
October 2009

SCHOOL FACILITIES

Physical Conditions in School Districts Receiving Impact Aid for Students Residing on Indian Lands



GAO

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Highlights of [GAO-10-32](#), a report to the Chairman, Committee on Indian Affairs, U.S. Senate

Why GAO Did This Study

State and local governments spend billions of dollars annually on the construction, renovation, and maintenance of public school facilities, yet concerns persist about the condition of some school facilities, particularly in school districts serving students residing on Indian lands. The Department of Education’s (Education) Impact Aid Program provides funding to school districts that are adversely impacted by a lack of local revenue because of the presence of federal land, which is exempt from local property taxes. Impact Aid can be used for school expenses, such as facilities and teacher salaries.

In response to concern about school facility conditions and concern that these conditions can affect student outcomes, GAO was asked to describe (1) the physical condition of schools in districts receiving Impact Aid because of students residing on Indian lands and (2) what is known about how school facilities affect student outcomes. GAO interviewed federal, state, and local officials; analyzed available independent school facility assessment data for three states; visited eight school districts that receive Impact Aid; and analyzed studies examining the relationship between school facilities and student outcomes.

GAO is not making recommendations in this report. Education provided technical clarifications, which GAO incorporated as appropriate.

[View GAO-10-32 or key components.](#) For more information, contact Cornelia Ashby at (202) 512-7215 or ashbyc@gao.gov.

SCHOOL FACILITIES

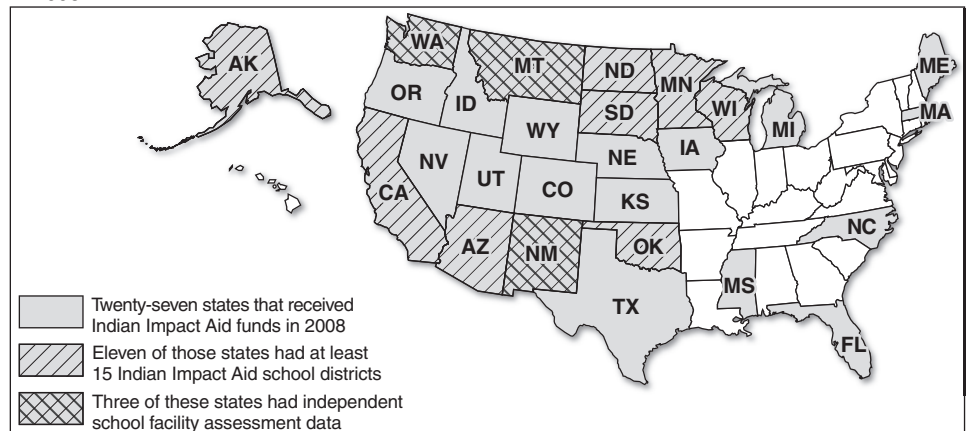
Physical Conditions in School Districts Receiving Impact Aid for Students Residing on Indian Lands

What GAO Found

Limited nationwide data are available about the physical condition of public school facilities in school districts that receive Impact Aid funding for students living on Indian lands, although data from three states indicate the conditions range from good to poor. Montana’s assessment data showed that the majority (39 of 60) of Indian Impact Aid school districts had facilities in good condition. New Mexico’s data showed that all 19 Indian Impact Aid school districts had facilities in either good or fair condition. Washington’s data—based on assessments from 9 of 29 Indian Impact Aid school districts—indicated about half (4 of 9) of the Indian Impact Aid school districts had facilities in fair condition and about half (5 of 9) had facilities in poor condition. Facility assessments are not comparable across states. School district officials from 8 districts told GAO their facility conditions are affected by factors such as fiscal capacity, the age of buildings, and remote locations.

The research studies GAO reviewed on the relationship between the condition of school facilities and student outcomes often indicated that better facilities were associated with better student outcomes, but there is not necessarily a direct causal relationship and the associations were often weak compared with those of other factors, such as the prevalence of poverty or other student characteristics. A majority of the studies GAO reviewed indicated that better school facilities were associated with better student outcomes—such as higher scores on achievement tests or higher student attendance rates. Most of the studies measured the extent to which better school facilities were associated with better outcomes, after taking into account the impact of other factors. None of the studies examined was able to conclusively determine how much school facility conditions contribute to student outcomes relative to other factors, such as student demographics, and none proved a causal relationship between school facilities and student outcomes.

States with School Districts That Received Impact Aid for Students Residing on Indian Lands in 2008



Source: GAO analysis of Department of Education data.

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Abbreviations

ESEA	Elementary and Secondary Education Act of 1965
FCI	facility condition index
HVAC	heating, ventilation, and air conditioning
NCES	National Center for Education Statistics
NCLBA	No Child Left Behind Act of 2001
NMCI	New Mexico condition index

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United States Government Accountability Office
Washington, DC 20548

October 29, 2009

The Honorable Byron L. Dorgan
Chairman
Committee on Indian Affairs
United States Senate

Dear Mr. Chairman:

State and local governments spend billions of dollars annually on the construction, renovation, and maintenance of public school facilities. However, concerns persist about the conditions of some school facilities, particularly those located near Indian lands. This is because Indian students often attend schools in rural areas with higher levels of poverty, and compared with other students often have poorer educational outcomes, such as lower scores on standardized tests and lower graduation rates. (In this report, we refer to American Indians and Alaska Natives as Indians.) Some education experts believe the condition of public school facilities can affect student outcomes, and numerous studies have attempted to document possible associations. To maintain and build public school facilities, school districts generally rely on their local tax base. Some school districts have limited access to this source of revenue because a portion of the nearby land is owned by the federal government, which is exempt from local property taxes. Although funding for school operations and construction is primarily considered a state and local issue, the Congress established the Impact Aid Program in 1950 to provide funding to school districts that are adversely impacted by a lack of local revenue because of the presence of federal land. Under the Impact Aid basic support program, the Department of Education (Education) awards funding to school districts generally on the basis of the number of federally connected students they serve, such as those students residing on Indian lands or military bases or who have parents in the military or who work on federal lands.¹ In 2008, Congress provided \$1.1 billion for basic educational expenses under the Impact Aid program. Education distributed these funds to about 1,200 school districts, with about half of

¹For the purpose of distributing Impact Aid funds, Indian lands are defined to include federal property held in trust by the United States for individual Indians or Indian tribes; other designated lands held by individual Indians or Indian tribes; and public land owned by the United States that is designated for the sole use and benefit of individual Indians or Indian tribes. For a complete definition, see 20 U.S.C. § 7713(7).

the funds going to Impact Aid school districts that have students residing on Indian lands.

In response to your request that we describe the condition of facilities in school districts that receive Impact Aid for students residing on Indian lands, this report addresses the following questions:

1. What information is available on the physical condition of facilities in school districts that receive federal Impact Aid due to students residing on Indian lands?
2. What is known about how school facilities affect student outcomes?

