Innovamat

Everything That Matters in Learning Mathematics

A map of the factors that influence learning and how schools can act on them

Lucas Gortazar
Director of Education at EsadeEcPol; senior consultant with the World Bank's Education Global Practice; research collaborator at the Innovamat Research Lab (external author).

Marc Colomer
Director of Research at the Innovamat Research Lab.

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Abstract

When a school's mathematics results fall short of expectations, the conversation quickly turns to blame: the latest education law, screens, families, teachers. This report brings clarity to that debate. It reviews research on the factors that influence mathematics learning and addresses three questions about each: how much it matters, how and when it operates, who can change it, and how long that takes. It develops four ideas.

- The effect of any factor can be observed across three levels of outcomes. Learning: whether it improves students' mathematical proficiency, in both content and practices. Students' relationship with mathematics: whether they enjoy it and feel capable of learning it. And progression through the education system: whether they repeat a grade, drop out, or continue their education. All three matter, and they do not always move together.

- Factors operate at different distances from the classroom and fall into two pathways that converge in mathematics class. On one side are society, the family, and what each student brings with them. On the other are education policy, school leadership, and the teacher. Materials contribute to both. How much each factor matters depends on the scale. More distant factors, such as wealth, values, and education policy, primarily explain differences across countries and systems and operate indirectly and slowly. Closer factors explain differences within each system, student by student and school by school. All accumulate over the years.

- All factors converge in the instructional core: the daily interaction among teachers, students in the classroom, and content around a task. Its three elements depend on one another: good materials accomplish little if the teacher does not know how to make the most of them. A good activity with good management loses its impact if the tasks do not connect with what students already know. And professional development disconnected from the classroom rarely changes what happens inside it.

- A school cannot act on every factor. Its levers are leadership, teachers, and materials, and through them it decides how to respond to what each student brings. Its room for action is limited, but its potential is substantial, especially when these levers reinforce one another. The improvement strategy with the strongest evidence is sustained support for teachers, in the classroom and tied to quality materials.

The report closes with a table and a figure summarizing what a school can change, seven questions for placing any decision on the map, and responses to the most common objections.

Introduction

Whenever mathematics results decline in an education system, everyone looks for someone or something to blame. For some, it is the latest education law. For others, screens or families who are not involved. Some point to a teaching method they dislike. Almost everyone ends up pointing to teachers. Interestingly, something similar happens when results improve. Yet people generally overlook these factors as a whole and how they relate to one another.

This report seeks to fill that gap. For more than half a century, education research has tried to bring evidence to this debate. Today, we understand much more about the importance of families, neighborhoods, policy, school leadership, and teachers for learning in general and mathematics learning in particular. Over the past two decades, we have also become better at distinguishing correlations from causal effects. We explain how to make that distinction in the report "Does it work? How to understand the evidence behind a mathematics program." Here, we apply it to organize and weigh the available evidence.

The main conclusion will disappoint those with the most simplistic, short-term views. Mathematics learning is shaped by many factors. The most influential is the one school professionals cannot change: the home. Others, such as the neighborhood or education policy, operate slowly and reach all students. But those within schools' reach—who teaches and with what support—also have enormous potential whenever a new school year begins. Today, that potential is not realized equally everywhere, and fulfilling it requires more support.

From a school's perspective, then, the most useful question is not "Who is to blame?" but "Of everything that influences mathematics learning, what matters most, how does it work, and how much can a school change?"

The report begins by defining what we mean by mathematics "outcomes." It then presents a map organizing the factors into two pathways: the social, cultural, and economic pathway, and the educational pathway, from policy to teachers. We follow each from the most distant factors to the closest until we reach the classroom, asking the same three questions about each: how much it matters, how it operates, whether a school can change it, and how long that takes. We then explain why any classroom action requires coherence among content, teachers, and students. We close with a table examining a school's room for action on each factor and a figure showing the importance of the three it can change—leadership teams, teachers, and materials—always keeping the student at the center.

By the End of This Report

you will know the three dimensions in which any factor can be expected to affect mathematics outcomes; how the factors are organized and how much each matters; why learning occurs in what we will call the "instructional core" and why its components depend on one another; why a good teacher's effect accumulates year after year; and why some factors matter greatly but are largely beyond a school's reach, and vice versa. You will also have more context for deciding what to ask about any program or project that aims to improve mathematics in a school.

1 | Three Different Ways of Understanding Mathematics Learning

Having defined the question we want to answer in the introduction—which factors influence mathematics learning, and how—we should clarify what we mean by "**learning mathematics**." When we talk about improving mathematics education, we usually think of classroom grades and external test results. These relate to the first level of mathematics impact: **learning**. The definition of mathematical proficiency falls within this learning dimension and has previously been discussed in greater detail in the Innovamat White Paper (2024). For this report, **we propose adding two more levels of impact**. One is informal: students' relationship with mathematics, which leaves no visible record but stays with them throughout their lives. The other is formal: progression through the education system, which makes mathematics a gateway to later stages.

The first is students' **relationship** with the subject during school and throughout life. This includes enjoyment of learning mathematics, the anxiety it generates, identity ("I'm not a numbers person"), and the intention to keep learning and thinking about mathematics once it is no longer required. All these variables can be measured, influence achievement (Foley et al., 2017), and are themselves affected by teachers in the classroom (Blazar and Kraft, 2017). This is the informal side of learning, but it matters at every stage of life.

The second is **progression and persistence** within the formal education system: whether students repeat a grade, drop out, choose pathways that include mathematics, and reach higher education. Here, mathematics matters more than any other subject. It opens doors: taking more mathematics in secondary school causally increases years of education and adult earnings (Cortes, Goodman, and Nomi, 2015). It also closes them: failing mathematics is probably more influential than failing any other subject in the decision to retain a student, and grade retention in secondary school increases the likelihood of dropping out (Jacob and Lefgren, 2009).

Consider a student in the third year of compulsory secondary education in Spain, equivalent to ninth grade, who begins to assume that "math isn't my thing" after two difficult school years. Their grades this term may not yet reflect it, but that belief can become a self-fulfilling prophecy. In what follows, therefore, our analytical framework uses "mathematics outcomes" to refer to all three things together: what students learn, how they progress through the system through mathematics, and the relationship they have with it.

"Mathematics is something we learn, something that stays with us throughout life, and something that largely determines how far we go in the education system."

2 | Mathematics Outcomes Depend on Multiple Interconnected Factors

To improve a school or implement a program with an impact, it is essential to understand the system in which that change must occur. This requires considering how society and the education system affect school outcomes in general and mathematics outcomes in particular. A useful starting point is a study that shaped the education debate: the Coleman Report.

In 1964, the U.S. Civil Rights Act required the federal government to produce a report on educational inequality. Sociologist James Coleman led the study, collecting data on hundreds of thousands of students. The initial hypothesis anticipated documenting how much worse the schools attended by Black children were. But Coleman's team found something different: differences in resources and outcomes across schools were large, but smaller than those observed within schools. Coleman thus found that family background, including that of other students in the same school, explained a larger share of differences in student outcomes than differences across schools did (Coleman et al., 1966). The report helped clarify the extent to which family background explained differences in educational outcomes and, to some extent, tempered expectations about the power of education and schools to shape student outcomes.

Although this finding was a minor setback for the emerging education reform agenda, it did not mean that nothing schools do matters. It meant that schools do not start from scratch: when children arrive at school, they bring individual characteristics, including their genetic inheritance, and several years of conversation, play, health, and care. In mathematics, this can mean enormous differences in experience already present at an early age: gaps in numeracy by social background are visible at school entry, and these early skills are among the strongest predictors of later mathematics learning (Duncan et al., 2007). Schools therefore receive a trajectory already underway. Their job is to help transform it, whatever each student's circumstances. And they have more room to act than it might seem. Later research found much of that room where Coleman could not look: in differences across classrooms within the same school and in teachers' impact on their students (Hanushek and Rivkin, 2012).

How Can We Organize the Factors That Affect Mathematics Learning?

To organize the factors involved in learning, we draw on the ecological approach developed by Bronfenbrenner (1979) and Bronfenbrenner and Morris (2006). This approach places development, and by extension learning, within mutually interacting systems: children's immediate environments, such as home and classroom; relationships among those environments; contexts that affect them indirectly, such as government decisions or neighborhood resources and social capital; and, finally, the surrounding cultural norms and economic structures.

Figure 1 organizes the factors that influence mathematics learning and the three outcome dimensions introduced earlier. It arranges them in layers and distinguishes two pathways of influence, from the broadest context to the environments closest to the classroom. Broader conditions help shape what happens in closer environments and can affect the entire system. In that sense, their reach and aggregate impact are substantial. This arrangement simplifies a reality in which the different layers and pathways are interconnected.

