforementioned lines of research on collaborative groupwork techniques (Aronson, 2000; E. G. Cohen & Lotan, 1997; D. W. Johnson & Johnson, 2009).

Motivation

Motivating students seems like one of the most obvious ways to bolster students' achievement. Yet, which pathway might best accomplish that is less clear. Hulleman and his colleagues (Hulleman & Harackiewicz, 2009) developed an intervention in which students elaborated on why the content they were learning in class might prove useful in their daily lives and found that doing so bolstered academic achievement particularly for students with less initial confidence in the subject. Dweck and her colleagues have developed interventions around having a “growth mindset” (i.e., believing intelligence is malleable and can grow with effort). Many interventions have found a range of positive effects. The most recent and most rigorous of these studies have shown the effects to be strongest on low achieving students (Paunesku et al., 2015; Yeager et al., 2019). Others have focused on the benefits of providing students with choices in the classroom and on assignments as ways to improve students' motivation and achievement (Iyengar & Lepper, 2000; Patall, Cooper, & Wynn, 2010). However, much of the evidence has focused on teaching practices that shift the classroom culture—e.g., towards having students focus on mastering material instead of trying to outperform each other, by assigning tasks that are cooperative rather than competitive or “no-excuses,” (Ames, 1992; Aronson, 2000; E. G. Cohen & Lotan, 1997; D. W. Johnson & Johnson, 2009; Midgley, 2002). Because these practices and general orientations shift numerous aspects of students' daily experiences, the effects are typically felt across many aspects of the classroom ranging from peer relationships to effort/persistence to interest in taking future courses to classroom behavior to

achievement. Typically, the specific qualities of the classroom culture that teachers cultivate are developed slowly over the course of a teacher's training and early career. Consequently, they are less likely to be captured empirically.

Self-Regulation

To the extent that students can regulate their emotions, remain focused, leverage effective learning strategies, and so forth, they are more likely to succeed in school. Evidence shows that interventions to help students accomplish these various aspects of self-regulation often improve their academic achievement as well as having collateral benefits. For example, while goal setting activities are commonplace in schools (and in life), adhering to those goals over time tends to be challenging for most people. Extending the success of a previously tested intervention (Duckworth, Grant, Loew, Oettingen, & Gollwitzer, 2011), Duckworth, Kirby, Gollwitzer, & Oettingen, (2013) developed an intervention to help students identify a goal but also think through strategies that they could use when they faced challenges in sticking to their goals. They found that this intervention bolstered students' grades, behavior, and attendance.

Bottom line: Many of these practices which are based on core psychological principles are free. However, for teachers to internalize them as routine practices may require them to hone their intuitions over a longer period of time and/or receive high quality teacher training. In summary, the effects from these types of interventions are indirect but can be pervasive. In addition, many of these practices are bundled into curricula that schools can invest in.

1.c. Early Childhood Education

Gaps in critical capabilities emerge early between students of different socioeconomic groups. These gaps often originate before formal schooling begins and persist through childhood and into adulthood. Remediating the problems created by the gaps is not as cost effective as preventing the gaps from occurring at the outset (Heckman, 2011).

A comprehensive review found that early educational intervention can have substantive and lasting effects on cognition, social-emotional development, schooling outcomes, and adult success for disadvantaged children. The key to such impact may lie in earlier health and nutrition components, providing rich educational experiences, and improving teacher practices (W. S. Barnett, 2011).

Children who had high quality early child-care experience scored higher on vocabulary tests in fifth grade than children who had poorer quality care (Belsky et al., 2007).

The duration of the high-quality early childhood education appears to be an especially important factor. Specifically, the students who receive exposure to high-quality care for the longest duration typically show the strongest effects. Longer duration and an early starting age in good quality centers is particularly beneficial (Mitchell, Wylie, & Carr, 2008).

After reviewing state-wide interventions that used random assignment and follow children at least into middle school, Currie (2001) concluded that even though only one project found any long-term effect on IQ, all the other projects found positive effects on measures of scholastic success.

