

Chapter 13

United States: The Size and Variation of the Pandemic Learning Losses



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Abstract Recent international and national assessments point to the substantial learning losses that resulted from school disruptions during the pandemic. The United States, which entered the pandemic with achievement near the OECD average, had rather average pandemic learning losses and came out of the pandemic at roughly the same international ranking as before the pandemic. The learning losses from the pandemic foretell substantial economic costs related to the lower skills of those in the COVID-19 cohort. At the same time, there was substantial heterogeneity in achievement losses across states and across individuals, leading to disproportionate economic impacts on some individuals and states. Unlike the other economic costs of the pandemic, those from learning losses are future costs that are yet to accrue and that can be ameliorated by public action—but the time for feasibly addressing them is quickly running out.

13.1 Introduction and Overview

As concerns about the health aspects of the COVID-19 pandemic have receded, more of the public discussion has turned to the learning losses that resulted from school closures and erratic reopening. We now have both national and international data that permit more rigorous discussions of the losses, of their sources, and of their costs. While these data will be analyzed for years to come, we can begin to put the

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impact the pandemic had on education into the perspective of the economic impact on individuals and on the nation. Unfortunately, policy responses to the learning losses do not appear to be commensurate with the magnitude of the future economic impact.

Recent international assessments of the Programme for International Student Assessment (PISA) and of the National Assessment of Educational Progress (NAEP) provide data on student performances that bracket the pandemic. By harmonizing these assessments, it is possible to place both the nation and the individual states in the world achievement distribution. It is also possible to translate the learning losses resulting from the school disruptions during the pandemic into economic implications.

Most, but not all, nations saw the achievement of their students fall below that prior to the pandemic. These falls proved to be very uneven around the world. Because higher performing countries tended to suffer greater losses than lower performing countries, there was some compression in the variations across countries. Unfortunately, the United States continued to rank closer to lower income countries than to more developed countries that are direct economic competitors.

Within the United States, there was also significant heterogeneity at the state level. Some states clearly came through the pandemic substantially better than others. While still not competitive with top-performing countries, the students in low-loss states became more competitive with students from abroad, while other states moved down in the international rankings.

From the available evidence it is difficult to identify the specific reactions to the pandemic that led to better outcomes. Countries clearly responded to the challenges in very different ways, from essentially no closures (Sweden) to multiple years of closures (Uganda, Indonesia). But simple statistics such as the length of school closures or overall health policies cannot explain much of the variance in outcomes. And, like many other countries, America saw widely varying reactions across the states and local districts.

In the 2022 edition of PISA, the United States ranks thirty-fourth in math among the participating countries and territories, thus reinforcing the challenges facing US students both before and after the pandemic.¹ Comparing the 2022 scores to those for the similar cohort tested in 2018 (i.e., pre-COVID cohort), we then get a rough estimate of the overall impact of the pandemic on learning. While subject both to influences other than the pandemic and to nonschool factors, this comparison provides a direct estimate of losses in human capital. Thirteen countries actually gain in math scores over the period. The United States was not one of the countries improving, but in fact it saw losses in the mid-range for the world.

Different American states and localities show large differences in learning losses. Using performance on NAEP, it is possible to put each of the states into the world distribution of math performance. The best performing state (Massachusetts) would rank sixteenth in the world, placing student performance just ahead of the average

¹ These data provide the most recent worldwide picture. Earlier world estimates can be found in Patrinos et al. (2022).

student in Austria and just behind the average student in the United Kingdom. The next best state was Utah, ranking twenty-first in the combined state and national rankings for the participating countries, placing it ahead of Finland but behind Slovenia. At the other end, thirteen states produced students whose math achievement fell behind the average student in Turkey.