The **first pathway**, at the top, captures students' social and family context and personal trajectory. Cultural, economic, and social patterns help shape neighborhoods and the conditions in which families live. This helps explain differences across education systems, but also those within each one: sharing the same system does not mean having the same resources and opportunities. Families' education, employment, and expectations, along with the academic support they provide, influence students' trajectories. Genetic inheritance and health in the earliest years also play a role. Each student thus enters the classroom with their own health characteristics and genetic inheritance, together with a cultural background and accumulated knowledge, beliefs, and experiences.

The **second pathway**, at the bottom, captures the education system as a whole. Education policy establishes public investment, teacher policies, the curriculum, and how the system, schools, and teachers are evaluated. These decisions shape the preparation and selection of those entering teaching and school leadership, learning objectives and their assessment, school support structures, and resources and working conditions. Part of these policies' influence on learning takes shape through the decisions and practices of leadership teams and teachers. In turn, as we will see, a leadership team's influence is channeled partly through teachers. These conditions help shape teachers' professional skills, beliefs, and opportunities for continuing professional development.

Finally, **mathematics (curriculum) materials** appear on the left side of the map: the structured set of resources designed to teach curriculum content. The **three outcome dimensions** described in Section 1 appear on the right.

The two pathways converge in the center, in the classroom. This is the location of what is known as the **instructional core** (Cohen, Raudenbush, and Ball, 2003)[1]: the interaction among teachers, students, and content around a task. It is where formal learning occurs at school, and other factors matter insofar as they change what happens there. To change it, a proposed approach must arrive under optimal conditions. The map surrounds the core with two levels of implementation: the system level, which establishes conditions for effective implementation in all schools, and the classroom level, where an instructional approach is first implemented with fidelity and then adapted with guidance and support. After presenting how each factor operates, the report concludes with an in-depth discussion of how to act on the instructional core and how its three dimensions depend on one another.

The layers in Figure 1 are interconnected, and their relationships do not run in only one direction. For example, initial teacher preparation policy directly affects the preparation teachers bring to the classroom. Families can influence leadership decisions, and school leaders can encourage family participation. Measures such as offering breakfast to every student directly affect readiness to learn. For readability, the figure prioritizes the most direct relationships. Appendix A presents a more detailed model.

Three Questions for Each Factor

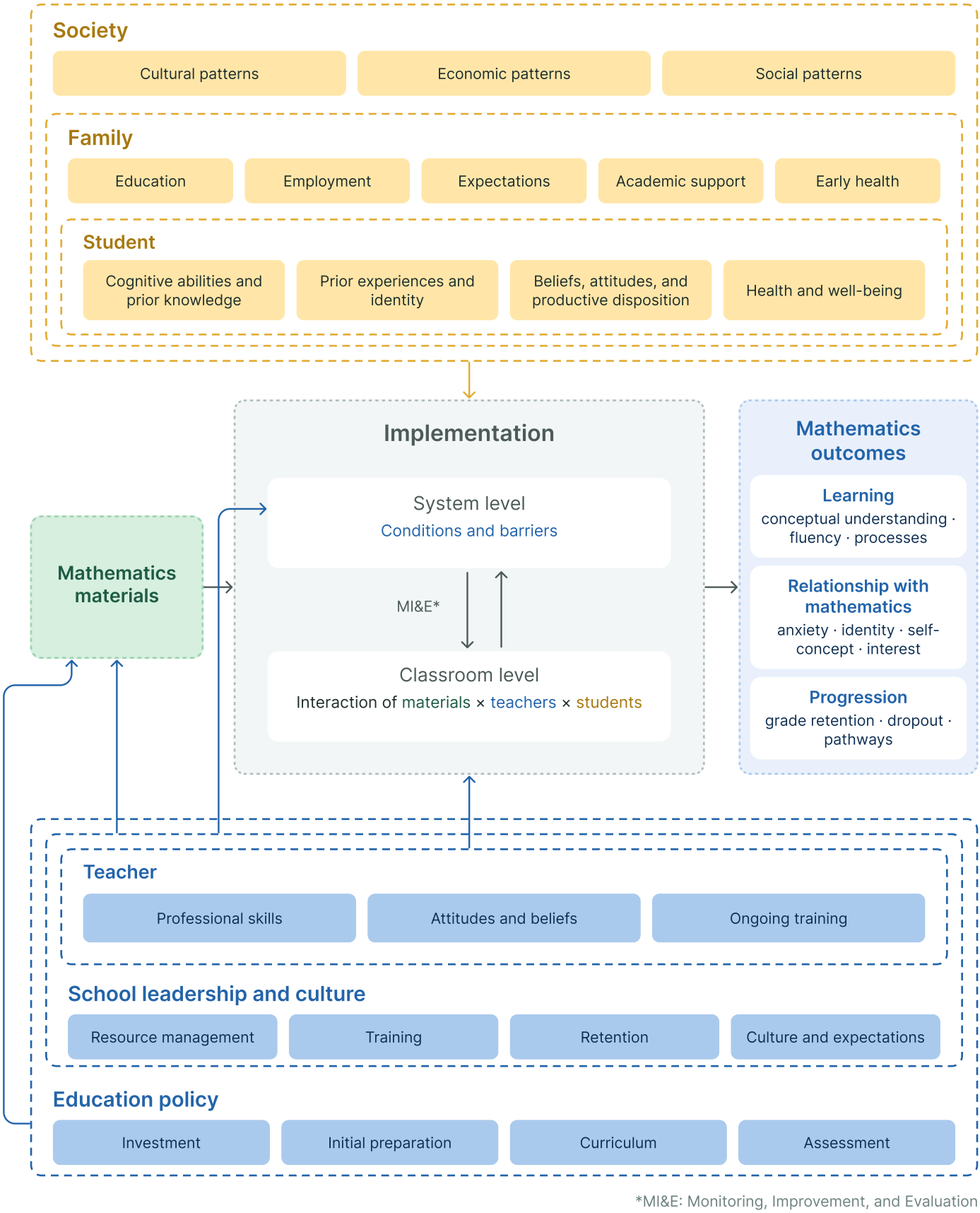
We will ask the same three questions about each factor. How much does it matter? How does it operate? And who can change it, and how long does that take?

How much a factor matters depends on the scale we examine. Across countries and education systems, the broadest conditions in Figure 1 carry weight: wealth, values, and education policy. Within a single system, much of the difference among students relates to their families and what they bring to the classroom. And within a school, the teacher is one of the factors with the greatest potential to influence learning. We therefore cannot compare the importance of all factors without distinguishing levels: their importance changes depending on which differences we are trying to explain.

Many factors operate gradually, and their effects accumulate. Families, neighborhoods, and policy do so, but so does a good teacher, whose effect is felt year after year. What differs is the lever and the time needed to move it. A teaching staff can change how it teaches fractions within a term, and a leadership team can reorganize staff time within a school year. Transforming family or neighborhood conditions usually takes years, and an education reform can also take time to reach the classroom.

It is therefore useful to distinguish a factor's importance from a school's ability to act on it. Family circumstances can have a substantial influence while remaining largely beyond the school's reach. Teaching, although not the most influential factor overall, is the school's strongest lever for improvement. This distinction avoids two opposite traps: believing that what schools do not control does not matter, and believing that because outside factors matter so much, schools can do nothing. **A school's room for action is limited, but it allows concrete changes that can begin benefiting students this very school year.**

1 Other theoretical frameworks, such as those of Houssaye (1988) and Chevallard (1985), share the pedagogical triangle structure, with content or knowledge, students, and teachers. However, the instructional core takes a more practical approach focused on school improvement.



*MI&E: Monitoring, Improvement, and Evaluation

Figure 1. A layered representation of the factors in mathematics learning and their relationship with the instructional core. *Note*: Authors' illustration based on Bronfenbrenner (1979) and Cohen, Raudenbush, and Ball (2003). At the top is the pathway through society, family, and student. At the bottom is the pathway through education policy, which moves down to school leadership and the teacher. Both converge in the classroom, where system- and classroom-level implementation translates these conditions into learning opportunities. Materials appear on the left; the three outcome levels from Section 1 appear on the right.

To put the numbers in perspective, we will use the following benchmark: a rigorously evaluated education program improves learning by a median of about 0.10 standard deviations in one school year (see the report “Can a Mathematics Program Really Change Learning?”).

The factors that influence mathematics learning fall into two pathways: society, family, and student on one side; policy, leadership, and teacher on the other. Both converge in the instructional core, the daily interaction among teachers, students, and content, and each factor matters insofar as it changes what happens there. To determine how much each factor matters, we ask how influential it is, how it operates, who can change it, and how long that takes.

3 | First Pathway: Society, Family, and Student

Economic Development, Values, and Their Importance for Education

Economic development and learning reinforce one another. Wealthier countries achieve better results: in PISA 2022, approximately 62% of differences in average scores across countries were associated with GDP per capita (47% among OECD countries). However, above roughly $75,000 in cumulative spending per student, the relationship between spending and results begins to weaken (OECD, 2023). The reverse also holds: countries whose populations have stronger competencies and skills develop more. The evidence suggests that the association between cognitive skills and growth reflects a causal effect of the former on the latter (Hanushek and Woessmann, 2012).