To determine what information is available about the physical condition of school facilities in Indian Impact Aid school districts, we contacted officials from state and federal agencies and reviewed relevant federal laws and regulations.^{2, 3} We also analyzed national state-level data on student populations residing on Indian lands and contacted the 11 states with a large number of Indian Impact Aid school districts (at least 15 districts). We obtained data from 4 states that indicated they had independent assessment data about the condition of or deficiencies in some or all of their public schools. We only accepted assessment data that were prepared by an independent party with no apparent vested interest in the results of the assessment. We analyzed the states' data to describe the condition of school facilities for all of the Indian Impact Aid and other school districts in Montana and New Mexico and the 118 of 295 districts in Washington for which data were available (9 of 29 Indian Impact Aid and 109 of 266 other school districts). We determined that the data were sufficiently reliable for the analyses used for this report. Although the 4th state, Arizona, also had independent assessment data, it identified deficiencies rather than the overall condition of school facilities, so we did not use the data, but we did include Arizona in site visits. The 3 states from which we had usable assessment data represented approximately

²We use the term "Indian Impact Aid" to refer to those school districts that qualify to receive Impact Aid basic support funding because they meet the minimum eligibility criteria, namely they have at least 400 students in average daily attendance who are federally connected, in this case who reside on Indian lands, or such students comprise at least 3 percent of the total number of students in the district.

³Although the Bureau of Indian Education also funds, and in some instances operates, schools for Indian students, we focus on public schools that receive Impact Aid funds for students residing on Indian lands.

27 percent of all students residing on Indian lands. In addition, we visited 2 school districts in each of the 4 states to obtain school district officials' perspectives on factors that affect facility maintenance and to observe their facilities. To determine what is known about how the condition of school facilities affects student outcomes, we conducted a literature search for studies that quantitatively analyzed relationships between school facility variables and a variety of student outcomes, such as student achievement test scores and student attendance rates. We selected a set of 24 studies—those in peer-reviewed journals and others that our methodologists regarded as sufficiently rigorous—and systematically reviewed these studies. (See app. I for a description of our selection criteria.) We also discussed the effects of the condition of school facilities on students and teachers during our 8 school district site visits and in interviews with representatives of Indian Impact Aid associations and state Indian Education officials.

We conducted our work from September 2008 to October 2009 in accordance with all sections of GAO's Quality Assurance Framework that are relevant to our objectives. The framework requires that we plan and perform the engagement to obtain sufficient and appropriate evidence to meet our stated objectives and to discuss any limitations in our work. We believe that the information and data obtained, and the analysis conducted, provide a reasonable basis for any findings in this product. See appendix I for further information on our scope and methodology, appendix II for a list of states with Indian Impact Aid school districts, and appendix III for a summary of studies on school facilities and student outcomes.

Background

Role of the Federal Government in Public Elementary and Secondary Education

Public elementary and secondary education is primarily a state and local government responsibility, although the federal government provides supplementary funds to public schools for a variety of purposes, including grants for disadvantaged students, special education students, and teacher improvement. The federal government provided about 8 percent of funding for public education in school year 2005-2006. The allocation of federal funds reflects a concern with student outcomes as evidenced by the Elementary and Secondary Education Act of 1965, as amended, which has the goal of ensuring that all children have a fair, equal, and significant opportunity to obtain a high-quality education. The No Child Left Behind Act of 2001 (NCLBA), which reauthorized and amended ESEA, requires

school districts to make improvements when they fail to make adequate yearly progress in raising student achievement.

The federal government has historically provided for the education of Indian children in part through the Department of the Interior's Bureau of Indian Affairs. Interior's Bureau of Indian Education, previously a part of the Bureau of Indian Affairs, funds 170 schools serving students living on Indian lands; however, most Indian students now attend public schools. In some cases, these schools and Indian Impact Aid schools are in the same communities, and students may transfer from one to the other.⁴ Among some 580,000 Indian children who attend public elementary and secondary schools in the United States, about one-third of them are enrolled in Indian Impact Aid school districts. An estimated 45,000 Indian students attend Bureau of Indian Education schools. The remaining Indian children attend other public schools or private schools.

Impact Aid Program

Congress established the Impact Aid program in 1950 to assist public school districts that have lost property tax revenue due to the presence of tax-exempt federal property, or that have experienced increased costs due to the enrollment of federally connected children, including children living on Indian lands, military bases, or other federal lands for which school districts receive no tax revenue. Public school districts qualify for and receive Impact Aid, in part, on the basis of the number of federally connected students they serve, such as those who reside on military bases, Indian lands, or other federal lands, or others who have parents in the military or who work on federal lands.⁵

The largest component of the Impact Aid program is basic support payments, which provided about \$1 billion for fiscal year 2008 to about

⁴For information concerning Bureau of Indian Education schools, see GAO, *Bureau of Indian Education Schools: Improving Interior's Assistance Would Help Some Tribal Groups Implement Academic Accountability Systems*, [GAO-08-679](#) (Washington, D.C.: June 27, 2008); and *Bureau of Indian Education: Improving Interior's Assistance Would Aid Tribal Groups Developing Academic Accountability Systems*, [GAO-08-1125T](#) (Washington, D.C.: Sept. 9, 2008).

⁵The formula for distributing Impact Aid basic support payments also takes into account the number of students in certain low-rent housing, the average daily attendance for the district, and the national and state per pupil expenditure figures. The Impact Aid program also authorizes separate payments on behalf of children eligible to receive services under the Individuals with Disabilities Education Act whose parents are members of the Armed Forces and those residing on Indian lands.

1,200 public school districts,⁶ including about \$520 million to 567 Indian Impact Aid school districts for students living on Indian lands in 27 states.⁷ (See app. II for preliminary fiscal year 2009 data.)

School districts eligible for Impact Aid decide how to use these funds.⁸ For example, they may use these funds for costs associated with teacher salaries and benefits; transportation; textbooks; and facility maintenance, repair, renovation, and construction. Some districts also hold a portion of these funds in reserve for use in future years. To be eligible for basic support payments for having students living on Indian lands, a school district must have at least 400 federally connected students, or these students must comprise at least 3 percent of their total number of students. The method for determining Indian Impact Aid basic support payments provides more funding per federally connected student in school districts where these students are a larger share of the total number of students and the basic support payments represent a larger share of current school district expenditures.⁹ For Indian Impact Aid school districts, the average amount of this basic support per student living on Indian lands was \$4,534 in fiscal year 2008. After adjusting for inflation, this average rose 7 percent from fiscal years 2002 to 2005 and has subsequently fallen back to about fiscal year 2002 levels.

⁶As of August 2009, 93 percent of the approximately \$1.1 billion of fiscal year 2008 appropriations for basic support payments had been paid to 1,229 school districts. Education makes final payments of the remaining funds when final decisions are reached on all applications, which Impact Aid Office staff indicate typically occurs about 2 years after the appropriation year.

⁷These are the amounts paid to date as of December 2008, at which time 92 percent of all basic support payment Impact Aid appropriations for fiscal year 2008 had been paid. Some states, such as New Mexico, with Education approved programs for equalization of funding for school districts adjust the level of state funding districts receive on the basis of the amount of local revenue and Impact Aid districts receive.

⁸ESEA places no specific restriction on the use of Impact Aid basic support funds, but does require, for example, that children living on Indian lands participate in the programs and activities supported by these funds on an equal basis with all other children, and that parents and Indian tribes are consulted and involved in planning and developing these programs and activities.

⁹Due in part to these provisions, in fiscal year 2008, Indian Impact Aid districts with more than 40 percent of students living on Indian lands received overall 2½ times as much in basic support per student living on Indian lands as Indian Impact Aid districts with fewer students living on Indian lands.