These declines in learning imply a future labor force that is less well-prepared than it would have been without the pandemic. If not corrected, the learning losses imply significant economic losses both for individuals in school during the pandemic and for the nation. Throughout the pandemic, continuous public consideration has been given to the economic impact of business closures and business cycle losses. In reality, the economic consequences of learning losses will dwarf these other economic costs without substantial changes in the schools. Importantly, unlike the business cycle costs, the losses in human capital can still be addressed, although the time to do this feasibly is running out as the affected cohort exits from the schools.

Based on the available research on the lifetime earnings associated with more skills, the average student in school during the pandemic will lose 5–6% of lifetime earnings. Because a lower-skilled workforce leads to lower economic growth, the nation will lose some \$31 trillion (in present value terms) during the twenty-first century. This aggregate economic loss is above the US GDP for one year. These losses dwarf the total economic losses from either the slowdown of the economy during the pandemic or the recessionary losses in 2008.

Students from different states can expect to lose wildly different proportions of their future earnings. While the students from Utah, who on average suffered the lowest learning losses in the nation, can expect 2% lower lifetime earnings, this economic loss climbs to 9% for the students in Delaware and Oklahoma.

State economic growth, like national economic growth, is directly related to the skills of the state labor force. In percentage terms the state losses mirror the losses to individuals. Utah can expect to lose slightly more than one-half percent of future state GDP, while Delaware and Oklahoma can expect to lose almost 3% of future state GDP. California, the state with the largest economy, is estimated to lose far more in total GDP than all other states even though its average learning loss was less than that in 39 states. The present value of total loss in California is estimated to be \$1.3 trillion. In fact, five states show losses greater than \$500 billion, but of those only Pennsylvania also had learning losses above average for the nation.

History suggests that the losses from the pandemic are likely to be permanent unless the schools become better than they were before the pandemic. Since the end of the pandemic, states and localities have made varying attempts to ameliorate the losses from the pandemic, including prominently extending school days and school years, providing varying amounts of tutoring, and establishing both voluntary and involuntary summer school. To date, however, they have not on average been very successful. In fact, there are some schools that have struggled just to return to their

pre-pandemic level of operations, and a portion of the school population has even disappeared.²

The federal government provided \$190 billion in extra school funding to deal with the problems of the pandemic. Much of this money was directed at individual districts, although a relatively small portion of these funds had to be directed specifically at student learning loss.³

Unfortunately, any ability to deal with the learning losses is largely limited to the time that the affected students are enrolled in K-12 schools. Over seventeen million students have already completed their K-12 schooling without being substantially brought up to the learning levels of the school as seen before the pandemic.

13.2 US Results in World Perspective

The PISA testing program, like the schools themselves, faced challenges during 2022. The OECD has strong requirements for the sampling and testing in each country, and a number of countries—including the United States—did not meet the cutoffs for school and student participation. Thirteen countries failed to meet one or more of the sampling criteria during the 2022 assessment (OECD, 2023b).⁴

For the United States, sampling problems occurred in terms of both the exclusion of selected students within the participating schools and the overall school response rates. The PISA standard calls for 95% or more of the targeted students to participate, but 6.1% were excluded in 2022—a significantly greater rate than for 2018.⁵ Additionally, the school response rates of 51% before replacement and 63% after replacement fell below the goals of 85% for each.⁶

As with the other countries failing to meet the sampling standards, the US results are reported for the tested students. After analysis, OECD (2023b) concludes for the United States: “Based on the available information, it is not possible to exclude the possibility of bias, nor to determine its most likely direction.” We take the sampled

² Dee (2023) observes, “More than a third of the loss in public school enrollment cannot be explained by corresponding gains in private school and homeschool enrollment and by demographic change.”

³ The federal funds were disbursed in three waves. The early funds went largely for health and safety uses that included buildings, capital expenditures, and equipment. This moved somewhat to professional development and to maintaining personnel in the schools, but throughout this period, limited amounts were specifically directed at ameliorating learning losses (see Stadler, 2023).

⁴ The countries falling below the sampling requirements were Canada, Ireland, New Zealand, the United Kingdom, and Scotland, where more than minimal bias was most likely introduced; and Australia, Denmark, Hong Kong (China), Jamaica, Latvia, the Netherlands, Panama, and the United States, where the possibility of more than minimal bias could not be excluded (OECD, 2023b).