Income explains a great deal, but not everything. Values help explain why countries with similar levels of wealth achieve very different results. Patience and effort, which contribute positively, and willingness to take risks, which contributes negatively, together explain between one-third and two-thirds of cross-country variation in PISA. The finding holds when immigrant students within the same country are compared according to the values of their country of origin (Hanushek et al., 2022; Zamarro, Hitt, and Mendez, 2019). When students in Shanghai and the United States were offered financial incentives to try harder on a test, U.S. students improved substantially, while Shanghai students did not: they were already doing their best because their intrinsic motivation, linked to values, was high (Gneezy et al., 2019). Children of immigrants from countries with strong PISA results outperform native-born peers from similar social backgrounds, even in the same school (De Philippis and Rossi, 2021). In the United States, Asian American students' advantage is primarily attributable to effort, rather than cognitive ability or social background. These students are more likely to believe that being good at mathematics can be learned (Hsin and Xie, 2014).

These values are transmitted through families and translate into private investment. Private tutoring has a long history in East Asia, including Korean *hagwons* and Japanese *jukus*, and plays an especially prominent role in that region (Bray, 2022). The costs of this value system are social and emotional: Asian American students have a poorer self-concept and spend less time with friends (Hsin and Xie, 2014). In Korea, competition for educational status is so intense that studies estimate the birth rate would be 28% higher without it (Kim, Tertilt, and Yum, 2024).

A country's wealth and values account for much of the difference across countries, and learning, in turn, fuels growth. They operate both inside and outside the classroom, through families and across generations. No school can change them in a single school year.

Society and Community: The Role of Neighborhoods and Peers

Beyond the values held by society as a whole, the community factors closest to students—and thus those that affect them most directly—are their neighborhood and their schoolmates and classmates.

Does the Neighborhood Matter?

The neighborhood where a student grows up matters over the long term, and its effect is cumulative. Chetty and Hendren (2018) followed more than seven million U.S. families who moved. Children's educational outcomes improved in proportion to the time spent in the new environment, at an approximate rate of 4% improvement relative to their previous neighborhood for each year of exposure to the new one. Growing up in an environment with more opportunities increases adult earnings and facilitates access to higher education. This factor's effect is therefore more visible in the third outcome dimension—educational progression—than in school outcomes, including mathematics, in a particular year. The design

identifies the effect, but not the channel. Aspirations, information, and school quality are plausible mechanisms that these data cannot disentangle.

What About Classmates and Schoolmates?

The effect of classmates is small on average but large at the extremes of the distribution. Within the classroom, the average peer effect on mathematics is small (Burke and Sass, 2013). However, several studies suggest that a few students with highly disruptive behavior generate real, lasting negative effects on the entire class, measurable even in their classmates' adult earnings over the long term (Carrell, Hoekstra, and Kuka, 2018). Sharing a classroom with low-achieving students, by contrast, is not inherently a problem: in the Project STAR experiment, kindergarten children randomly assigned to classes with peers repeating a grade scored slightly lower in mathematics that first year. The effect disappeared, and in the long term they were more likely to complete high school (Bietenbeck, 2020). Peers primarily exert their influence through classroom climate, which depends partly on teachers' classroom management practices.

Neighborhoods have real, cumulative effects, especially on educational progression and adult earnings. Peers matter little on average, except in cases of severe disruption. Neighborhoods operate outside the classroom and over the years; peers operate inside the classroom through the learning climate. A school cannot change its neighborhood in a year, but it can improve classroom climate management, the mechanism through which peers have the greatest influence.

Family Is the Most Influential Factor for Students

According to the body of prior research, the next layer inward along the societal pathway has the greatest influence on educational outcomes. And that influence begins long before schools start to play a role.

In PISA, comparing students by socioeconomic status, the mathematics gap between 15-year-olds in the most advantaged 25% and those in the least advantaged 25% averaged 93 points across the OECD. A one-standard-deviation increase in the socioeconomic index was associated with 39 additional points. The OECD estimates that a 15-year-old progresses by about 20 points per school year. Thus, 39 points is nearly two school years, and 93 is more than four (OECD, 2023). The relationship between family background and outcomes is substantial across all countries, periods, and possible measurement instruments.

These findings require some methodological caution. In general, the relationship between family background and educational outcomes comes from statistical associations and correlations, rather than causal effects. An index explains between 15% and 25% of the variation in outcomes within each country.[2] Although such indices cannot capture everything families contribute to students—genes, habits, expectations—this indicates that a substantial share of what distinguishes one student from another is attributable to other factors.

Through Which Channels Do Families Exert Their Influence?

Parents' education is the first channel of influence, though somewhat less important than a raw correlation between parental education and student outcomes suggests: part of that correlation captures other resources and habits of more educated parents (Holmlund, Lindahl, and Plug, 2011). Parents' employment status and occupations also matter greatly. For example, when fathers lose their jobs, evidence shows that their children's educational outcomes decline by around 0.15 standard deviations, as observed in Barcelona during the Great Recession, with effects concentrated among families experiencing long-term unemployment and lower levels of education (Ruiz-Valenzuela, 2020). Finally, beyond more material circumstances, household expectations, practices, and habits also matter (Pinquart and Ebeling, 2020; Daucourt et al., 2021).

2 Both figures come from the same PISA regression. The slope (39 points) measures the size of the gap; the strength (15% of explained variance) measures how much of the total variation it captures. They are not interchangeable, and a large gap is compatible with substantial variation that background does not explain.

More specifically, the academic support families provide to their children matters. A recent meta-analysis finds that high family expectations are associated with better mathematics achievement, while help with homework has, on average, a negative association with achievement (Wang and Wei, 2024). This association does not mean that help is inherently harmful. To interpret it, we should distinguish between family involvement perceived as controlling, associated with poorer results and lower motivation, and support perceived as helpful, associated with greater persistence on tasks (Silinskas and Kikas, 2019). Anxiety can also pass from parents to children: children of math-anxious parents who frequently help with homework learn less mathematics during the school year and end the year with greater anxiety (Maloney et al., 2015). The effect of families' academic support thus operates across at least two outcome dimensions: learning and students' relationship with mathematics.

"Family" is the most influential factor for students. When we discuss the importance of family, we are not referring to a single characteristic or something for which anyone should be blamed. The term encompasses several channels: education, employment, expectations, academic support, and health in the earliest years. They must be distinguished because the evidence and possible responses differ in each case.

How Much of the Family Gap Is a Health Gap?

Beyond cognitive, material, and relational dimensions, health is an important channel in explaining the relationship between family and educational outcomes. This channel is often easier to identify because it depends on what happens to families rather than what they do: children's health in the earliest years of life. In Rhode Island, a study showed that each one-microgram-per-deciliter reduction in blood lead during early childhood reduced the likelihood of scoring below minimum mathematics proficiency in third grade by about 0.8 percentage points, from an initial rate of 16% of students (Aizer et al., 2018). Because poor children face much greater exposure, this widens the social gap.

In Sweden, another study showed that children exposed in utero to Chernobyl radiation in the hardest-hit areas were approximately 3.6 percentage points less likely to reach upper secondary education beyond compulsory schooling. This exposure was unrelated to any family decision, and the harm was concentrated in mathematics grades (Almond, Edlund, and Palme, 2009). In Guatemala, a nutritional supplement in the early years translated, 25 years later, into approximately a quarter of a standard deviation higher scores on reading comprehension and reasoning tests (Maluccio et al., 2009). These effects emerge decades later, in learning and educational progression that shape adult life.

Thus, part of the socioeconomic learning gap originates as a health gap. This makes it possible to address it through public health policies—prenatal care, nutrition, and social and emotional support for families—outside school.

"Part of the socioeconomic learning gap originates as a health gap."

Can Schools Do Anything About All This?

It is possible to act on the home environment, and the benefits can emerge in different areas. In Jamaica, a stimulation program involving weekly visits over two years to children with stunted growth increased their labor earnings by 25% two decades later (Gertler et al., 2014). Although it was not a school intervention, it shows that support for the home can have lasting effects. In preschool, a simpler intervention—sending families text messages with brief activities—improved parental involvement and increased children's early literacy by about 0.11 standard deviations (York, Loeb, and Doss, 2019).

Family–school collaboration can also foster participation and a positive school climate, goals with educational value in their own right. In a trial in France, three family–school meetings increased parental involvement and reduced absenteeism and disciplinary sanctions (Avvisati et al., 2014). However, these gains were not accompanied by improvements on external reading and mathematics tests. Other interventions influence educational choices: providing families with materials for discussing the usefulness of mathematics and science led their children to take more courses in these areas in high school and subsequently improved their combined score in both subjects on a college entrance test (Harackiewicz et

al., 2012; Rozek et al., 2017). Evaluating such interventions therefore requires attention to their different goals: supporting learning, strengthening ties with school, or helping students continue along pathways that include mathematics.