One of the programs that is best known and has received the most attention from researchers is Head Start. The research on this program is largely congruent with the aforementioned themes—Head Start generally leads to positive student outcomes (including health outcomes). Where this research gets more complicated is in documenting whether these benefits endure for students. Several studies suggest they do (Deming, 2009; Garces, Thomas, & Currie, 2002; Lee, 2011); other studies suggest that the benefits fade with time (W. Steven Barnett & Hustedt, 2005; Puma et al., 2010).

Bottom line: Early childhood education has well documented benefits for students (and for society), however the quality of the care and education is critically important. Because expenditure of resources earlier may result in substantial downstream savings, it seems like a particularly promising area in which to invest.

2. INVESTING IN TEACHERS

Although less direct than expending resources on students, investing in teachers has the potential benefit of producing effects that get dispersed broadly to students and endure from year to year over the course of a teacher's career. There is substantial agreement that teacher quality matters and has substantial and lasting benefits for students. For instance, improving teacher effectiveness can lead to improved wage earnings for former students at age 28 (Chetty, Friedman, & Rockoff, 2011). However, how teacher effectiveness is developed and assessed

and which student outcomes might benefit are contentious questions over which there is considerable controversy in the literature.

2.a. High Quality Teacher Preparation

One highly contentious area of research is the value of teachers who enter the profession through traditional (typically more expensive) training programs versus alternative certification pathways (which tend to be cheaper). Darling-Hammond et al (2005) found evidence that uncertified Teach For America recruits are less effective than certified teachers. Goldhaber (2018) counters that the value of formalized preservice teacher education has not been clearly demonstrated. Two core problems in this research include (1) the lack of possibilities for randomly assigning teachers to a particular certification pathway and (2) the number of choices researcher have in examining relevant data. For example, Darling-Hammond et al. examined data that compared regularly certified teachers versus Teach for America, in Houston, using 4th and 5th grade students, between 1995 and 2002, controlling for certain variables, and examining standardized test scores as outcome measures. Thus, examining different alternative certification programs, or different locations, or different student populations, or different years, or different control variables, or different student outcomes could lead to different results.

Two additional notes are worth mentioning. First, there is little, if any, evidence (none that I am aware of) that claims that alternative certification routes help develop *better* teachers than traditional training programs. In other words, the question is whether regular certification is better than alternative routes or whether they are indistinguishable. In addition, some research suggests that there are other negative outcomes of alternative certification routes that may indirectly affect students. For instance, Carver-Thomas & Darling-Hammond (2019) find that those teachers who utilize alternative certification pathways may leave the profession sooner.

2.b. Teacher Professional Development

It would be logical that providing teachers with professional development opportunities should improve student outcomes. However, as before, research in this area is complicated by the variety in the types of professional development opportunities offered as well as the quality of the implementation of the training. Furthermore, many professional development opportunities are oriented around new policies or reforms that teachers need to adjust to (Coburn, 2001, 2005). These may or may not even be designed to improve student outcomes in

the first place (e.g., training on a new attendance software program is unlikely to help students).

One approach to professional development is to provide teachers with specific, content-relevant training. A meta-analysis on the effects of teacher professional development on student learning in math concluded that students whose mathematics teachers received well-designed, content-focused professional development scored higher than those whose teachers did not (Blank, de las Alas, & Council of Chief State School, 2009).

A second approach entails providing teachers with more generalized coaching (e.g., by observing their classrooms). A number of studies have found that well-designed mentoring programs improve retention rates for new teachers, as well as their attitudes, feelings of efficacy, and instructional skills (Headden, 2014; Ingersoll & Strong, 2011). Key to success is having a mentor in the same subject area, joint lesson planning and collaborating with other teachers regularly (Headden, 2014). Beginning teachers' practice is enhanced further when their mentors also receive formal training, and are able to provide one-to-one observation and coaching (Smith & Ingersoll, 2004). There is at least one study that links this type of coaching/mentorship with improved student achievement, although, to my knowledge, this finding has not been replicated (Allen, Pianta, Gregory, Mikami, & Lun, 2011).