⁵ The top three reasons for exclusion in the United States were intellectual disability, functional disability, and language.

⁶ The sampling identified a primary set of sampled schools and another set of schools that could replace primary schools that did not participate. The United States had the lowest participation rate after replacement of the seven countries that failed to reach the 85% goal after replacement.

scores at face value with the caveat that some of the following analysis might be affected by obtained sampling.

13.2.1 Aggregate Performance Levels in 2022

At the end of the pandemic, the United States was not doing well in an absolute sense. The United States falls slightly below the OECD mean score and is competing with Malta and the Slovak Republic. This places the US a full three-quarters of a standard deviation behind students in Singapore and half of a standard deviation behind Macao and Taiwan.

This level of performance is concerning because it has significant economic implications. At the individual level, skills are rewarded in the labor market. In fact, the United States rewards skills more than most OECD countries.⁷ The high return to skills reflects the fact that America has a very dynamic economy, and people with higher skills are rewarded for being generally more able to adjust to change.⁸ The rewards to skills also come into play in terms of the overall national economy. Countries with a more skilled workforce also tend to grow faster. Long term annual growth rates are the closely related to the skills of the population as measured by international test scores.⁹

13.2.2 International Learning Losses with the Pandemic

The pandemic was a worldwide phenomenon that had varying impacts across countries and, as will be seen in the next section, within the United States. It is useful to look directly at the changes in performance over the pandemic.

Thirteen of the countries with scores available for 2018 and 2022 actually showed gains in the math assessment over the pandemic.¹⁰ This finding underscores a key element of interpretation: the differences in scores between the two cohorts of fifteen-year-olds include not just the school factors but also nonschool factors such as family and peer inputs. Further, because they are different cohorts of students, they may

⁷ These estimates rely on data from the OECD Program on International Assessment of Adult Competencies (PIAAC). In different waves beginning in 2011, a random sample of adults ages 16–65 was surveyed about demographics and employment and, importantly, was given a bank of achievement tests including math and reading assessments. The estimates come from a separate regression in each country of log income on potential experience and experience squared, years of schooling, and the math test score in standard deviation units (see Hanushek et al., 2017c).

⁸ For background on the value of skills, see Nelson and Phelps (1966), Welch (1970), and Schultz (1975).

⁹ The details of this relationship along with a discussion of causation can be found in Hanushek and Woessmann (2015).

¹⁰ For details, see Hanushek and Strauss (2024).

have entered the pandemic at a different level, perhaps reflecting earlier changes in the schools. Given the disruption of the pandemic, it is doubtful that the average student enrolled in school during the pandemic did better than would have occurred without the pandemic. While we interpret the changes in scores between cohorts as an estimate of how much less learning was accomplished by the average student during the cohort, it must be recognized that this is a rough estimate. Nonetheless, there is no reason to expect this estimate to be biased positively or negatively.

The United States did not do well during the pandemic. Among the countries with estimated losses in math scores, the US ranked thirty-first in losses. This loss is slightly better than seen for all OECD countries.

The losses tended to be larger in countries with higher achievement before the pandemic (see Hanushek and Strauss, 2024). This perhaps reflects the fact that the lower rate of learning in schools for low-achieving countries means that school closures had relatively less impact on overall achievement. But the fact that Taiwan, Japan, Singapore, and South Korea all show gains over the pandemic suggests that families there stepped in to offset any potential losses from school closures and the pandemic.

13.3 Heterogeneity in the United States

Just as seen internationally, American states had very heterogeneous performance, both in absolute terms and in response to the pandemic. This heterogeneous performance has obvious implications for the long-run economic costs that students from different states absorb.