Family background is the factor most strongly associated with mathematics outcomes, and its importance reflects several channels combined: education, employment, expectations, academic support, and early health. It operates inside and outside the classroom, largely before schooling begins. Schools cannot change many of these factors—early health, employment, and others—but they can improve family participation, provide resources to support learning at home, and help families adjust their expectations.

From Home to Classroom: What Each Student Brings to School

All of the above enters the classroom in the form of a particular student with unique characteristics that define them as a person beyond their circumstances. The neighborhood, family resources, early health, and household expectations take shape in students who bring prior knowledge and strategies, a cultural background, aspirations, an already developing relationship with mathematics, and experiences, languages, and knowledge that schools may or may not turn into resources for learning. At the same time, there is something individual about how each student approaches learning and their relationship with school. The same person may even reason confidently in one context and freeze in another.

What each student brings matters greatly and operates directly because the student is one of the three elements of the "instructional core." Even so, their future is neither written nor predetermined: schools can and commonly do influence students regardless of family background or individual characteristics. Three dimensions both constrain and stimulate this process: what students already know, their specific difficulties, and how they feel about mathematics.

How Much Does What a Student Already Knows Matter?

A great deal. What students already know shapes how they interpret and integrate new information (Brod, 2021; Schneider and Simonsmeier, 2025). Their starting point—their mathematical knowledge and skills, together with cognitive resources such as working memory—is ultimately related to achievement years later (Geary, 2011; Ruiz et al., 2024). As we have seen, numerical skills at school entry are among the strongest predictors of later mathematics learning (Duncan et al., 2007). But how much each student learns varies considerably with the content and the conditions under which they learn at school (Simonsmeier et al., 2022). **Initial skills** are not destiny, which is why early, effective intervention is so important: early learning facilitates later learning, and its effects last longer when subsequent experiences sustain it (Cunha and Heckman, 2007; Bailey et al., 2020), reinforcing the cumulative-effect argument developed earlier.

What About Learning Difficulties?

So-called "learning difficulties" affect a minority of students but have implications for teaching, materials, and school organization. In mathematics, for example, an estimated 3% to 7% of students have dyscalculia, a persistent difficulty in understanding, representing, and working with numbers and quantities (Butterworth, Varma, and Laurillard, 2011; Devine et al., 2018). These difficulties affect the development of number sense and the ability to perform basic operations and calculate fluently, and they generally require more explicit, structured instruction, tailored supports, and more guided practice (Jitendra et al., 2021).

How Do Students Feel About Mathematics?

Students' emotions about mathematics affect their achievement and later choices. How students feel about mathematics, how they perceive it, and how much confidence they have in their ability to learn it are ultimately related to achievement and academic decisions (Barroso et al., 2021; Di Martino and Zan, 2011; Eccles and Wigfield, 2024). These findings show that the second outcome dimension in Section 1—students' relationship with mathematics—appears here as a starting point and affects the other two. But

because it is also an outcome in its own right, we understand it as something malleable rather than fixed. Influence runs in both directions (Carey et al., 2016).

The practical conclusion is straightforward. The same practice, activity, or resource will not have the same effect on every student. Students differ in their knowledge, abilities, experiences, beliefs, emotions, and interests in mathematics. We cannot assume they all start from the same place or will respond in the same way, but we must ensure a high-quality education tailored to every student's needs.

What each student brings individually matters greatly: prior knowledge, possible difficulties, and their relationship with mathematics shape what they will learn and their long-term outcomes. This operates directly, inside the classroom, because the student is one of the three elements of the instructional core. It has developed over years, but it changes with every task, teacher, and classroom climate. This makes it one of the factors schools can influence most within a school year: by knowing what each student knows and needs and adjusting instruction accordingly.

4 | Second Pathway: The Education System and the School

Education Policy Shapes the Conditions for Success

Having discussed the social, family, and community dimension and its influence on educational and mathematics outcomes, we now turn to the educational dimension as a whole, the second pathway of impact. The most distant layer in this pathway is education policy: the decisions, goals, investments, rules, and support structures governments establish so that schools can act and have an impact on their students. Below, we examine the four most important policies included in the map: investment policy, teacher policy, assessment and evaluation policy, and curriculum policy.

Education policy can have a substantial impact on mathematics outcomes. But it takes years to unfold fully and depends on two things: its design and the capacity of the governments, agencies, and intermediary actors that implement it. Implementation capacity matters so much that it can reverse the direction of a policy's effect. For example, granting schools more autonomy is associated with better results in systems with strong institutions and worse results where schools have less capacity (Hanushek, Link, and Woessmann, 2013). Design and implementation matter at the system level because the distance between government documents and the classroom is the greatest of any relationship shown in Figure 1.

Investment and Funding Policy: Does Money Matter?

Resources do matter, but they must be sustained and well targeted. For years, the claim that "money does not matter" was repeated on the basis of correlational studies comparing districts and systems with higher and lower spending (Hanushek, 2003). More recent studies using causal designs have changed that conclusion. Jackson, Johnson, and Persico (2016) followed students exposed to U.S. school finance reforms over the preceding two decades and found that sustained increases in per-student spending increased years of schooling and adult earnings, especially among children from poor families. Lafortune, Rothstein, and Schanzenbach (2018), in turn, studied post-1990 local school finance reforms in the United States. Ten years later, the relative outcomes of low-income districts had improved by about 0.1 standard deviations, one-fifth of the gap with higher-income districts. The implied effect is between 0.12 and 0.24 standard deviations for each additional $1,000 in annual spending per student, specifically in the U.S. context. Thus, the key words for funding here are "sustained" and "targeted" toward students who benefit more than others, an argument that can also apply when comparing lower-income systems where the potential for improvement is greater.

Teacher Policies: Who Enters, How They Are Prepared, Where They Teach, and How They Are Evaluated

Teacher policy determines who reaches the classroom, which classrooms they enter, and under what incentives. It matters, but its best results do not always hold up at scale.

Who enters the profession and how they are initially prepared. In Florida, teachers who entered during economic recessions, when alternative job opportunities were less attractive, subsequently proved more effective, suggesting that the profile of entrants matters (Nagler, Piopiunik, and West, 2020). Initial teacher preparation programs show differences in their graduates' effectiveness (Boyd et al., 2009), although we know less about which features explain these differences. Finally, degrees and certifications are weak predictors of teacher performance in U.S. data: effectiveness varies considerably among teachers with the same certification from their very first year (Kane, Rockoff, and Staiger, 2008).

Where teachers teach. Students have unequal access to effective teachers. Which teachers end up in which schools explains a substantial share of the gap between students from advantaged and disadvantaged backgrounds (OECD, 2018), and this distribution is shaped by education policy. Each system's rules governing entry, placement, and retention in the profession matter as much as what individual teachers subsequently do in their classrooms. When we examine teachers as a factor in their own right, we will see that they are the most influential school-based factor.

How teachers are evaluated and what impact evaluation has. In Washington, D.C., the IMPACT system combined evaluations with performance-based financial incentives and the possibility of dismissal. The system increased voluntary departures among the lowest-rated teachers and improved the performance of those who stayed (Dee and Wyckoff, 2015). But these more aggressive evaluation models have costs: when teacher evaluation reforms spread to dozens of states, their effects on learning and graduation were null (Bleiberg et al., 2025). Continued pressure for results also came at a cost to the number and quality of people choosing to enter teaching (Kraft et al., 2020). It is therefore important to remember that what works in a district with the capacity to implement it well may not hold up when expanded and may have unintended system-wide consequences.

Assessment Policy: Does More Testing Improve Mathematics?

Policies for assessing systems and schools can improve results, but not every change they produce translates into learning. The U.S. No Child Left Behind Act (NCLB) of 2002 required annual mathematics and reading testing for all students in grades three through eight and imposed consequences on schools that failed to make sufficient progress. By 2007, it had raised fourth-grade mathematics results by approximately 0.23 standard deviations, with gains across the distribution—a meaningful effect. Gains were smaller in eighth grade and absent in reading (Dee and Jacob, 2011). However, part of that increase reflects responses to test incentives and test design, rather than necessarily more learning for every student (Koretz, 2017).

Curriculum Policy: Does Changing the Curriculum Change What Students Learn?

Curriculum policy has a small average impact when considered on its own. Here, we define curriculum policy as the process through which a government writes a curriculum, sets objectives, provides support, and implements it up to the school door. The specific program and materials each school selects are a separate matter, addressed in the section on the instructional core. For example, adopting the Common Core standards in the United States produced barely discernible effects (Song et al., 2022). The mechanism of impact encompasses the entire implementation layer. If the fourth-grade teacher continues explaining fractions just as she did last year, using the same task and the same conversation, a curriculum decree will have traveled through the entire system only to stop at the classroom door.