The Impact Aid program also includes funding for construction, through both a formula grant program and a competitive grant program for school districts with high percentages of children living on Indian lands or high percentages of children who have a parent on active military duty. Congress provided about \$17.8 million to the formula grant program in both fiscal years 2006 and 2007, but no funding for fiscal years 2008 or 2009. Formula grants are restricted to Impact Aid school districts with at least 50 percent of students living on Indian land or at least 50 percent of students who have a parent on active military duty. The competitive construction grant program did not receive any funding in fiscal years 2006 or 2007, but received approximately \$17 million for fiscal years 2008 and 2009. These grants are for school facility emergencies and modernization and are restricted to school districts with at least 40 percent of students living on Indian lands or at least 40 percent of students who have a parent on active military duty. The competitive grant program to date has provided funding only for emergency repairs. In July 2009, this program awarded grants from the fiscal year 2008 appropriation—totaling about \$17 million—to 13 Indian Impact Aid school districts.¹⁰ The American Recovery and Reinvestment Act of 2009 (Recovery Act) appropriated \$100 million for construction projects by Impact Aid school districts.¹¹ The Recovery Act requires that Education provide nearly \$40 million of this appropriation as formula grants and nearly \$60 million as competitive grants. The Recovery Act also provides a \$53.6 billion State Fiscal Stabilization Fund, some of which may be available to provide funding to school districts, including Indian Impact Aid school districts, for a variety of purposes (e.g., modernizing, renovating, or repairing public school facilities).¹²

¹⁰Education regulations define the term “emergency” as “a school facility condition that is so injurious or hazardous that it...poses an immediate threat to the health and safety of the facility’s students and staff or can be reasonable expected to [do so] in the near future.” 34 C.F.R. § 222.176.

¹¹Pub. L. No. 111-5, § 805(b), 123 Stat. 189 (2009). Of the \$100 million available for construction, approximately \$60 million is available for competitive construction grants, which are expected to be available to a larger number of Impact Aid districts, because the Recovery Act provides eligibility criteria that do not include requirements for a minimum number of students who are living on Indian lands or are connected to military bases.

¹²Pub. L. No. 111-5, Division A, Title XIV.

Assessing Facility Conditions

Building and maintaining sound school facilities is important not only to provide a safe and healthy learning environment, but to avoid costly repairs or replacements. Facility managers who routinely assess the condition of their facilities can identify problems at their earliest stages and evaluate buildings for future maintenance and repair needs. Facility assessments take a variety of forms, from staff walking through a facility and visually inspecting its condition and identifying repair and maintenance issues to a more comprehensive assessment in which individual building systems, such as electrical, heating, and air conditioning, are assessed by a professional inspector and deficiencies are identified. To compare the relative condition of facilities, assessors often use a “facility condition index” (FCI), which is computed as the cost of repairing or replacing parts of the facility that are identified as deficient divided by the cost of replacing the entire facility. FCIs are useful in comparing the relative condition of facilities only if they are calculated using a consistent methodology. A lower FCI indicates a facility in better condition. In some cases, assessments of school facilities also include estimates of the costs for projects that do not specifically address a facility deficiency. These may include projects for bringing facilities into compliance with current building codes that the school was not required to meet when built; providing additional space in schools that are overcrowded; or providing equipment to meet the school’s needs, such as a science lab facility.

Little Information Is Available on the Condition of School Facilities in Districts That Receive Impact Aid for Students Living on Indian Lands, but Data from Selected States Indicate Conditions Ranged from Good to Poor

Limited independent information is available about the physical condition of public school facilities that receive Impact Aid funding for students living on Indian lands. However, three states—Montana, New Mexico, and Washington—have collected independent school facility assessments for some or all of their Indian Impact Aid school districts. Assessment data from these states indicate that the condition of Indian Impact Aid school facilities varies within states and ranges from good to poor. School district officials with whom we spoke attributed the condition of their school facilities to a number of factors, including age and remote location.

Limited Information Is Available at the National Level about the Condition of School Facilities in Indian Impact Aid School Districts

We did not find independent nationwide data about the condition of school facilities in Indian Impact Aid school districts. Education and its research entity have collected some information regarding the physical condition of school facilities, but none of this information was based on independent assessments of school facilities and none covered all Indian Impact Aid school districts. According to federal officials with whom we spoke:

- Education collects information on the condition of Indian Impact Aid schools from surveys it receives from school districts that are awarded construction formula grants. School districts that received construction payments in the prior year are required to complete a brief survey as part of the Impact Aid application in which they rank the overall condition of their school facilities on a scale of 1 (excellent) to 6 (replace). From its 2008 application, Education collected surveys from 181 school districts, of which 31 percent indicated their facilities were in good to excellent condition; 54 percent indicated adequate to fair condition; and 15 percent indicated poor condition or in need of replacement. However, Education does not independently verify the responses or use this information in awarding grants, and the number of respondents represents only a small portion of the approximately 1,200 Impact Aid school districts that received Impact Aid basic support funding in 2008.

-
- In 2007, Education’s National Center for Education Statistics (NCES) surveyed a nationally representative sample of 1,205 public schools about their school’s condition.^{13, 14} School principals completing the questionnaire were asked about the quality of their schools, including their satisfaction with the physical condition of their buildings. Eighty-three percent of the principals were satisfied or very satisfied with the physical condition of their permanent buildings. However, due to the small sample size, we were not able to obtain statistically meaningful responses for Indian Impact Aid schools. In addition, NCES did not independently verify the survey responses that were provided by school principals.

Three States Collect Independent Assessments on the Condition of School Facilities at Indian Impact Aid School Districts

Among states with large numbers of Indian Impact Aid school districts (at least 15 districts), only Montana, New Mexico, and Washington had independent information about the condition of school facilities in some or all Indian Impact Aid school districts. These 3 states represented approximately 27 percent of all students living on Indian lands. The other states with large numbers of Indian Impact Aid school districts (8 of 11) had no independent information about the physical condition of the school facilities in their school districts (see table 1.) For example, Alaska requires districts to assess their own facilities and submit condition assessment reports to apply for state maintenance and construction grants. However, the data Alaska collects about school condition are not independently verified by the state. Arizona began independently assessing school facilities in 2004 as part of its public school assessment program to ensure that schools meet state minimum condition standards. Arizona has collected information on variables related to facilities, including the number, type, and size of buildings and whether the school site, equipment, and building systems meet the state’s adequacy standards. While these data can be used to identify deficiencies, they do not provide an overall assessment of whether the school facilities are in good, fair, or poor condition.

¹³NCES is the primary federal entity for collecting, analyzing, and reporting data related to education in the United States.

¹⁴B. Chaney and L. Lewis (2007), *Public School Principals Report on Their School Facilities: Fall 2005* (NCES 2007-007). U.S. Department of Education. Washington, D.C.: National Center for Education Statistics.

Table 1: Eleven States with Large Numbers of Indian Impact Aid School Districts in 2008

State	Number of school districts receiving Impact Aid for having students who live on Indian lands	State collects independent assessments of the condition of school facilities	Number of Indian lands students on the basis of average daily attendance	Percentage of national total of Indian lands students served by Impact Aid
Alaska	34	No	12,114	10.57%
Arizona	58	No	30,383	26.52
California	35	No	4,897	4.27
Minnesota	23	No	3,530	3.08
Montana	61	Yes	7,434	6.49
New Mexico	19	Yes	18,294	15.97
North Dakota	17	No	2,346	2.05
Oklahoma	194	No	10,610	9.26
South Dakota	26	No	5,839	5.10
Washington	29	Yes	5,686	4.96
Wisconsin	17	No	3,273	2.86

Source: GAO analysis of Department of Education and state data.

The facility assessment programs in Montana, New Mexico, and Washington are unique in terms of their purpose, frequency of assessment, number of districts assessed, and data collected.