The range of performance across states is perhaps best seen by placing the individual states into the world distribution of achievement as seen in PISA 2022. The NAEP testing of mathematics in 2022 for eighth-graders provides a parallel assessment that can be related directly to the PISA scores and that makes it possible to judge where individual states fall in the international distribution.¹¹ Overall, the learning losses highlighted by the PISA score changes are very similar to the learning losses found in the NAEP test.¹² Because of the similarity in math tests for these comparable age groups, we treat PISA and NAEP testing as complementary, providing details about the heterogeneity of skills that are measured for a common underlying distribution.

¹¹ For this, we rely on the Main NAEP assessments of eighth-grade math in 2022. We put the NAEP scores on the same scale as the PISA scores by transforming the mean and standard deviation of NAEP data to that of PISA. This is an exact equating if the distributions are normal and are measuring the same skills. Of course, the NAEP and PISA tests are given at different ages and grades and are constructed with different philosophies, possibly introducing some errors in the equating.

¹² The change in math scores with PISA amounted to -0.13 standard deviations for fifteen-year-olds between 2018 and 2022; the change for the NAEP math scores was -0.23 standard deviations for thirteen-year-olds between 2020 and 2023 on LTT NAEP; and -0.20 for eighth-graders between 2019 and 2022 on Main NAEP.

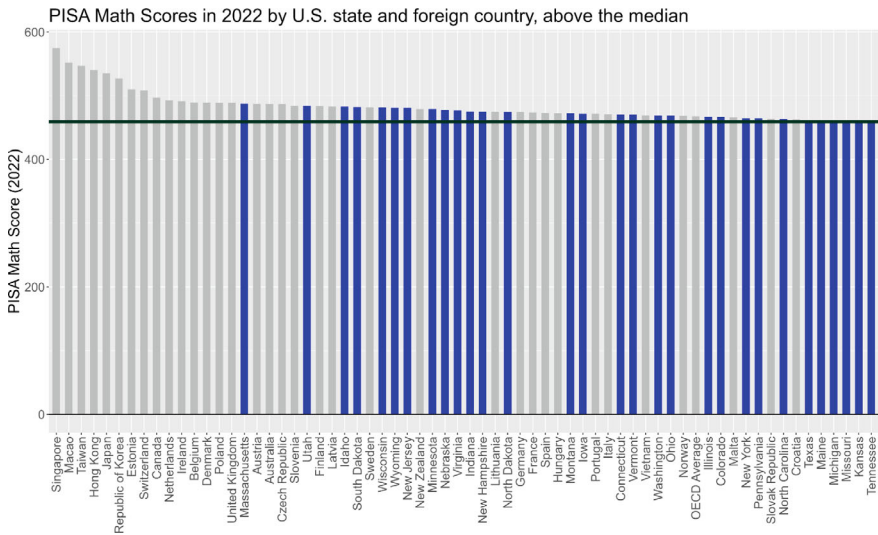


Fig. 13.1 Math Achievement in 2022 for US States and Countries above International Median. *Note* State scores on NAEP 2022 are transformed onto the PISA 2022 scale. *Source* Author calculations from *Source* Organization for Economic Cooperation and Development, *Pisa 2022 Results*, Vol. 1, *The State of Learning and Equity in Education* and <https://www.nationsreportcard.gov/ndecore/xpl/ore/nde>

Calibrating the state distribution to the international distribution shows that the highest achieving state—Massachusetts—would place sixteenth in the world distribution (Fig. 13.1 for states and countries above the median; Fig. 13.2 for those below the median). Utah would place twenty-first. A total of thirty states placed in the top half of the participating countries and states. The majority of states are bunched just above or just below the international median, but that does not have them competing with the most vibrant countries economically. The lowest ranking state (New Mexico) is competing with Romania and Kazakhstan.

The simple summary of these comparisons is that even the best performing of American states is not doing well when compared to what is possible. The large number of countries where the average student performs better than the average student in the best states raises concerns about the economic future of the US.¹³

As with the range of outcomes over the pandemic that was seen internationally, the states differed dramatically in how they dealt with closures and learning losses. Utah lost very little during the pandemic (again, as measured by score comparisons for those eighth graders preceding the pandemic in 2019 with those in 2022). But, as seen in Fig. 13.3, Oklahoma and Delaware at the other end of the spectrum suffered huge losses.