The benefits of these coaching/mentoring programs might be localized to beginning teachers (however, in most cases, the opportunities to receive mentoring may only be made available to beginning teachers). Researchers have found that beginning teachers who participate in induction are more able to keep students on task, develop quality lesson plans, use effective questioning practices, adjust classroom activities to meet students' interests, maintain a positive classroom atmosphere, and demonstrate successful classroom management (Ingersoll & Strong, 2011). A study found that students of beginning teachers who participated in induction showed stronger achievement gains (Glazerman et al., 2010).

2.c. Teacher Turnover

High rates of turnover negatively impact student learning. For example, one longitudinal study estimates the effects of teacher turnover on over 600,000 New York City 4th and 5th grade student. Students in schools with higher teacher turnover scored lower in both ELA and math. Notably, the effect was particularly strong in schools with more low-performing and black students (Ronfeldt, Loeb, & Wyckoff, 2013). When teacher turnover is persistent, it can impact school stability,

instructional programs, the formation of organizational culture, collegial relationships, collaboration between teachers, and the accumulation of institutional knowledge. Thus, ripple effects of high teacher turnover may extend to the learning and achievement of all students in a school, not just those with a new, inexperienced teacher (Carver-Thomas & Darling-Hammond, 2019).

Although these sorts of primary and secondary effects appear to be the rule, there is at least one empirical illustration of a documented exception. If teacher turnover is catalyzed by a systematic identification of underperforming teachers who then leave and are replaced by higher performing teachers it may benefit students, although the effect sizes are modest (Adnot, Dee, Katz, & Wyckoff, 2016). These scholars also acknowledge that the general trend for teacher turnover (i.e., teacher turnover that is not targeted) is negative.

So how might teacher turnover be mitigated? A meta-analysis of the research (Borman & Dowling, 2008) found consistent evidence of the association between teacher turnover and personal factors as well as organizational factors. Personal factors such as social capital greatly influence teacher's decision to stay or leave their jobs, which partly explains why attrition and turnover is higher during early stages of teacher's career. For example, early career teachers have fewer social connections for support and less access to the expertise of others that might help them solve chronic classroom challenges that they are facing. Working conditions such as higher salaries, teacher collaboration, and administrative support also help retain the teachers. The importance of organizational factors was echoed by studies later conducted with all the teachers in Massachusetts (S. M. Johnson, Kraft, & Papay, 2012) and North Carolina (Ladd, 2011). These researchers found that the teachers' decision to leave their jobs was strongly driven by their dissatisfaction with their working environment, independent of the student body SES or racial mix. The perception of working environment is not limited to physical surroundings and technological facilities, but the functioning of school as a whole, and principal's leadership is the most dominant dimension of all. These findings are complemented by other work indicating that dissatisfaction with accountability and administration are core elements of teachers' decisions to leave the profession (Sutcher, Darling-Hammond, & Carver-Thomas, 2016). Sutcher, Darling-Hammond, & Carver-Thomas (2019) note that providing well-designed expert mentoring programs for new teachers, increasing teacher input in decision-making, and improving teaching conditions, especially in high-poverty schools, may also mitigate teacher turnover.

2.d. Teacher Salaries

In a closely related topic, teacher salaries may be important factors with respect to student outcomes because they could draw higher quality teachers into a school or district and/or they might reduce teacher turnover.

One pathway through which higher teacher salaries might boost student outcomes is by attracting (and retaining) higher quality teachers into the profession—a basic supply and demand argument. Teaching as a profession must compete with other occupations for talented college and university graduates. A 2014 study by the Center for American Progress (CAP) found that, increasingly, a teacher’s salary in much of the United States is too low to support a middle-class lifestyle. These salaries likely affect the quality of those who choose to enter the teaching profession and thus impact teacher quality which, in turn, affects student outcomes (Baker, 2016).