- In 2005, Montana’s legislature authorized the appropriation of funds for a one-time condition and needs assessment for all K-12 public schools. This occurred in 2008 when Montana assessed school facilities in its 422 public school districts using a facility condition assessment approach that involved inspecting various school building components, identifying the observable deficiencies, and estimating the costs to repair the deficiencies and replace the entire facility. Montana inspected 11 building systems for each facility, including the HVAC system (heating, ventilation, and air conditioning); electrical system; plumbing system; foundations; exterior sidings; floor systems; roof systems; interior finishes (walls, floors, and windows); special fixtures (cabinets, chalkboards, and fixed seating); conveying systems (elevators); and fire and building code systems (fire detection and suppression, and building accessibility). Montana’s inspections resulted in an FCI value for each school district based on assessments of all of the facilities in the school district. Montana’s FCI used a scale of 0 to 100 percent and the higher the percentage, the closer the cost of the repairs were to the cost of a new facility. Montana considers school facilities with FCIs from 0 to 9 percent to be in good condition, FCIs from 10 to 19 percent to be in fair condition, and FCIs of

20 percent and greater to be in poor condition. Facilities with FCIs greater than 50 percent are considered to be experiencing such levels of fatigue that the merits of reinvestment in the existing structure should be carefully considered.

- New Mexico created a facility assessment program that required it to evaluate the capital needs of every school facility in the state, rank all 789 public schools in terms of needed capital improvements, and prioritize funding on an annual basis for those public school facilities most in need of repair. This program enables it to optimize the allocation of limited resources. In 2003, New Mexico assessed all K-12 public school facilities and developed the New Mexico condition index (NMCI) that measures both the physical condition and the adequacy of a school facility against New Mexico's adequacy standards. Facility assessments include evaluations of eight building systems, including site utilities; structural systems (foundations, exterior walls, doors, and roof); interior systems (walls, ceilings, and floors); mechanical and plumbing systems, electrical systems; building and fire code systems (accessibility and fire detection suppression); equipment (gym equipment and technology); and special fixtures (cabinets and chalk boards). The NMCI incorporates weighting factors for specific deficiencies, such as conditions that present health or safety threats, inadequate space, and inadequate equipment. In addition, New Mexico's assessment process includes a life-cycle analysis that takes into consideration whether a building system is within or beyond its recommended life. New Mexico updates the facility condition data when it completes new assessments of facilities, receives new data from school construction applications, or receives information from the life-cycle analysis. Each year, New Mexico uses the NMCI to rank the schools from the highest score (indicating those most in need of repair or replacement) to the lowest score and typically provides funding for the 100 schools most in need of capital improvement.
- Washington collects building condition evaluations from school districts that apply for a study and survey grant. This state program provides school districts with funds to complete a long-range planning document, which is a prerequisite for state school construction assistance and includes an independent evaluation of school facilities. Washington provided the evaluation information to us for the 118 school districts that have submitted building evaluations since 2003, including 9 evaluations from Indian Impact Aid school districts and 109 from other school districts, from a total of 295 school districts statewide. School districts may apply for a study and survey grant once every 6 years. As a part of the process to complete the building condition evaluation form, the building inspector scores the condition of various components of a building's exterior system

(foundation, wall, and roof); interior system (floor, wall, and ceiling); mechanical system (electrical, plumbing, and HVAC); and safety and building code system (fire alarm and detection, and emergency lighting). Each building component is awarded points based on its assessed condition. For example, if the inspector determines the exterior walls of the facility to be in good condition, a total of 8 points can be awarded compared with a total of 2 points that can be awarded if the exterior doors and windows are determined to be in good condition. The component scores are summed to create the buildings' evaluation score, which can range from 0 to 100 points. The building evaluation scores can provide relative information about the condition of different facilities, but they differ from FCI calculations because they do not include an estimate of the repair and replacement costs. According to state officials, the building evaluation scores are used in the process for prioritizing school districts for funding. The scores are not used to categorize school districts in terms of the condition of their facilities. However, the evaluations of several school districts in Washington conducted by one consultant included a scoring table that associated different building scores to different levels of condition. Based on this table, a score of 90 to 100 indicates good condition, a score of 60 to 89 indicates fair condition, a score of 30 to 59 indicates poor condition, and a score of 0 to 29 indicates unsatisfactory condition.

Montana, New Mexico, and Washington each measure facility condition differently, and, as a result, we are not able to make comparisons about school condition among the states. For example, Montana calculated FCIs on the basis of the condition of 11 building systems, while New Mexico calculated FCIs on the basis of 8 building systems. Washington's school facility evaluations use a 0 to 100 point scale, rather than an FCI calculation. Since each state applied the same method for all schools within the state, we are able to compare districts within states.

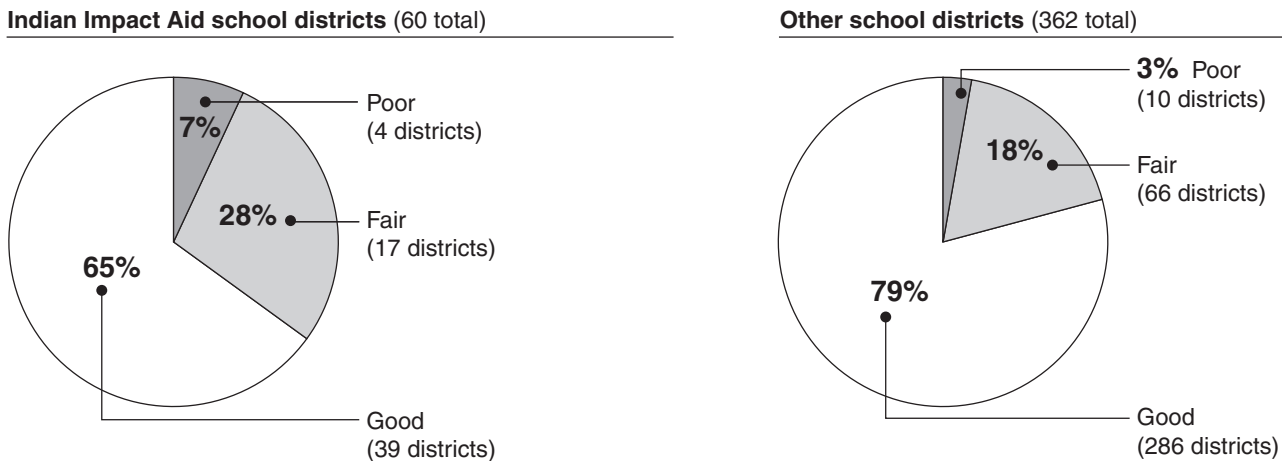
Data from 3 States
Indicated Condition of
School Facilities at Indian
Impact Aid School
Districts Ranged from
Good to Poor

Montana

Montana's assessment data showed that most of its Indian Impact Aid school districts' facilities were in good condition, although a larger proportion of other school districts—that is, those that do not receive

Impact Aid for students residing on Indian lands—had facilities in good condition. (See fig. 1.)

Figure 1: Condition of School Facilities in Montana’s Indian Impact Aid and Other School Districts



Source: GAO analysis of Montana data.

Note: The number of Indian Impact Aid school districts and other school districts is based on 2008 data from the Department of Education, the most recent data available at the time of this analysis.