¹³ See the implications of current skills for future economic well-being in Hanushek et al. (2013).

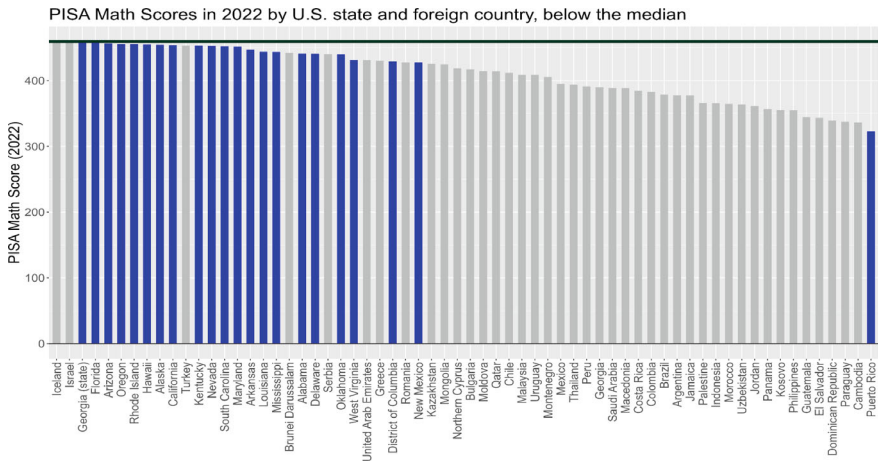


Fig. 13.2 Math Achievement in 2022 for US States and Countries below International Median. *Note* State scores on NAEP 2022 are transformed onto the PISA 2022 scale. *Source* Author calculations from Source: Organization for Economic Cooperation and Development, *Pisa 2022 Results*, Vol. 1, *The State of Learning and Equity in Education* and <https://www.nationsreportcard.gov/ndecore/xplore/nde>

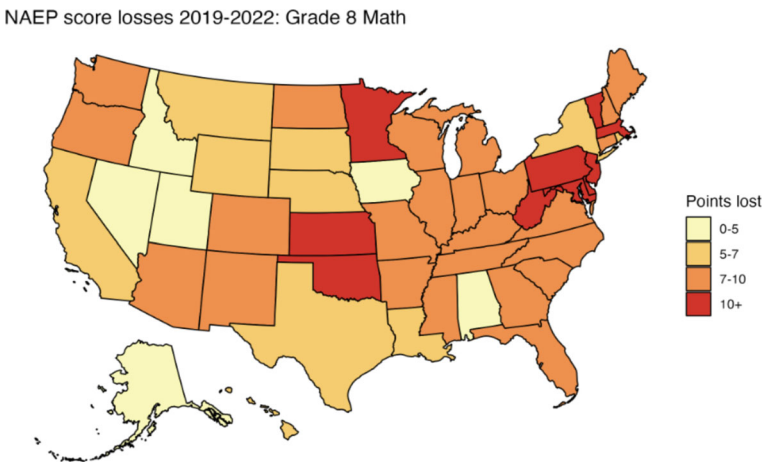


Fig. 13.3 NAEP Score Declines by State, 2019–2022. *Source* Author calculations from <https://www.nationsreportcard.gov/ndecore/xplore/nde>

13.4 The Economic Costs of the Pandemic

The results on both the NAEP and PISA assessments are measured in arbitrarily chosen scale scores that have no natural meaning. Saying that a state lost six points on the NAEP scale or that a country lost eight points on the PISA scale provides little

indication of the severity of any lowered achievement. To provide a more precise and understandable measure of these losses, we translate such test score losses into their economic implications.