Another way in which teacher pay can affect student outcomes is through where teachers teach. According to Borman and Dowling (2008) teachers are primarily attracted by “soft” working conditions including effective leadership, teacher collaboration, and by having the instructional materials they need readily available. Thus, it is not uncommon for teachers to flee lower paying, urban districts with challenging working conditions for higher-paying suburban positions with better resources.

However, state policies could make the calculus more complicated for teachers. States can provide districts incentives to raise salaries and subsidize poor districts more extensively. In addition to salary perks, states can consider multiple strategies for making teaching more financially viable, particularly in more challenging districts. Other forms of compensation may include housing supports, child care supports, and opportunities to continue teaching and mentoring after retirement (Sutcher et al., 2016).

Finally, one could focus on incentive pay for teachers as a lever to help retain them in the profession. A meta-analysis by Borman and Dowling (2008) indicates that higher pay is associated with lower odds of leaving the profession. However, this finding pertains to base salary (Firestone, 2014) and should not be connected to performance- or merit-based pay. Research suggests limited or no benefits of pay-for-performance structures (Ford, Van Sickle, Clark, Fazio-Brunson, & Schween, 2017).

Bottom line: The research on teacher preparation programs does not provide a clear sense of which pathway is best for training teachers (between traditional and alternative pathways). The lack of clarity is likely due to the variability of both traditional and alternative programs as well as the number of choices that researchers have in terms of how they study the problem. Professional development opportunities for teachers either through targeted, content-based learning or through more generalized mentorship can work—the challenge is knowing enough about the professional development opportunity to know if it will work (and if it will be implemented with enough fidelity to work). Although conducting experiments that would allow for strong causal inferences is not feasible, the bulk of the evidence suggests that trying to minimize teacher turnover would be likely to benefit a wide array of student outcomes. The one caveat is when teacher turnover is a product of a systematic (and accurate) identification of problematic teachers—in these cases, teacher turnover might have small modest benefits for students. Using teacher pay as a lever may boost student outcomes indirectly. Specifically, higher annual salaries may attract and retain higher quality teachers into teaching as a profession and into teaching at a particular school. There is no evidence that teacher incentive pay (where teachers are paid, in part, on how much they improve certain student outcomes) consistently yields beneficial student outcomes.

3. SCHOOL LEADERSHIP

One might imagine a number of ways that school leaders could influence student outcomes. However, because the influence is disproportionately indirect, it is challenging to design studies with sufficient sensitivity to detect that influence. In other words, school leaders might influence student outcomes by providing professional development to their teachers. Alternatively, leaders might develop positive policies or working conditions for teachers that promote positive teacher-administrator relationships, trust, etc. In these examples it would be through improved teacher- or teaching-quality that student outcomes improved.

One of the relatively rare experimental designs conducted in this area illustrates this challenge well. In this study, the Center for Educational Leadership (CEL) program randomly assigned elementary principals to receive 188 hours of professional development (or not), including a 28-hour summer institute at the beginning of the program, quarterly virtual professional learning community sessions in which principals met other principals and CEL coaches, and 50 hours per year of individual coaching in which principals worked with their CEL coaches

to set goals, implement strategies, and analyze effects of strategies (Herrmann et al., 2019). The professional development received by principals appeared to translate into improved professional development for teachers. Principals helped teachers improve instruction by observing teachers, giving feedback, and selecting curricula. In addition, they sought to improve their recruitment, management, and retention strategies, held professional development sessions for teachers; and focused on setting a school mission, improving school climate, and deploying resources effectively. However, following the first, second, and third years, there were no differences between experimental and control schools on standardized measures of student reading or mathematics achievement, no differences on school climate, and no differences on principal or teacher retention. Similar studies have found zero, limited or inconsistent effects of principal leadership training on student academic outcomes (Jacob, Goddard, Kim, Miller, & Goddard, 2015; Nunnery, Ross, & Yen, 2010; Robinson, Lloyd, & Rowe, 2008).