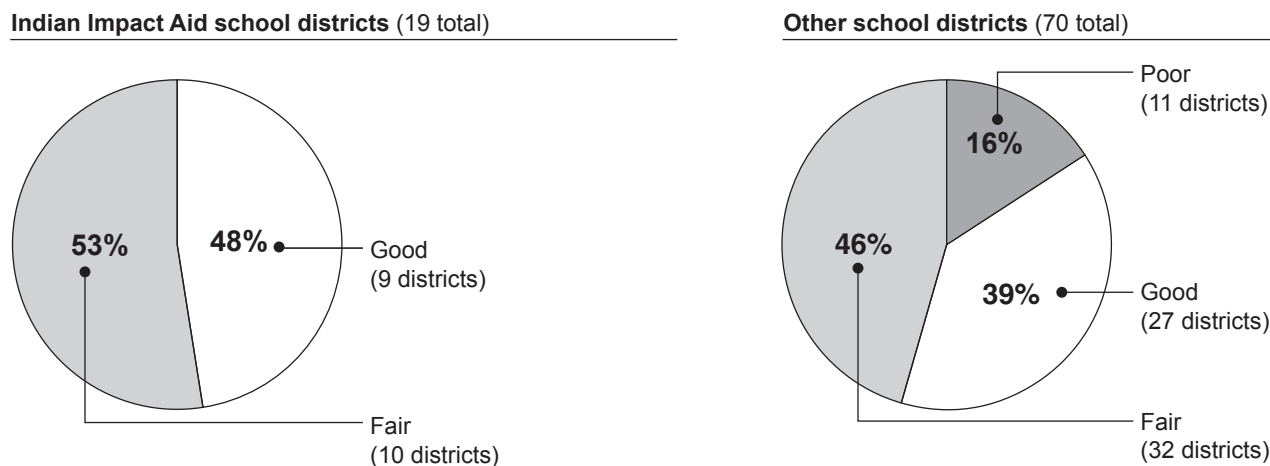
Montana’s data indicated that most of the school facilities’ building systems were in good condition. For example, 75 to 100 percent of the Indian Impact Aid school districts had roof systems, HVAC systems, plumbing systems, building foundations, and floor systems that were in good condition. The data were similar for the other school districts. On the other hand, the assessment data indicated that about one-half of the Indian Impact Aid and other school districts had fire and building code systems and about one-quarter had electrical systems that were in poor condition. The biggest difference between the Indian Impact Aid and other school districts was the condition of their interior finishes, with respective rates of 50 percent and 78 percent that were in good condition, 30 percent and 13 percent that were in fair condition, and 20 percent and 9 percent that were in poor condition.

New Mexico

New Mexico uses its facility assessment information and the NMCI to rank its schools relative to their capital needs and does not define specific NMCI levels that would correlate to schools being considered in good, fair, or poor condition. According to a New Mexico official, excluding the

equipment and special fixtures systems and the weighting factors from New Mexico's assessment data would result in a more traditional FCI.¹⁵ After making these adjustments, the analysis of New Mexico's data indicated that all of the Indian Impact Aid school districts had facilities that were in either good or fair condition. The data were similar for New Mexico's other school districts with 84 percent having facilities that were in good or fair condition. None of the Indian Impact Aid and less than a fifth of the other school districts had facilities that were in poor condition. (See fig. 2.)

Figure 2: Condition of School Facilities in New Mexico's Indian Impact Aid and Other School Districts



Source: GAO analysis of New Mexico data.

Note: The number of Indian Impact Aid school districts and other school districts is based on 2008 data from the Department of Education, the most recent data available at the time of this analysis. Also, totals may not add to 100 percent because of rounding.

According to New Mexico's data, most Indian Impact Aid and other school districts had building systems that were in good to fair condition. The school districts' structural systems were in the best shape overall—95 percent of the Indian Impact Aid and about 87 percent of the other school districts had structural systems that were in good condition. New Mexico's data showed that at least one-half of the Indian Impact Aid school districts had electrical systems that were in good condition, while

¹⁵Our analysis uses an FCI scale wherein an FCI below 10 percent indicates the facility is in good condition, an FCI that is 10 to 19 percent indicates the facility is in fair condition, and an FCI that is 20 percent and greater indicates a facility is in poor condition.

at least one-half of both types of school districts had building and fire code systems that were in good condition. Although about one-half of the Indian Impact Aid and other school districts had site utility systems that were in good condition, this was also the building category with the highest proportion of districts that were in the poor condition category. For the remaining two building systems, New Mexico's data indicated that about one-quarter of the Indian Impact Aid and other school districts had mechanical and plumbing systems that were in good condition and one-third of the Indian Impact Aid and one-quarter of the other school districts had interior systems that were in good condition.

Washington

Washington's data were based on evaluations from 118 of 295 school districts, including 9 of 29 Indian Impact Aid school districts and 109 of 266 other school districts.¹⁶ As we have previously discussed, Washington does not categorize school districts in terms of their condition, but one consultant has associated the building scores with different levels of condition. For our analysis, we used this consultant's scoring table to categorize the school districts' facilities as being in good, fair, or poor condition. Based on this scoring table, the state's data showed that 4 Indian Impact Aid school districts were in fair condition and 5 were in poor condition. The data indicated that none of the Indian Impact Aid districts were in good condition. The data showed that 2 percent (2) of the other 109 school districts were in good condition, 55 percent (60) were in fair condition, and 43 percent (47) were in poor condition.¹⁷

Washington's data indicated that none of the 9 Indian Impact Aid school districts and about 14 percent of the other school districts had building systems in good condition. Washington's data showed 5 to 7 of the 9 Indian Impact Aid school districts had exterior building systems, interior building systems, and safety and building code systems that were in fair condition and 6 districts had mechanical systems that were in poor condition. The data were less clear-cut for the 109 other school districts, although they showed that almost two-thirds (67) of these districts had

¹⁶The number of Indian Impact Aid school districts is based on 2008 data from Education, the most recent data available at the time of this analysis.

¹⁷To more easily describe the condition of facilities, we combined districts with poor and unsatisfactory scores into one category, which we titled "poor." Of the 5 Indian Impact Aid districts, Washington's data showed that 2 had schools that were unsatisfactory. Of the 47 other school districts, the data showed that 20 districts had schools that were unsatisfactory.

mechanical systems that were in poor condition and almost three-fourths (81) had exterior systems that were in fair condition.

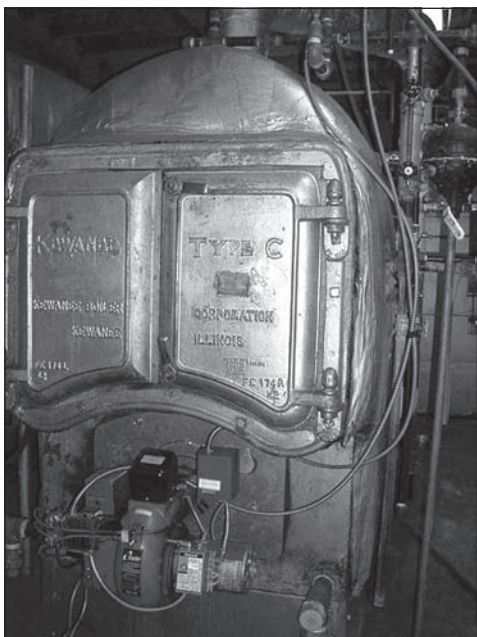
School District Officials Identified Several Factors That Contribute to Facility Conditions, Including Fiscal Capacity, Age, and Location

While localities often rely on issuing bonds to raise funds for school renovations and new construction, the officials at most of the school districts we visited commented that their restricted tax base impacts their ability to issue bonds. Officials in one New Mexico school district said that they were able to secure a limited level of bonding on the basis of expected Impact Aid funds. Most officials said that they are unable to issue bonds because so few property owners pay taxes, which is a source of revenue to repay the bonds. Some officials said they accumulate funds over time for a reserve to pay for emergency repairs and larger maintenance and major capital improvement projects. These officials said that Impact Aid is critical to their ability to accumulate such funds. According to officials in one Arizona school district, Impact Aid funds made it possible for the district to accumulate several million dollars that it plans to spend in 2010 on building improvements (e.g., upgrading windows) and digging a water well. At one school district in Montana, officials said that they maintain an emergency fund because without such a reserve, a major problem with a facility could cause a school to be closed. Additionally, several school district officials in Arizona and New Mexico said that they often need to replace roofs, but generally have to partially repair or patch them until sufficient funds are accumulated for a replacement.