The significance of the skills measured by the standardized PISA and NAEP tests is readily apparent in the economic realm. Students who know more tend to earn more, and countries with more skilled labor forces grow faster. Two things are important for understanding the pandemic losses. First, these losses will persist throughout individuals' lifetimes unless something is done to make up for them. In simplest terms, if schools were doing the best that they could before the pandemic, a return to that pace of learning will not erase the deficits from the pandemic.¹⁴ Second, this cohort can expect lower earnings than the cohort finishing school immediately prior to the pandemic and the cohort starting school immediately after the pandemic.

13.4.1 Aggregate Economic Impact of the Pandemic for the United States

The COVID cohort implies that the labor force of the future will evolve with less-skilled students. As such, the previous description of the relationship of skills to growth implies that the learning losses will have a lasting impact on the economy.

We can estimate the impact by comparing the lower growth as the COVID cohort works through the system with growth that would be expected without a pandemic.¹⁵ The simulation behind this allows for members of the COVID cohort to move into the labor force steadily as they graduate, to stay in the labor force for forty years, and then to retire. Thus, the quality of the labor force dips for a period as this cohort moves fully into the labor force and then returns to the pre-COVID quality level as this cohort fully retires. Using the historic growth relationship, we estimate future growth in GDP through the remainder of the twenty-first century. We then calculate the present value of GDP with and without a pandemic (using a 3% discount rate) so that the differences in future GDP are all placed in terms of present value.¹⁶

The impact of the lower-quality future labor force on the economy is dramatic. The present value of the losses amounts to \$31 trillion (in 2020 dollars). While numbers of this magnitude are difficult to understand, Table 13.1 puts them into perspective.¹⁷ This loss on average amounts to a 3% lower GDP throughout the remainder of the century.

¹⁴ See the discussion on pace of learning in Raymond (2023). Discussion of historical periods of school closures can be found in Hanushek and Woessmann (2020).

¹⁵ A detailed description of these calculations can be found in Hanushek and Woessmann (2020).

¹⁶ Present value can be thought of as calculating what amount needs to be deposited in a bank account today to completely offset the future losses in GDP, assuming that the bank account accrues 3% interest on any annual balances.

¹⁷ Aggregate changes use the scores on the LTT NAEP from 2020 to 2023.

Table 13.1 Comparisons of aggregate economic costs of pandemic

PV of learning losses (billion USD)	Compared to discounted GDP	Compared to GDP in 2020	Cumulative business cycle	
			2008	COVID
\$30,711	3.1%	147%	\$4983	\$1760

Source Author calculations

The lopsided attention to the business-cycle losses from the 2008 recession and from the pandemic is startling once we see the comparable pandemic figures. Table 13.1 displays the total losses from the two recent economic downturns: the 2008 recession and the COVID-recession. The 2008 recession continues to spur discussions of its severity—a recession labeled the largest since the Great Depression, but the total costs from unemployment and lowered productivity are one-sixth of the estimated economic costs of the pandemic learning losses. The business cycle costs of the pandemic are a fraction of the costs that are likely from learning losses.

13.4.2 *Heterogeneous Individual Economic Losses*

As calculated from the historical skill-earnings relationship of the US, the average student in the United States will have 5–6% lower lifetime earnings compared to expected earnings without the pandemic. This reduced payoff acts just like an income tax surcharge applied just to the pandemic cohort.

The school disruptions and closures, however, had a very uneven impact on students, implying that the average losses do not tell the entire story. Clearly, some families were better able to offset the school closures—by direct help in learning, purchase of learning supplements, etc.—than others. The differential impact was also seen in NAEP scores where there was a noticeably larger decline at the bottom of the score distribution than at the top. The PISA 2022 scores also show an increased variation of skills.

The NAEP score differentials imply a 4% loss for those at the top of the score distribution and a 9% loss for those at the bottom of the score distribution. The full explanation of the causes of the differential losses is not available, but there is evidence that the hybrid and remote instruction related to closures contributed to the distribution of losses (Goldhaber et al., 2023).