> *"A law changes what is on paper. Learning changes only if what happens on a Tuesday morning in a particular classroom changes."*

Education policy can matter greatly, but over a period of years. Sustained, targeted spending improves learning and progression; teacher policy determines who can teach and how they are prepared and evaluated; external assessment of systems and schools can change mathematics results, though not always in the intended ways. These are, in sum, a government's levers: their effects are slow, reach all students, and take years to become visible in schools, but when the policies are well chosen, their impact is substantial.

Good Leadership Multiplies Teachers' Impact

School leadership is the first stop on the educational pathway once we reach the school. It matters greatly because it helps teachers work more effectively and enables the school to operate around shared goals. Although some estimates of its effect on learning are small, it remains a strategic point for intervention: it can organize improvements for the entire teaching staff and connect instruction with families, resources, and school values. To assess its contribution, we should distinguish how much influence it has from how it exerts that influence.

How Much Does Leadership Influence Student Learning?

Recent estimates suggest moderating expectations about one individual's effect. Grissom, Egalite, and Lindsay (2021) estimated that a one-standard-deviation increase in principal effectiveness raised learning by 0.13 standard deviations in mathematics and 0.09 in reading. However, some methods attributed to

leadership changes caused by other factors, and principals' limited mobility across schools made it difficult to separate the individual's effect from the school's. Addressing these problems with data from Tennessee, New York, and Oregon, Bartanen, Husain, and Liebowitz (2024) estimate an effect of approximately 0.03 standard deviations in mathematics. This figure includes influence exerted through teachers: it is not an exclusively direct effect to which we can then add indirect effects.

How Does Leadership Help Improve Teaching?

The main pathway is improving the conditions for teaching. Reviews highlight instructional support, professional development, and collaboration as relevant leadership practices (Robinson, Lloyd, and Rowe, 2008; Grissom, Egalite, and Lindsay, 2021; Tan, Dimmock, and Walker, 2024). A review of 51 studies finds associations between leadership behaviors and student learning ranging from 0.08 to 0.16 standard deviations; associations are larger for teacher well-being—between 0.34 and 0.38—and instructional practices—0.35 (Liebowitz and Porter, 2019). The evidence is almost entirely observational: it identifies meaningful relationships but does not, on its own, establish causality.

These relationships take shape in how the teaching staff works. Teachers in schools with higher-quality professional collaboration improve more quickly (Ronfeldt et al., 2015). Likewise, more highly rated principals retain more high-performing teachers and see more departures among the lowest-rated teachers (Grissom and Bartanen, 2019). Teacher management therefore deserves particular attention: it exhibits weaknesses and is closely related to instructional practices and learning (Bloom et al., 2015; Lemos, Muralidharan, and Scur, 2024).

Organizing a school well is also part of instructional improvement. Across more than 1,800 schools in eight countries, Bloom et al. (2015) find that better management—of work organization, resources, outcomes monitoring, and personnel—is associated with better educational outcomes. The study cannot establish causality. Using a design that exploits changes in principals at Italian secondary schools, Di Liberto et al. (2026) estimate that a one-standard-deviation increase in management quality raises results by 0.09 standard deviations in mathematics and 0.07 in language, and increases college aspirations. These figures answer different questions from estimates of individual effectiveness: they cannot be added together and do not demonstrate that impact automatically increases over time.

School organization also rests on school culture: trust among professionals, shared expectations, and the conviction that the teaching staff can improve outcomes. This last factor, collective teacher efficacy, is associated with reading and mathematics achievement, although observational evidence cannot attribute those differences to it alone (Goddard, Hoy, and Woolfolk Hoy, 2000). Leadership helps sustain these conditions through clear priorities, support, and routines for collaboration (Grissom, Egalite, and Lindsay, 2021).

What Happens When School Leadership Changes?

Continuity helps protect this collective work. Bartanen, Grissom, and Rogers (2019) estimate that principal turnover reduces achievement by approximately 0.03 standard deviations the following school year, on average. The cost is greater when a principal moves to another school and may be mitigated if the successor is experienced. This suggests managing transitions carefully, without equating stability with effectiveness.

The practical implication is to strengthen the practices that enable teachers to teach better and embed them in the school's everyday operations. This is leadership's contribution: turning the work of many teachers into shared improvement.

A **principal's** direct effect on mathematics is small within one school year, approximately 0.03 to 0.07 standard deviations, but grows over time when management practices are sustained. It operates indirectly, through teachers: organizing collaboration, protecting time, maintaining high expectations, and retaining those who improve. It is an essential lever for every school, and stability matters: leadership changes have a measurable cost.

The Teacher Is the Most Important School-Based Factor

We have reached the end of the second, educational pathway. Here we find the individual teacher: teachers are the school-based factor with the greatest impact on mathematics in a single school year, and that effect accumulates over time.

How Much Does a Good Teacher Matter?

A great deal, every school year. The teacher value-added literature, based largely on U.S. administrative data, places differences among teachers at between 0.10 and 0.20 standard deviations of mathematics learning per school year (Rockoff, 2004; Rivkin, Hanushek, and Kain, 2005; Chetty, Friedman, and Rockoff, 2014a). This figure describes how much teaching varies across classrooms within the same system, and its magnitude is substantial. In a single year, moving from an average teacher to an especially effective one is worth as much as a good education program, or more: recall that the median effect of rigorously evaluated programs is about 0.10 standard deviations. Unlike a program, that effect recurs every year with each group. A student who has a succession of good teachers accumulates a substantial advantage over peers (Figure 2).

Value added. A teacher's contribution to students' progress after accounting for their starting point and the group's characteristics. It is the least unfair way of comparing teachers who teach very different groups, and the estimates pass the most rigorous available tests for bias (Chetty, Friedman, and Rockoff, 2014a).

What Else Does a Good Teacher Change?

More than what is visible in grades or external tests. Students taught by high-value-added teachers are more likely to attend college and have higher adult earnings (Chetty, Friedman, and Rockoff, 2014b). The part that tests do not capture may be the most important: Jackson (2018) followed more than half a million ninth-grade students in North Carolina and found that a teacher's effect on student behavior—attendance, disciplinary sanctions, and grade promotion—predicts graduation much better than their effect on grades. Overall, a good teacher influences all three outcome levels in Section 1: learning, connection with school and the subject, and progression or trajectory.

What Distinguishes Teachers Who Produce More Learning?

Their knowledge and teaching experience. We have already seen that degrees predict little. What does predict student learning is teachers' knowledge, and not just any knowledge. In mathematics, the German COACTIV study followed 181 mathematics teachers and their 4,353 tenth-grade students for one school year. Pedagogical content knowledge, more than mathematical knowledge alone, drove student progress. The mechanism was cognitive activation in lessons: how much the assigned tasks made students think (Baumert et al., 2010). The OECD Teacher Knowledge Survey, involving approximately 20,000 secondary teachers in eight countries, points in the same direction. Where teachers know more about how to teach, students perform better in PISA and classes spend more time on instruction and less on maintaining order (OECD, 2026). These are, however, correlations rather than causal effects.

Pedagogical content knowledge. Knowing mathematics for teaching: which representation works for each concept, which errors are common, and which question helps a stuck student move forward. It is distinct from knowing more mathematics, and it predicts learning better.

Can Teacher Effectiveness Improve?

Yes, and for longer over a career than previously thought. Teachers continue to improve appreciably beyond their first five years, especially in mathematics, and there is evidence that improvement continues into the second decade (Papay and Kraft, 2015). Some improvement is collective: the quality of colleagues a teacher has worked with explains approximately 20% of their individual performance (Jackson and Bruegmann, 2009). This channel can be activated deliberately: an experimental project that paired

The cumulative effect of teacher effectiveness

A student's cumulative advantage depending on the teachers they have year after year