District officials told us that older schools, like any older buildings, are often expensive to maintain because they are less efficient and other problems are more likely to surface once a repair is started. At both school districts we visited in Montana, officials said that the districts' schools are quite old, with sections in one district dating back to 1919 and the other dating back to 1930. School district officials said some buildings are still heated by boilers originally installed in the 1940s. Officials from one of the Montana school districts told us that they replaced the boiler at their high school 2 years ago after accumulating the funds necessary for the project over several years. This year, officials expect to replace the elementary school boiler—originally installed in 1942 (see fig. 3). According to district officials, the older boilers are inefficient and make it difficult to maintain a comfortable building temperature. Several school district officials in Arizona, Montana, and Washington also said that their older buildings have single pane windows, which make it difficult to maintain an adequate classroom temperature compared with more efficient double pane windows. Officials also said that the older buildings generally do not meet

and are not required to meet the current building codes, and attempts to retrofit buildings to make them more accessible are often difficult and expensive.

Figure 3: Examples of Old and New School Heating Systems in One Montana School District



Elementary school's 1942 boiler



High school's recently installed heating system

Source: GAO.

A school's remote location was also cited as a contributing factor to facility conditions. Several of the school districts we visited were located in remote areas, and one district spanned about 3,000 square miles. School district officials in New Mexico and Arizona said that because of their remote locations, quality services may be difficult to obtain and may cost more. School officials in these states said higher costs are often due to a lack of commercial builders in rural areas. For example, at one remote school district we visited in New Mexico, officials said the area lacks maintenance services for HVAC and quality roofing contractors. Officials said the HVAC system needs constant repairs, and repair services take longer and cost more when contractors must travel from urban to rural areas. According to officials from one New Mexico district, to minimize the number of trips and effectively respond to building repairs among schools that span 60 miles, maintenance personnel are required to check the online maintenance system at the school for any work orders that can

be completed while maintenance personnel are on location. State officials in New Mexico are also trying to understand whether relative remoteness was a factor in building two different schools for about 100 students that cost \$3.5 million in one remote area of the state and \$8 million in another remote area. The state has appointed a task force to address concerns that some remote school districts are not receiving the same quality of services as others from electricians, carpenters, and other contractors.

Some Research Suggests That Better School Facilities Are Associated with Better Student Outcomes, and School District Officials Agreed, but There Is Little Evidence of a Causal Relationship

The research studies we reviewed on the relationship between the condition of school facilities and student outcomes often showed that better facilities were associated with better student outcomes; however, there is not necessarily a direct causal relationship, and the associations were often weak compared with their associations with other factors. Also, some researchers suggest that specific characteristics of facilities, such as lighting, may be directly associated with student outcomes. Other characteristics of facilities, such as the general condition of the buildings, may be indirectly associated with student outcomes through their effects on other factors. We identified and reviewed 24 studies that analyzed the relationship between facility conditions and student outcomes. A majority of these studies indicated that better school facilities were associated with better student outcomes—such as higher scores on achievement tests or higher student attendance rates.¹⁸ Most of the studies measured the extent to which better school facilities were associated with better outcomes after taking into account the impact of other factors that can affect student outcomes, such as poverty and other demographic characteristics.¹⁹

¹⁸Of the 24 studies, 14 studies found correlations between school facility conditions and student outcomes; 9 studies found such correlations in some cases, but not in others, depending on the facility variables and outcome variables studied; and 1 study found no relationship after controlling for poverty status. In this case, researchers measured the extent of poverty as the percentage of students in each elementary school that was eligible for free or reduced price school lunch, a program funded through the U.S. Department of Agriculture's Food and Nutrition Service. Generally, students at or below 130 percent of federal poverty guidelines are eligible for free lunch, and those between 130 percent and 185 percent are eligible for reduced price lunch. We identify statistically significant associations as those for which there is less than a 5 percent chance that the differences observed could be accounted for by chance.

¹⁹Methodologies such as randomized trials are often impractical, or even unethical, for studying educational outcomes because some students would have to be assigned to the control group and would not receive potentially useful educational goods or services. Nevertheless, randomized trials are considered to be the best way to test hypotheses about causal mechanisms and provide more certainty in determining treatment effects than quasi-experiments and other approximations of randomized trials.

However, none of these studies proves that better facilities caused better student outcomes. About one-half of the studies we reviewed examined broad measures, such as the general condition of the school buildings based on evaluations by facilities specialists or by teachers, or the suitability of school buildings—the extent to which district officials rated the facilities as being suitable for the grades being served. Based on these studies, it is unclear to what extent better facility conditions contribute to better student outcomes, or whether the associations identified may exist because other factors, such as the level of community commitment to education, contribute to both better facilities and better student outcomes, and none proved a causal relationship. The other studies focused on specific aspects of facilities, such as heating, air conditioning, ventilation, or lighting. None of the studies we examined was able to conclusively determine how much school facility conditions contribute to student outcomes relative to other factors, such as the educational achievement of students’ parents or teachers’ qualifications.

Studies of Broad School Facilities Measures

Of the studies that focused on broad measures, such as measures of physical conditions or the suitability of school facilities, about one-half (7 of 13) found that schools with better facilities generally had better student outcomes. These included cases in which researchers noted possible direct connections between better facilities and student outcomes and cases in which they noted indirect connections, with better facilities contributing to conditions that in turn contribute to better student outcomes. Some studies indicated associations between facilities and student outcomes with some but not all measures of student outcomes.²⁰ One of the studies examining all elementary and secondary schools in the District of Columbia estimated that students attending schools in fair condition had average achievement test scores 5.45 points higher on a 0 to 100 point scale than those attending schools in poor condition.²¹ This was the case after taking into account other factors that may have an influence on student achievement, such as race and income. Similarly, a study in the Los Angeles Unified School District found that in schools with facilities

²⁰Outcomes identified in the studies we reviewed included achievement test scores, speed and error rates when performing specific tasks, student attendance rates, drop-out rates, and incidence rates of student misbehavior.

²¹Maureen M. Berner, “Building Conditions, Parental Involvement, and Student Achievement in the District of Columbia Public School System,” *Urban Education* 28(1) (April 1993), 6-29.

that met health and safety compliance requirements, the schools' average student California Academic Performance Index scores were likely to be higher.²² Compared with schools in the lowest compliance category, schools in the highest compliance category had an estimated average score that was 36 points higher on the composite index, with scores ranging from 200 to 1,000. This was the result after taking into account factors, such as the percentage of students eligible for free or reduced price school lunch and the percentage of students who were black or Hispanic. This study found that although the school facilities that were in better condition were associated with better student achievement, some of the other important factors, such as poverty, were more strongly associated with achievement. For example, holding all else constant, schools with the lowest percentage of students who were eligible for free or reduced price lunch were expected to have average achievement scores 113 points higher on the 200 to 1,000 point scale than schools in which all students were eligible for free or reduced price lunch—more than three times the estimated difference between school facilities in the worst and the best compliance categories.