In examining the possibility that leaders might change the culture and working conditions to the point that it improves teaching quality, the research is suggestive but not conclusive. In a correlational study, Seashore Louis, Dretzke, & Wahlstrom (2010) find that teachers' perceptions of instructional leadership, trust, and shared leadership are generally associated with a stronger professional community, a greater focus on instruction, and slightly higher student achievement in math.

Bottom line: Quantitative research on the impact of school leadership on student achievement typically shows varying results for many reasons. Two of the most important are that (a) leadership is hard to measure—there are many leadership styles which may offer better/worse fits for different contexts and (b) because there are so many intervening factors between leadership inputs and student outcomes. Nevertheless, there is a strong perception that leadership matters among practitioners and experts, even though researchers have yet to demonstrate it empirically.

4. INFRASTRUCTURE

4.a. Building Facilities and Environment

So far, the evidence suggests that wise interventions at the student level seem to have the biggest effects, followed by smaller but still compelling effects of intervening at the teacher level, followed by ambiguous results of intervening at the level of school leadership. Thus, it seems like investing in infrastructure—

arguably the most distal aspect of students' experience might be the least likely to matter for student outcomes. Research suggests this is not the case—perhaps because of the condition of the infrastructure is so extremely different between schools.

For example, a study in 2001 indicates that student academic achievement improves with improved building condition; factors such as lighting, air quality and temperature and acoustics, have an effect on student behavior and outcomes (Fisher, 2001). More recently, Park, Goodman, Hurwitz, & Smith, (forthcoming) estimate that without air-conditioning each 1 degree F increase in the average temperature will reduce student learning by 1%. This finding disproportionately impacts minority students, potentially explaining up to 5% of the racial achievement gap. Evans (2006) finds similar effects of heat on learning. Given climate change and the number of days many schools are closing for extreme weather, this finding seems acutely important.

Relatedly, the quality of school infrastructure has a significant effect on school attendance, attention, and drop-out rates. Poorly maintained heating, ventilation, and air-conditioning systems and low ventilation rates may give rise to environmental contaminants in school buildings, and have been associated with absenteeism levels among school children (Environmental Protection Agency, 2000; Rosén & Richardson, 1999). Changes in ventilation rates that affected carbon monoxide levels were associated with attention level among school children (Coley, Greeves, & Saxby, 2007). Students are less likely to attend school if the buildings need structural repairs, use temporary structures, and have understaffed janitorial services (Branham, 2004). This finding accounted for important contextual variables such as social racial composition, socio-economic status of the school, etc.

Conversely, access to nature and the natural environment seems to facilitate a number of positive outcomes for students. Such exposure has been associated with better attentional and emotional self-regulation ability in children (Taylor, Kuo, & Sullivan, 2002). Preschool children developed better motor skills when they played in more natural areas compared with traditional playgrounds (Fjørtoft, 2004). Playing in natural areas also benefit children with attention deficit-hyperactivity disorder (Taylor, Kuo, & Sullivan, 2001). Nearby nature may also enhance the cognitive functioning of low-income urban children (N. M. Wells, 2000) and buffer the effects of chronic stressors (N. M. Wells & Evans, 2003).

To examine the causal impact of capital expenditures on school district proficiency rates in Michigan, the authors employed a regression discontinuity design and provided some evidence that capital expenditures can have positive effects on student proficiency levels (Hong & Zimmer, 2016).

Bottom line: Students learn less and perform worse when they are physically uncomfortable. They may also feel negative psychological effects from attending school in buildings that implicitly signal that they are being neglected. Although it is a new area of research with a modest number of studies, there are indications that exposure to nature benefits students.

4.b. Technological Infrastructure

In recent years more and more students have gotten access to computers at school. Research has kept pace and many studies have examined whether and in what way this access benefits students. The general answer signals that there can be important benefits, but with two important caveats.