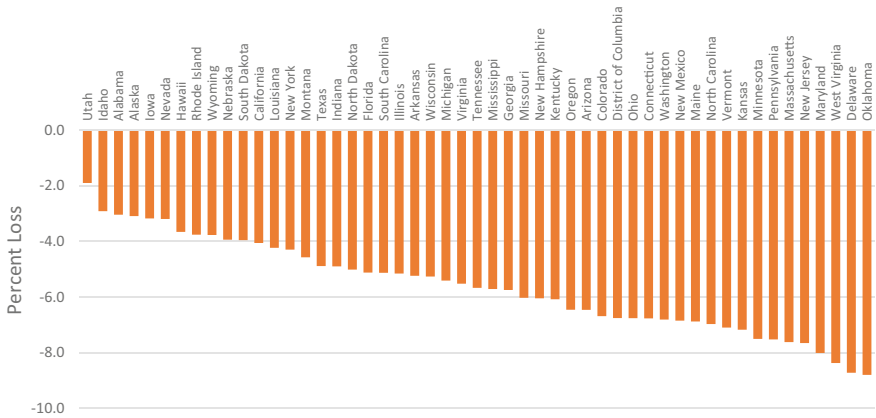


Fig. 13.4 Average individual economic losses by state. *Source* Hanushek (2023). *The Economic Cost of the Pandemic: State by State*. Stanford, CA: Hoover Education Success Initiative, Hoover Institution

13.4.3 Heterogeneous State Economic Losses

An alternative perspective on the heterogeneous losses comes from the differences in outcomes seen across the states. The differential losses shown in Fig. 13.3 translate into very different expected economic outcomes.

At the individual level, students in Utah, which navigated the pandemic better than other states, would on average lose 2% of their lifetime income (Fig. 13.4). But students in Delaware and Oklahoma can expect to lose 9% of their lifetime income. These dramatic differences underscore the direct linkage between learning loss and expected incomes of students.

As previously seen at the national level, there is also a direct linkage between skills of the state population and state GDP growth (Hanushek et al., 2017a, b). In percentage terms, the losses in state GDP follow exactly the same pattern as seen for individual earnings. Utah can expect future GDP that is 0.6% lower than that without the pandemic while Oklahoma and Delaware can expect 2.9% lower GDP.

But the picture changes when considering the total dollar value of losses, because these involve not only the magnitude of the learning losses but also the size of the state economies. The lowest losses come in Wyoming and Alaska, which have low learning losses and relatively small economies, thus limiting the present value of economic loss at around \$15 billion (Fig. 13.5). On the other hand, California’s learning losses were only slightly above Wyoming’s, but the total economic loss is \$1.3 trillion, a differential reflecting the size of the economies.

Beyond California, the economies of Texas, New York, Florida, and Pennsylvania each have losses greater than \$500 billion. Again, these losses reflect both the magnitude of learning losses and the size of the economies. Each of these large-loss