One study used a potentially more rigorous methodology by comparing achievement test scores at schools before and after renovation of 3 of the district's 21 elementary schools.²³ The study showed that math, but not reading test scores, improved as the proportion of students in recently renovated schools increased. The researcher concluded that a larger sample would be needed to provide better evidence of a connection between school facilities and student achievement.

Another study found no association between better school facilities in Wyoming and student achievement. The study found that before and after taking into account the income status of students' families, there was no statistically significant association between schools in better condition

²²Jack Buckley, Mark Schneider, and Yi Shang, "LAUSD School Facilities and Academic Performance," (National Clearinghouse for Educational Facilities, Washington, D.C.: 2004). See <http://www.edfacilities.org/pubs/LAUSD%20Report.pdf> (last accessed on Dec. 20, 2008).

²³Lorraine E. Maxwell, "School Building Renovation and Student Performance: One District's Experience," (Scottsdale, Ariz.: Council of Educational Facility Planners International, 1999).

and schools with higher average achievement.²⁴ Similarly, no statistically significant association was found between student achievement and the suitability of the school facilities.

School district officials at all of the eight Indian Impact Aid school districts we visited said that in their experience, better school facilities are associated with better student outcomes, though they also often cited other factors that some believed had more influence, such as whether students' families placed a high value on education. Several district officials noted that many of their students are from low-income families that may not place an emphasis on education. Although officials in several districts we visited said their students are affected by the condition of school facilities just as other students are affected, other officials remarked that their students, who often come from homes in poor condition, may be especially affected by a school's good condition because it provides a more comfortable environment.

Some studies indicate that better facilities can contribute to student outcomes indirectly—through their effects on other factors—and school officials with whom we spoke believed this was true in their districts. For example, a study of Virginia middle schools indicated that although better student achievement was associated with the quality of school facilities, better student achievement was more highly associated with a variable identified as “school climate,” which measures attitudes in the school community that support learning, such as students' respect for others who get good grades and teachers' commitment to helping students.²⁵ The authors concluded that rather than having a direct effect on student achievement, better school facilities can indirectly influence student achievement by contributing to a good school climate for learning. School officials we interviewed noted that good facilities contribute to students' pride in their school. One official noted that good school facilities send a message to students that the community values education, which can result in better student outcomes. Similarly, a study of New York City elementary schools found that better school building conditions were

²⁴Lawrence O. Picus, Scott F. Marion, Naomi Calvo, and William J. Glenn, “Understanding the Relationship Between Student Achievement and the Quality of Educational Facilities: Evidence from Wyoming,” *Peabody Journal of Education*, 80(3) (2005), 71-95.

²⁵Cynthia Uline and Megan Tschannen-Moran, “The walls speak: the Interplay of Quality Facilities, School Climate, and Student Achievement,” *Journal of Educational Administration* 46(1) (2008), 55-73.

associated with better student attendance rates, and that these in turn were associated with better English and math achievement.²⁶

Several school officials also noted the importance of good school facilities for attracting and retaining good teachers who in turn can improve student achievement. Research points to teacher quality as an important school-level factor that influences student learning.²⁷ The association between good school facilities and teacher retention was the focus of one study that identified several factors associated with teachers' plans to remain another year in their current school, including better school facility conditions.²⁸ This study found an association between the school facility and teacher retention even after taking into account several other factors, including the teachers' ages, their tenure at the school, and their satisfaction with pay and the community.

Studies of Specific Characteristics of School Facilities

Studies we reviewed that focused on the effect of specific characteristics of the school facility found that some factors, such as lighting, are directly associated with better outcomes. Rather than simply examining whether students have enough light to be able to see classroom materials, some studies have examined the extent to which classrooms provide daylight or light that simulates daylight. For example, a study of 24 elementary schools in Georgia found that third-grade students in classrooms with more daylight had higher average achievement test scores after taking into account the free or reduced price lunch variable and other aspects of the school facility design. Including daylight in the analysis explained an additional 2.5 percent of the variation in average test scores among the schools.²⁹ Similarly, a study of 102 schools in California, Colorado, and

²⁶Valkiria Durán-Narucki, "School Building Condition, School Attendance, and Academic Achievement in New York City Public Schools: A Mediation Model," *Journal of Environmental Psychology* 28 (2008), 278-286.

²⁷For a discussion of efforts to improve teacher quality, see GAO, *Teacher Quality: Sustained Coordination among Key Federal Education Programs Could Enhance State Efforts to Improve Teacher Quality*, GAO-09-593 (Washington, D.C.: July 6, 2009); and *Teacher Quality: Approaches, Implementation, and Evaluation of Key Federal Efforts*, GAO-07-861T (Washington, D.C.: May 17, 2007).

²⁸Jack Buckley, Mark Schneider, and Yi Shang, "The Effects of School Facility Quality on Teacher Retention in Urban School Districts," National Clearinghouse for Educational Facilities, www.ncef.org (February 2004).

²⁹C. Kenneth Tanner, "Explaining Relationships among Student Outcomes and the School's Physical Environment," *Journal of Advanced Academics* 19(3) (Spring 2008), 444-471.

Washington found that students in the classrooms with the most daylight increased their test scores overall about 21 percent more than those students in rooms with the least amount of daylight after taking into account additional information, including teacher characteristics and grade levels. A follow-up study taking into account additional information, including teacher characteristics and grade levels confirmed these findings, showing that students in the classrooms with the most daylight increased their test scores overall about 21 percent.³⁰ Another study found that classrooms with full-spectrum fluorescent light bulbs, which simulate daylight, were associated with faster academic progress compared with classrooms using high-pressure sodium vapor bulbs, which do not simulate daylight as well.³¹ Average test scores in classrooms with full-spectrum bulbs indicated that students increased their level of academic achievement by about 2 grade levels over the 2-year study period, compared with 1.6 years for students in classrooms with the high-pressure sodium vapor bulbs.

Few of the school administrators with whom we spoke cited lighting as a factor related to student outcomes, although we found that the extent to which students were exposed to natural light varied in the schools we visited. While many schools had classrooms with windows that let in light, the level of natural light varied considerably. One school had installed dividing walls to create smaller classrooms out of large spaces, and some of the resulting classrooms had no natural light. In at least one school we visited in Washington, renovations included upgrading lighting to provide full-spectrum light and reduce energy use.

Studies examining the quality of air in classrooms found associations between better air quality and better health or lower absenteeism. A study of schools in Finland found that in an elementary school with moisture or mold problems, there was a higher occurrence of respiratory infections, repeated wheezing and prolonged coughing, and emergency room visits

³⁰Lisa Heschong, Ihab Elzeyadi, and Carey Knecht, "Re-Analysis Report: Daylighting in Schools, Additional Analysis," (Fair Oaks, Calif.: Heschong Mahone Group, Feb. 14, 2002). This study assessed changes in scores from achievement tests taken in the fall and spring in one district and compared schools' average test scores at the end of the school year with district average test scores.