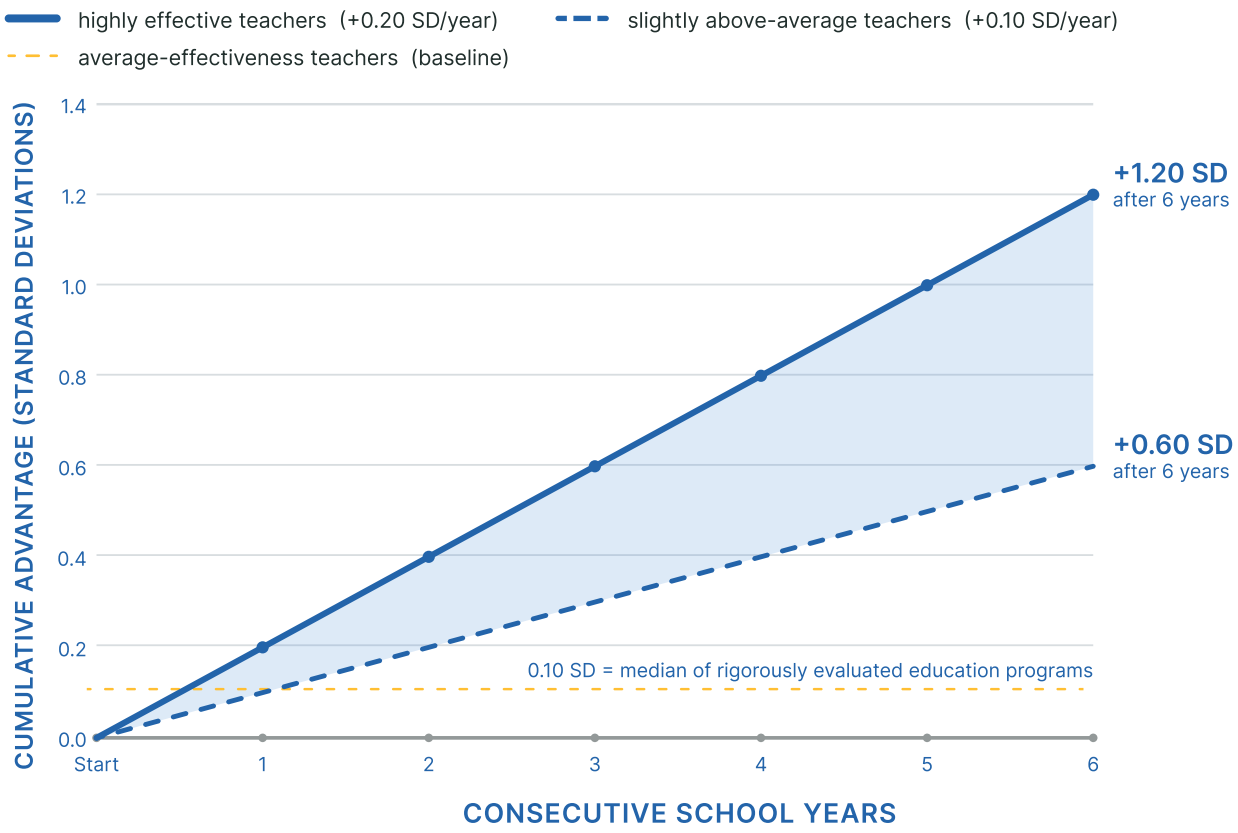


Figure 2. The cumulative effect of teacher effectiveness.
Note: Simulated trajectories comparing a student with a succession of teachers of average effectiveness with a student whose teachers are a level above, with advantages of 0.10 and 0.20 standard deviations per school year. An illustrative simulation, not an empirical estimate: it assumes that each year's effect is retained in full, which the evidence on the fading of effects over time does not guarantee. Authors' illustration based on the value-added ranges cited in the text.

teachers struggling with a specific skill with colleagues who had mastered it raised student outcomes by 0.12 standard deviations, with effects that persisted the following year (Papay et al., 2020). This shows that a school can achieve more than the sum of its teachers' initial capabilities and that supporting teachers has considerable potential for impact.

Among ways to invest in practicing teachers, in-class support—teacher coaching—has the clearest causal evidence. An expert works with each teacher on their own practice and in their own classroom, through frequent individual sessions based on observation, sustained over months, and focused on specific skills. This is the opposite of a generic, one-afternoon workshop for a group of teachers. Kraft, Blazar, and Hogan (2018) synthesized 60 causal studies of coaching and found that teacher coaching improves instructional practice by 0.49 standard deviations and student learning by 0.18, more than most interventions in this report. One included trial, involving 78 secondary teachers, measured student improvement in the year after the program, suggesting that the effect does not disappear when coaching ends (Allen et al., 2011).

These findings nevertheless require caution. Programs involving more than 100 teachers achieve approximately one-third of the learning effect of smaller programs, again illustrating the challenges of implementing a good program at scale (Kraft, Blazar, and Hogan, 2018; Kraft and Blazar, 2018). Moreover, the number of hours in a coaching program does not predict impact; what matters is what happens in each session and its continuity. The system's greatest opportunity for short- and medium-term improvement lies in supporting practicing teachers. But this is expensive, weakens as programs grow, and depends on design rather than accumulated hours.

The teacher is the most influential school-based factor: between 0.10 and 0.20 standard deviations in mathematics per year, as much as or more than a good program, with effects extending to college attendance and adult earnings. Teachers act directly, inside the classroom and every school year, and their effects accumulate. Schools can help them improve: teachers improve over many years, learn from colleagues, and respond to classroom coaching, the improvement strategy with the clearest causal evidence and also the most difficult to expand at scale.

5 | Everything Leads to the Classroom: The Instructional Core

Both pathways end here. Neighborhood, family, policy, leadership: all improve learning only insofar as they change what happens in a particular classroom around a particular task.

Instructional core. The interaction among the teacher, students, and content around a task. It is described as an interdependent relationship—sometimes simplified as multiplication—rather than addition because no element operates on its own. The effect of improving one depends on the state of the other two, and all other factors in the map improve learning insofar as they alter what happens here.

Where Does Learning Occur?

Cohen, Raudenbush, and Ball (2003) formalized this understanding of teaching, which later became widely known as the foundation for school improvement (City et al., 2009). In mathematics, the interaction is structured through tasks and the way teachers introduce and manage them: which problems they pose, how they incorporate students' responses, and what opportunities they offer to develop the content (Vilalta-Riera, Deulofeu-Piquet, and Morera Úbeda, 2024).

None of the three elements operates separately, as both pathways have shown. A teacher with extensive pedagogical content knowledge falls short if the student does not participate. Student motivation is insufficient if the task does not allow a connection with prior knowledge. And a teacher creates more meaningful learning situations when the learning objective is clear. This is why the core resembles multiplication more than addition, although this is a simplification using mathematical language. What matters is the interdependence among its three elements: if one is close to zero, learning is unlikely.

We focus on the instructional core for three reasons. It brings together the elements directly involved in learning. The most effective programs act on it. And it is where schools can act most directly: they cannot change the law or the neighborhood, but they decide which program to teach with, how to support teachers, and how to meet each student's needs.

Do Materials Matter?

Without adequate support, they matter little. When linked to professional development, they matter considerably more. High-quality instructional materials (HQIM)[3] for mathematics give concrete form to the content and tasks students work on, which is why they have their own box in the map. But changing textbooks alone does not make a large difference (Blazar et al., 2020). Intensive professional development in mathematical content without connections to materials and classroom practice improves what teachers know but rarely what their students learn (Garet et al., 2016). When materials and professional development are combined, the effect grows. In a meta-analysis of 95 programs to improve science and mathematics instruction, the average effect was 0.21 standard deviations, and programs combining materials and professional development produced effects about 0.10 standard deviations larger than those offering only one or the other (Lynch et al., 2019; see also Fryer, 2014, and Clements et al., 2011). A product enters the classroom at a single point. A program acts on all three elements of the core at once.

What Role Does Implementation Play?

It determines whether everything described above reaches the classroom. The map distinguishes two levels, as shown in Figure 1, reproduced here. System-level implementation establishes organizational conditions and support. Classroom-level implementation turns those conditions into learning opportunities. School leaders can offer professional development, but its usefulness depends on whether

3 HQIM: High-Quality Instructional Materials.

time is available, workloads allow it, and teachers participate. And having good materials does not guarantee they will be used in ways that realize their potential.

Implementation quality is associated with outcomes (Durlak and DuPre, 2008). The rule proposed in the figure is implementation fidelity first, followed by guided adaptation through feedback: this preserves empirically supported components without turning the program into an unchangeable script (Century and Cassata, 2016). In a summer reading program, planned teacher adaptations based on local context improved reading comprehension while maintaining high fidelity to core components (Kim et al., 2017). The process does not end there, because implementation requires an ongoing feedback process: observing what actually happens, sharing that information, and using it to make adjustments (Meyers et al., 2012).

The instructional core is where both pathways converge and where learning occurs. Its three elements—teacher, students, and content—multiply: improving one accomplishes little if the others fail. Materials matter little on their own and considerably more when linked to professional development. None of this works unless it reaches the classroom under the right conditions: fidelity first, then guided adaptation, and always a feedback loop. This is where a school can act most directly every school year.

6 | A Guide to Understanding What Schools Can Do

We have followed both pathways to the instructional core. This section answers, factor by factor, the question that gives the report its purpose from a school's perspective: of everything that influences mathematics, what can a school act on, and how long will it take to see a difference? Table 1 brings together the answers, and Figure 3 represents them. First, we should clarify what we mean by being "able to act" on a factor, because understanding both depends on that distinction.

What Does It Mean for a School to Be "Able to Act" on a Factor?