The findings from a meta-analysis of 84 studies based on over 60,000 K-12 participants showed that educational technology generally produced a positive effect in comparison to traditional methods. Specifically, innovative technology applications and interventions that were incorporated in tandem with teachers' professional development showed more promising evidence (Cheung & Slavin, 2013). In a separate review, Bebell and O'Dwyer (2010) found that participation in the one-to-one computing programs positively correlated with increased student engagement and interest, as well as modest increases in student achievement (Suhr, Hernandez, Grimes, & Warschauer, 2010).

The first caveat is that in most of the examples of successful technology applications, students have access to one-to-one computing opportunities with adequate hardware and bandwidth to support their work (Darling-Hammond, Zieleski, & Goldman, 2014). One-to-one availability is particularly important for lower-income students, since they are less likely to have these opportunities at home. In a study conducted in California, the implementation of a one-to-one laptop program led to significantly higher gains in mathematics among lower-income students relative to the higher-income ones (Grimes & Warschauer, 2008).

The second caveat is contextualized within the technological disparities between wealthier and poorer schools. The National Center for Educational Statistics data showed that the student-to-computer ratio gap has been closing up

over the years, with many schools in low-income communities using government funding to purchase educational computers (J. Wells & Lewis, 2006). However, a survey conducted by the Pew Research Center showed disparities continue to exist in ownership and internet access across socioeconomic and racial groups (Madden, Lenhart, Duggan, Cortesi, & Gasser, 2013). The caveat is this: Compared to the high-SES schools, the low-SES schools tend to have less investment in professional development, hiring full-time media specialists and IT support staff, which made teachers less confident that the equipment would actually work, and more reluctant to plan for technology use (Warschauer, Knobel, & Stone, 2004). Moreover, when teachers actually use computers for classroom instruction, the way they use them varies: low-SES schools use it predominantly for drill and practice, while high-SES schools use computers for more interactive and constructivist activities, which leads to a discrepancy that the high frequency of technology use was correlated with higher test score outcomes in high-SES students, but correlated with lower test score outcomes in low-SES students (Wenglinsky, 1998).

Bottom line: Resources expended on computers in schools can be beneficial provided that they come with professional development on how to use computers effectively. Effects will likely be larger to the extent that schools can provide one-to-one computing to their students.

5. SUMMARY

Overall, expenditures to provide extra support for students is an effective use of resources to bolster student outcomes. In particular, tutoring and groupwork approaches provide particularly robust effects. Providing more adequate and equitable student-to-counselor ratios also seems like a prudent expenditure of resources, particularly in higher-need districts. Attention to students' social, motivational, and self-regulatory needs is likely to be similarly helpful in promoting desired student outcomes, although some of this might be accomplished without excessive costs. Investing in early childhood education pays off well provided that the childcare is high quality. Giving students extended time at school probably will not produce effects that are comparably strong to these other areas. However, afterschool programs that focus particularly on tutoring and/or addressing students' social, motivational, and self-regulatory needs will likely provide benefits provided they are high quality programs.

Investing in teachers is also a useful approach to try to improve student outcomes. However, the effects are not likely to be as strong as intervening directly at the student level. Teacher training, professional development, mitigating turnover, and boosting teacher salaries are all promising strategies but because their effects on student achievement are indirect, they are harder to capture. As a result, effect sizes might seem smaller. Of these approaches, targeted teacher professional training (e.g., that focuses on one of the important areas from the student support section) and addressing teacher turnover in districts where teachers leave regularly may be the best expenditures of resources.

While school leadership is often discussed as an important area to invest in—and bad leadership could possibly undermine otherwise sage investments—the empirical evidence showing the benefits of school leadership on student outcomes is lacking. Conversely, making sure the facilities most in need of repair actually get repairs (and air conditioning) are clearly effective uses of funds. Investing in technology can help boost student outcomes provided that teachers receive quality training to understand how to use the technology effectively.



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