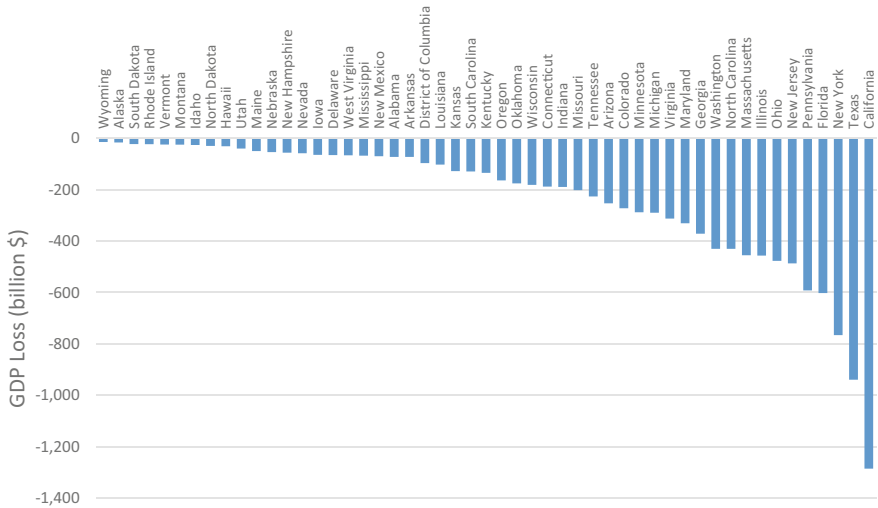


Fig. 13.5 Present value of aggregate state losses in GDP. *Source* Hanushek (2023). *The Economic Cost of the Pandemic: State by State*. Stanford, CA: Hoover Education Success Initiative, Hoover Institution

states, except Pennsylvania, suffered less than average learning losses as measured by NAEP scores.

13.5 Dealing with Learning Losses

The recessionary costs have already occurred and cannot be erased. The costs associated with the learning losses are future costs, and they can be eliminated with appropriate remedial measures. Unfortunately, the opportunity to alleviate the costs for the COVID cohort is quickly disappearing because the chance to aid this cohort becomes difficult if not impossible as this cohort ages out of the schools.

Substantial historical research suggests that these losses will be permanent unless something is done to make the schools better than they were before the pandemic.¹⁸ And that underscores the urgency of the situation. We have few systematic ways to remediate students of the pandemic once they have left the K-12 schools. This means that long-term plans, no matter how useful for future school improvement, cannot deal with the learning losses of the pandemic cohort of students.

¹⁸ See the summary of international studies in Hanushek and Woessmann (2020), Werner and Woessmann (2021), and Cygan-Rehm (2022).

From the start of the pandemic in March 2020 through 2023, about seventeen million students left the K-12 system with, according to the recent data, significant learning deficits.¹⁹ This group on average has little chance of recovering.

The federal government appropriated \$190 billion to K-12 schools to compensate for the disruptions and challenges of the pandemic. These funds, which mostly went directly to schools, will disappear soon, but little of these funds has been directed at remediating the learning losses.

The most widely employed approaches have been either tutoring programs or additional time through expanded school days, summer school, or other ways of adding time. Schools have pursued very different strategies with, for example, a minority of schools offering the high-dosage tutoring that is often held to be the best alternative.²⁰ For these, initial investigations suggest highly variable outcomes where attempted.²¹

One alternative that has received limited attention is using the current teacher corps more effectively. A substantial body of evidence has emphasized the effectiveness of teachers in raising student achievement (see, e.g., Hanushek & Rivkin, 2012; Chetty et al., 2014; Bacher-Hicks & Koedel, 2023). This importance of teachers is the clearest way to interpret the evidence of the superiority of in-class instruction to hybrid instruction to fully remote instruction (Jack et al., 2023). Moreover, there is evidence that effective teachers will respond to incentives in taking on more demanding classroom tasks (Morgan et al., 2023).

If the more effective teachers could through varying incentives be induced to teach a greater proportion of the students, the average effectiveness of the schools could be improved immediately (Hanushek, 2022; Raymond, 2023). Of course, this would require a restructuring of school operations and as such meets with considerable opposition.

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¹⁹ These calculations include students in grades nine through twelve in spring 2020 from public (15.3 million) and private (1.4 million) schools along with home-schooled (0.3 million) students (U.S. Department of Education, 2022). There is no consistent information on the differential learning losses across sectors. There is some partial evidence suggesting that charter and private schools responded more quickly than traditional public schools. The reaction of home schooling is less clear although school closures have less meaning for this population.

²⁰ Data for the 2023–2024 school year show different kinds of tutoring offered by tutors with varying backgrounds or training; see <https://nces.ed.gov/surveys/spp/results.asp>.

²¹ Guryan et al. (2023) report very strong impacts of high-dosage tutoring on Chicago high school students, but there is little evidence of general adoption in either Chicago public schools or in other schools.

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