All factors in the map have an origin and some potential for change; what matters here is how much of that change can occur within the school. For example, a teacher was trained outside the school, at a university and in previous schools, and none of that is determined by the school where they work today. Yet almost everything they do as a teacher happens within the school: the support they teach with, how they prepare lessons, and the coaching and professional development they receive. The same applies to the leadership team.

By contrast, influence over a student's development is more widely distributed. A very important part occurs in the classroom: what the student currently knows about fractions, how they approach a problem that does not work out on the first try, whether they participate in mathematical discussion, or whether they have begun to think "math isn't my thing." Schools act on that part every day through the task used, how the teacher manages it, and the classroom climate. But students continue learning and developing outside school, at home and with family, and what they bring from earlier years—their inheritance, early health, and conversations at home—is neither determined by the school nor something it can undo.

With families, the key question for a school is which mechanisms it can influence. Some are within reach: a family's expectations for their child, participation, and support for learning at home. Other mechanisms cannot be influenced: parents' education, employment, income, and children's health in the early years. Finally, at the far end of the map, society and education policy arrive at school already established: schools receive their conditions and, at most, can influence them collectively over a period of years.

These distinctions matter. When this report says that family "matters more than school," we are referring to the origins of differences. When we say that schools "can influence students," we are referring to what happens from the moment a student enters the classroom.

How Much Room for Action Do Schools Have, and How Much Does Each Factor Matter?

Before answering these questions, we should establish the starting point. What a school primarily wants to influence is **the student**: what they learn, how they relate to mathematics, and how they progress through the system. Students are therefore not simply another lever; they are the intended beneficiaries of all the levers. The other factors matter insofar as they affect those outcomes.

With this goal in mind, **Table 1** seeks to explain schools' room for intervention by focusing on three questions: whether a school can act on a given factor, how easy it is to change, and how far its effects **reach**. The first question has three possible answers. "Yes," when almost all of a factor's expression occurs within the school: teachers, leadership, and materials. These are the school's levers. "Partially," when a school can act on some mechanisms but not others: families. Schools can influence family expectations, participation, and support at home, but they cannot change most characteristics of the family. "No," when a school simply receives the conditions: society and education policy, with the exception of classroom climate, the channel through which peers operate. The dots indicate how much of each factor's expression is within the school's reach.

Once the room for action has been defined, the second question is how much each factor **matters**. The answer depends on what we mean by this. We can ask which factors best explain observed results, which depends heavily on the scale we examine. Looking across systems, as in Figure 1, society, values, and education policy explain a substantial share of cross-country differences. Within a specific system and

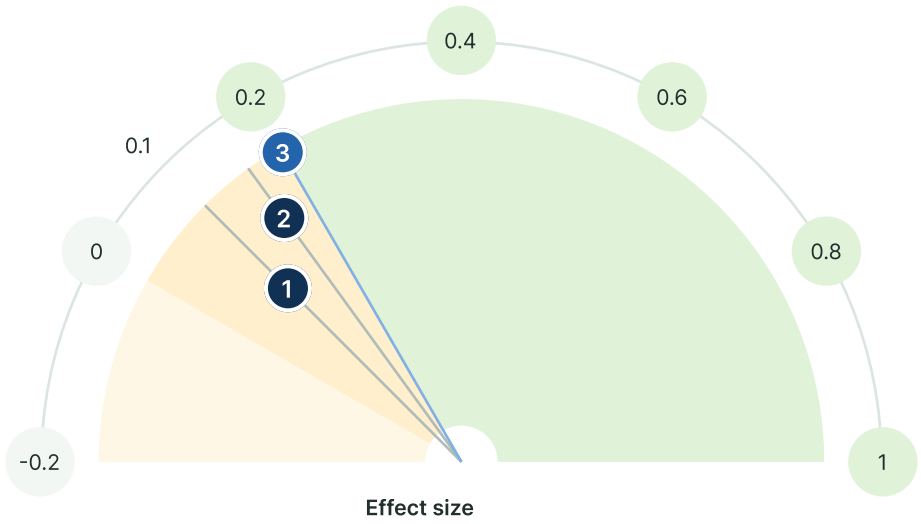
Factor	Controlled by the school? Does the school decide?	Ease of change How easy is it for the school to change it?	Reach Who benefits when it changes?	Example initiative An action a school can take
Teachers	**Yes**	●●●○ Medium	One classroom	Sustained classroom coaching tied to mathematics materials
Materials (HQIM)	**Yes**	●●●● High	The entire school	High-quality materials and professional development on how to use them
School leadership and culture	**Yes**	●●●○ Medium	The entire school	Protected time for teachers to plan together and observe one another
Families	Partially	●●○○ Low	Individual students	Brief weekly activities at home and advice on talking positively about mathematics
Education policy	No	●○○○ Very low	The entire system	—
Society	No	●○○○ Very low	The entire system	—

Ease of change ●○○○ very low ●●○○ low ●●●○ medium ●●●● high

Table 1. A school's room for action on each factor and whom it reaches
Note: Authors' illustration.

society, families and what each student brings are the most influential factors behind differences among students. In all cases, however, the analysis focuses on the starting point rather than the potential for improvement. In other words, it concerns what schools receive, not necessarily what they can change.

A more useful question for a school is which of the accessible **levers** has the greatest impact on the ultimate goal: the student. Figure 3 ranks the three factors schools can act on by their average effect on student learning and by their reach, whether classroom-wide or school-wide. Teachers are the highest-impact lever and the most accessible from within the school through professional development, coaching, interaction, and support. Next come leadership teams, whose impact can be meaningful but generally operates through teachers. Then come curriculum content and materials, whose influence varies with their quality and whether they are accompanied by implementation support and professional development.



INTERPRETING EFFECT SIZE

No effect = 0 SD

Small < 0.05 SD — "less than 2 weeks of learning"

Medium = 0.05–0.19 SD — "2 weeks to 2 months"

Large ≥ 0.20 SD — "more than 2 months"

According to Kraft (2020). Approximate equivalences for the early elementary grades (0.10 SD ≈ 1 month). SD = standard deviation.

1 Materials and curriculum

+0.05 to +0.1 SD

Impact of high-quality mathematics materials on learning

Reach: the whole school

2 Leadership

+0.07 to +0.16 SD

Impact of effective leadership on learning

Reach: the whole school

3 Teachers

+0.2 SD / year

Impact of an especially effective teacher on learning

Reach: the classroom

Figure 3. How much each of the three factors schools can act on matters.
Note: Authors' illustration based on the main findings of this report.

7 | Questions for Practice

Throughout the report, we have seen that the system influencing student outcomes is complex and involves multiple interconnected factors. The following seven questions offer a practical way to place any mathematics decision on the map before making it. They follow the order of our discussion: what we want to change, what we are acting on, and whether it will reach the classroom.

1. Which outcome do we want to improve? Learning, students' relationship with mathematics, or progression through the system. A program can improve one without affecting the others. We need to state which one we expect to change before we begin.

2. Which factor does this decision act on, and can a school change it quickly? Schools cannot change the neighborhood or the law in one school year. They can support families, respond to what each student brings, organize leadership, coach teachers, and choose materials. Every hour the teaching staff spends lamenting what cannot be changed is one less hour for what can be done.

3. What does each student already know, what do they bring, and what do they need? Useful assessment identifies both the specific knowledge students lack and the strategies, languages, experiences, and interests already available to them. A persistent difficulty calls for early support and, when appropriate, specialized assessment. The response remains mathematical: adjust the task, representations, language, and intensity of support.

4. What does leadership do to retain teachers who are improving? Protecting time, organizing peer observation, and deliberately retaining teachers who are improving is how leadership amplifies impact. And every change in the leadership team has a measurable cost.

5. Who supports our teachers inside the classroom, and in which content areas? If only one investment can be protected, let it be sustained support for teachers in their classrooms, focused on the specific content they teach: fourth-grade fractions, early algebra. Abstract pedagogical training has little effect on student learning.

6. How does the proposed approach act on all three elements of the instructional core? A product enters the classroom at a single point—materials—and its effect depends on what teachers and students do with it. A program acts on all three elements. The strongest causal evidence in this report comes from designs of this kind, and the report "Can a Mathematics Program Really Change Learning?" reviews what mathematics curriculum programs can promise.

7. How will fidelity to essential components be maintained as the program grows? The impact of teacher coaching falls to one-third when a program exceeds 100 teachers. The uncomfortable question for any provider is who trains the trainers and how mathematics expertise is maintained when a program expands from 100 schools to 1,000.

These seven questions help place a decision on the map before it is made. The first two establish what we want to improve and whether it is within our control. The remaining questions follow the map to the core: what each student brings, who supports teachers, whether the approach reaches the classroom through all three elements at once, and whether it will hold up as it grows.

