Question: *How much variance in student achievement can be attributed to school, teacher, and student-level variables?*

Response:

Preliminary research cited by the University of Pittsburgh Learning Research and Development Center (Leana & Pil, 2006) examined the influence on student achievement of student characteristics, teacher human capital (defined as years of experience), and school group. This study suggested that student characteristics explained 57% of the variability in gains in student achievement, teacher human capital explained an additional 20% of the variability, and the school group or "group social capital" explained 23% of the variability in student gains in student achievement. Together, a total of 43% of the variability in student achievement was explained by teacher and school level characteristics.

More recent research by these authors (Pil and Leana, 2007) used a multi-level model to describe the influence of human capital and social capital, while controlling for student attendance, socio-economic status, grade level, and special education status. The study included 202 elementary schools with 1,020 teachers in 240 grade-level teams (a total of 24,327 students). Human and social capital at both the individual level and grade team level were examined for their influence on math achievement of 4th and 5th grade students. Human capital was defined as "an individual's cumulative abilities, knowledge, and skills developed through formal and informal education and experience" (pg. 6). Team human capital was scored as the average of the individual human capital scores in a specific grade-level team. Social capital was characterized by collaboration with other teachers and administration about school matters. Team or group-level social capital, according to Leana & Pil (2007), is characterized by close relationships and high levels of interaction with other teachers in the same team group, which is thought to promote better performance in teachers. Vertical social capital refers to the frequency of interactions between administrators and teachers with the expectation that teachers with more frequent and closer interactions with administrators will have higher performance.

This study found that 62.5% of the variance in student achievement was explained by student level variance, an additional 26.5% of the variance was at the teacher level, and 11% of the variance could be explained by grade-level team variance. At the *individual teacher level*, human capital (teaching experience, ability to teach math, and interpret students' mathematical thinking) was significantly and positively associated with growth in students' math achievement. Intensity of interactions between teachers with administrators was also a positive and significant predictor of growth in students' achievement in math.

When considering *grade-level teams*, team social capital had a significant and positive influence on growth in student performance. In addition, intensity of interactions among grade-level team teachers significantly predicted growth in students' achievement in math. This effect was most pronounced among the more highly skilled teachers in the group. Curiously, intensity of team-level interactions with administration (vertical social capital) was negatively related to teacher ability.

Additional findings on variance in student achievement

Several other studies have examined the sources of variance in student achievement and achievement growth. Zvoch & Stevens (2006) conducted a study in 24 middle schools (6^{th} - 8^{th} graders) in one district in the southwestern United States. Using multilevel-modeling, they found that 16% of the variability in mathematics achievement and 28% of the variability in mathematics growth was due to school-to-school differences. Individual background characteristics (gender, non-Anglo, ELL, and economically disadvantaged status) accounted for 29% of the variation in students' initial status in mathematics, 9% of the variation in student growth, 72% of the variation in school mean achievement, and 17% of variation in school mean growth.

The authors also examined the influence of school context as defined by free or reduced-price meals, mean education level of sixth-grade teachers, and approach to teaching math curricula. They found that school context was statistically associated with school mean achievement. First, they found that the percentage of students eligible for free or reduced-price lunch accounted for 58% of the variance in school-achievement means (growth was unchanged). For every unit increase in percentage of students eligible for free or reduced-price lunch, there was almost a quarter of a scale-score point drop in student achievement. The mean education level of sixth-grade teachers was not statistically associated with school mean achievement, but was related to school growth rates. For every unit increase in teacher education level (about 1 year), there was a 3.25-point yearly increase in the average mathematics growth of students. In addition, schools using a traditional approach to teaching math curricula outperformed schools that adopted a reform curricula by under 3 scale-score points per year. Together, math curricula and teacher education accounted for 40% of the remaining variation in school growth rates.

To summarize Zvoch and Stevens (2006) study, students and schools differed significantly in achievement levels and growth rates. Results indicated that the variation within schools (individual student scores) was greater than the variation found between schools on both achievement and growth in math. This suggests that the influence of individual characteristics is greater than the influence of school characteristics. Differences between schools in growth were more varied than school-to-school differences in achievement.

Additionally, Hedges & Hedberg (2007) conducted a study to look at variance in student achievement across a nationally representative sample of schools in grades K-12. They found between 14%-26% (mean of 22%) of the variance in math achievement between schools, which means that the remaining variance resides within schools (thus, there is a wider distribution of scores among individuals in a school than there is between schools). Similar results were found for reading achievement with 17%-27% (mean of 22% across grades) of the variance in reading achievement residing between schools.

References

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