8 | Closing Thoughts

The question that often opens a conversation about mathematics results—"Who is to blame?"—has a more useful version: of everything that influences outcomes, what matters most, how does it operate, what can a school do, and how long does that take? This report has tried to answer it piece by piece. Along one pathway, the environment advances or hinders progress over time, the family establishes a starting point that enters the classroom as knowledge, emotions, languages, and identities, and the student participates in what happens. Along the other, policy sets the conditions, leadership organizes, and teachers act where learning occurs. Almost everything has an influence. Very little produces learning directly. And what a school can change is concentrated in a single place: the daily interaction between teachers and students around rich tasks, and the support that improves that interaction year after year (Cohen, Raudenbush, and Ball, 2003).

Learning mathematics takes an entire system. The part a school can change has a clear name: who teaches, the support they receive, and how that teaching responds to what each student brings.

9 | Frequently Asked Questions

"If family matters more than everything schools do, why bother changing anything in the classroom?"

For precisely that reason. Unequal starting points do not mean everything is already decided. They make schools more necessary: schools are the only institution that reaches every child, regardless of background. And the most powerful school-based factor—the teacher—acts every year, with cumulative effects. Moreover, the importance of family is an average, and an average describes no individual student. The socioeconomic index explains around 15% of the variation in outcomes within each country: most of what distinguishes one student from another lies elsewhere. Every classroom includes students who learn much more than their background predicts, and others who learn considerably less. The correlation is real. The individual path is not predetermined. It makes no sense to ask mathematics materials alone to compensate for six years of inequality. It does make sense to concentrate effort where schools can act.

"I'm a teacher, and this report puts all the responsibility on me. That doesn't seem fair."

The conclusion is the opposite. Being the most powerful school-based factor does not mean outcomes depend only on teachers' individual effort. It means that a system that fails to support them wastes its most valuable lever. The evidence in this report assigns responsibility upward: to school leaders who protect time and organize collaboration, authorities who fund sustained support rather than isolated workshops, and programs that bring professional development and support into classrooms, not just materials. Teacher improvement is also partly collective: it depends on colleagues and on structures that enable teachers to learn from them. The conclusion is not "try harder." It is "no one should teach mathematics without the support they need."

"Our school paid for excellent materials, and results barely improved. Were we misled?"

Probably not. More likely, the other two parts of the multiplication were missing. Materials on their own have a modest effect: this is one of the most consistent findings in the literature, not something unusual about your school. Without professional development tied to them, they remain underused. Even with professional development, they do not deliver if no one examines how students respond. Before changing materials again, ask what support you have for the current ones: how much training focused on those specific tasks, who entered classrooms to support their use, and what was adjusted in response to students. The good news is that the sequence can be reversed. The materials you already have can become the basis for coaching. And the tools for interpreting the effectiveness studies you are shown can be found in the report "Does it work? How to understand the evidence behind a mathematics program."

"So do students need to arrive motivated for teaching to work?"

No. Motivation is not an admission fee students must pay before they can learn. Every student brings a history with mathematics, but their response changes with the task, level of challenge, support, feedback, and classroom climate. Growth mindset interventions offer a useful example. In a national U.S. experiment, a brief intervention improved lower-achieving students' grades by one-tenth of a grade point, with larger effects in schools where peer norms supported effort (Yeager et al., 2019). On average, their effects on achievement are small (Sisk et al., 2018). They can help, but they do not replace teaching that provides real experiences of understanding and progress. The question is which conditions allow each student to engage, and what their response tells us about the support they need next.

"What about class size? Homework? Screens? They aren't on this map."

They are, within the layers. Class size is an investment policy decision and, within the school, a matter of resource organization. Homework involves both classroom and home, and we have already seen that family help with it produces mixed results. Screens cut across education policy, school decisions, and, outside school, family life. Each issue deserves its own evidence review. What this map provides is a way to locate them: through which layer they enter and which element of the instructional core they reach.

"My daughter has 'one of the good teachers' this year. How much difference does that make?"

More than will be visible in June. In a single school year, the difference between a teacher of average effectiveness and an especially effective one is around 0.10–0.20 standard deviations. If we lined up a class of 25 students by achievement, that would be equivalent to moving the student in the middle up one or two places. That may seem small. But the effect extends to things grades do not capture: confidence, behavior, and the desire to keep learning. And when students have a succession of good teachers, improvements accumulate year after year, eventually affecting later trajectories and adult earnings. No single school year determines an entire trajectory, but every year counts. The reverse is also true: one bad year is not a life sentence.

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Appendix A

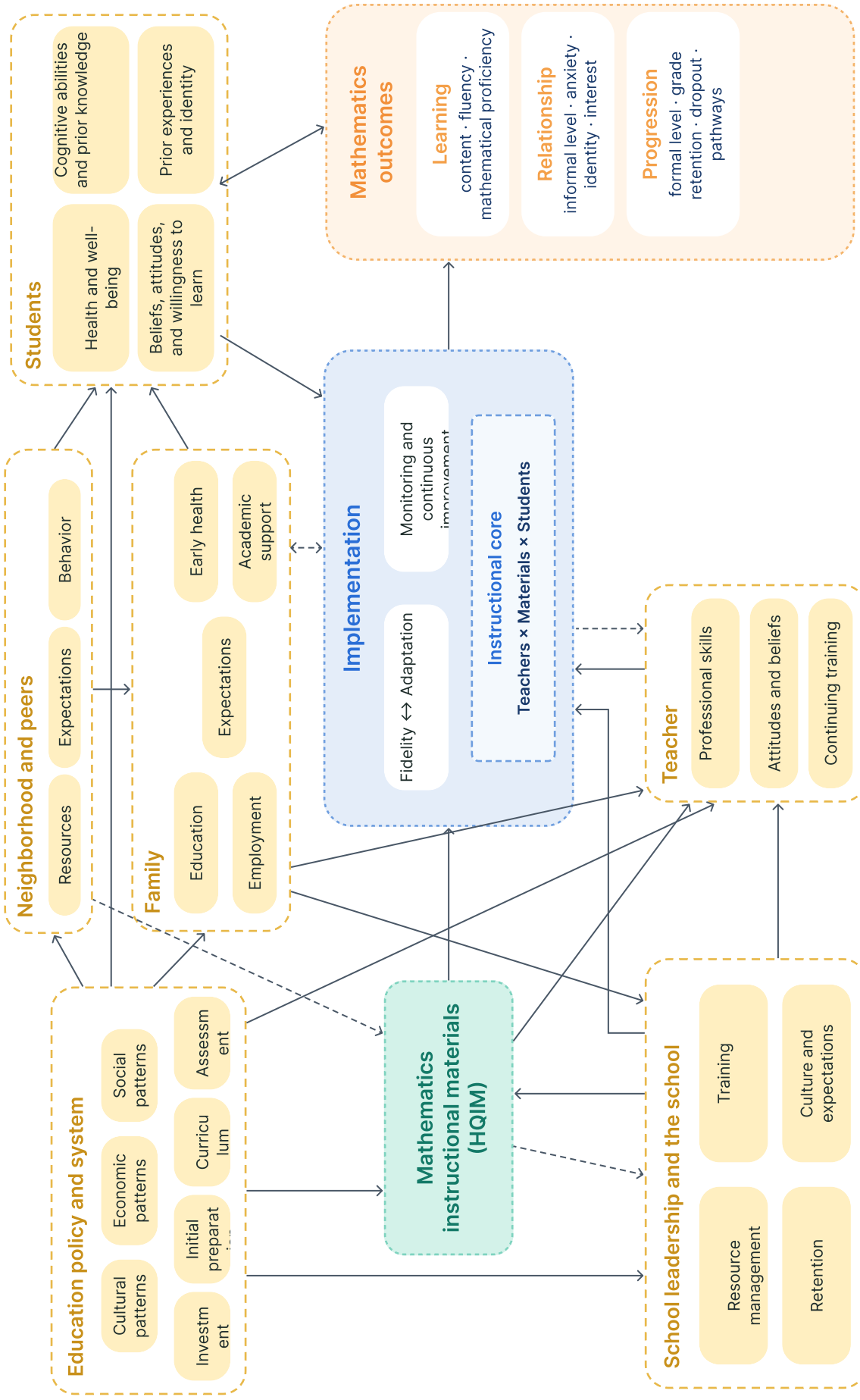

Figure A1. An alternative representation of Figure 1 showing the many potential interactions among factors. Solid lines indicate more direct effects, and dashed lines indicate more indirect effects. These relationships can occur at different levels. For example, school leadership and the school influence instructional materials by selecting the educational approach to be implemented. In turn, instructional materials can influence both teachers' classroom practices and their professional development. The arrows are not an exhaustive account of all possible interactions: they represent both causal effects supported by empirical evidence, such as leadership's effect on teachers, and theoretically plausible influences, such as those of neighborhoods and peers on families. Some causal relationships have deliberately been prioritized to highlight the most relevant effects. For example, the leadership → teacher relationship is shown as one-way to emphasize leadership's influence on teachers, although teachers can also influence leadership.

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