³¹Warren E. Hathaway, "Effects of School Lighting on Physical Development and School Performance," *Journal of Educational Research* 88(4) (March-April 1995), 228-242.

than in other schools.³² Another study of schools in Finland had similar results and showed that although background concentrations of fungi in wooden buildings were significantly higher than in concrete or brick buildings, moisture damage increased fungal concentrations significantly in the concrete or brick buildings, but not in wooden school buildings. Moisture damage increased the likelihood that students would have respiratory symptoms in schools constructed of concrete or bricks.³³ Another Swedish study found that two day-care centers that installed electrostatic air cleaning systems reduced the concentrations of fine particles in the air, and absenteeism fell by 55 percent at the larger center and by a smaller proportion at the smaller center.³⁴ Absenteeism almost returned to the original level after the system at the larger center was turned off. Another study found that new ventilation systems in Swedish schools reduced the prevalence of asthmatic symptoms in classrooms compared with those without the new systems.³⁵ Studies in Danish elementary school classrooms found that ventilation systems that drew in larger volumes of outdoor air were associated on average with an 8 percent increase in the speed at which students worked.³⁶ Air quality was a concern in two of the districts we visited, such as at a middle school we visited in Washington where the main hallway had no ventilation or air circulation and the stale air had a noticeable odor. School administrators cited the poor air quality as a concern they felt was a high priority to address. Another school in the same district faced complaints about air

³²Taina Taskinen, A. Hyvärinen, T. Meklin, T. Husman, A. Nevalainen, and M. Korppi, "Asthma and Respiratory Infections in School Children with Special Reference to Moisture and Mold Problems in the School," *Acta Paediatrica* 88(12) (1999), 1373-1379.

³³Teija Meklin, T. Husman, A. Vepsäläinen, M. Vahteristo, J. Koivisto, J. Halla-Aho, A. Hyvärinen, D. Moschandreas, and A. Nevalainen, "Indoor Air Microbes and Respiratory Symptoms of Children in Moisture Damaged and Reference Schools," *Indoor Air* 12(3) (2002), 175-183.

³⁴Karl G. Rosén and George Richardson, "Would Removing Indoor Air Particulates in Children's Environments Reduce Rate of Absenteeism—A hypothesis" *The Science of the Total Environment* 234 (1999), 87-93. The decline in attendance at the smaller center was not statistically significant.

³⁵Greta Smedje and Dan Norbäck, "New Ventilation Systems at Select Schools in Sweden—Effects on Asthma and Exposure," *Archives of Environmental Health* 55(1) (January/February 2000), 18-25.

³⁶Pawel Wargocki and David P. Wyon, "Research Report on Effects of HVAC on Student Performance," *ASHRAE Journal* 48(10) (October 2006), 22-28 (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.) The study compared results from ventilation systems providing 3.0 and 9.5 liters per second, per person. Error rates declined significantly for one numerical task, but not for other tasks.

quality, and administrators speculated that the air quality was adversely affected by old carpeting.

One study considered the effects of temperature control in elementary schools in Denmark and found an association between comfortable temperatures and student performance. The study found that reducing classroom temperatures from 77 degrees Fahrenheit was associated with improved speed in math and language tests. The study indicated that a 1.8 degree Fahrenheit drop in temperature was associated with about a 4 percent increase in the speed at which students worked. The number of errors students made decreased when performing some tasks, but not others. School officials in several districts we visited cited difficulties in maintaining comfortable temperatures in classrooms and concurred that when students are too cold or too warm, it is difficult for them to concentrate on their studies.

Agency Comments

We provided a draft of the report to the Department of Education for review and comment. We received technical clarifications from Education's Impact Aid Program within the Office of Elementary and Secondary Education, which we incorporated in the report as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Education, and other interested parties. In addition, the report will be available at no charge on GAO's Web site at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact Cornelia Ashby on (202) 512-7215 or ashbyc@gao.gov; or Terrell Dorn on (202) 512-6923 or dornt@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix IV.

Sincerely yours,



Cornelia M. Ashby
Director, Education, Workforce,
and Income Security Issues



Terrell G. Dorn
Director, Physical Infrastructure Issues

Appendix I: Objectives, Scope, and Methodology

To determine what information is available about the physical condition of school facilities in Indian Impact Aid school districts and what is known about how the condition of school facilities affects student outcomes, we interviewed officials from state and federal agencies, and associations and reviewed relevant federal laws and regulations. This included interviews with officials from the Department of Education's National Center for Education Statistics (NCES); state education agencies; school districts; and education associations, including the National Indian Impacted Schools Association, the National Association of Federally Impacted Schools, National Council for Impacted Schools, National Indian Education Association, as well as state Indian education officials in Washington and Montana. We conducted a literature search to identify research studies and analyzed selected studies. We also visited school districts in four states—Arizona, Montana, New Mexico, and Washington.

To determine what information is available about the physical condition of school facilities in Indian Impact Aid school districts, we contacted officials from Education's Impact Aid Office, NCES, and Indian Impact Aid associations for independent national data on school condition. We decided to accept only assessment data that were prepared by an independent party with no apparent vested interest in the results of the assessment. We determined that Education collects surveys about school condition from school districts that received an Impact Aid construction formula grant, but we determined that the survey data were of limited use because they were not based on independent assessments and did not cover all Indian Impact Aid schools. We determined that although NCES published the results of its study of a nationally representative sample of school districts in which it asked school principals about the condition of their schools, we could not use these data because we are not able to obtain statistically meaningful responses for Indian Impact Aid schools due to sample size, and NCES did not independently verify the survey responses that were provided by school principals. We found that national associations like the National Indian Impacted Schools Association and the National Council for Impacted Schools do not document the condition of school facilities in Indian Impact Aid school districts.

Because we could not identify a source for nationwide data, we sought state-level data. Education provided us with the list of states with school districts that received fiscal year 2008 Impact Aid funds for students living on Indian lands. From this list of 27 states, we identified 11 states with a large number of Indian Impact Aid districts (at least 15 districts) and contacted their state education officials to determine whether they had independent assessment data about the physical condition of public

school facilities. We determined that four states—Arizona, Montana, New Mexico, and Washington—had assessment data for some or all of their public schools.

We obtained and analyzed these data from the four states, which did not maintain the data in similar fashions. Montana and its contractor provided us with a copy of its complete school building and system-level analyses of repair and replacement costs, which we used to generate our school district-level analysis. New Mexico provided us with school district-level data of building system repair and replacement costs. Arizona collected only deficiency information at the school building-level, which we used to create our district-level information for site selection. Washington maintained hard copies of the building-level evaluation reports, which we keypunched to create raw data for district-level files. On the basis of our analysis, we were able to describe the condition of schools in Indian Impact Aid districts in three of the four states. We determined that these data were sufficiently reliable for the analysis used in this report. We were not able to use Arizona's data because, although it describes a variety of information, including the number, type, and size of buildings and whether the school site and building systems meet the state's adequacy standards, the data do not determine whether the school facilities are in good, fair, or poor condition. For the other three states, we combined the facilities data with Education's Common Core of Data to describe the characteristics of the school districts, which we used for selecting school districts for site visits.

Because each state's assessment program is unique, it does not allow for comparisons among states. For example, while both Montana and New Mexico create a facility condition index that is based on the ratio of renewal cost to replacement cost, New Mexico weights deficiencies in a manner consistent with its own state priorities, (e.g., classroom space); whereas, Montana does not rely on any explicit weighting scheme. In addition, each state bundled its building system groups differently, consistent with state priorities with the respective indexes for each bundle being incorporated into the calculation of the overall facility condition index. In contrast, the assessment program in Washington does not calculate a facility condition index. Only districts seeking funds for planning grants or construction participate in the Washington assessment program, unlike in Montana and New Mexico where all school districts were assessed. Because of these differences, facility condition measures are not strictly comparable across states. While comparison among states would not be valid to evaluate the condition of schools in Indian Impact Aid districts, the condition of school facilities can safely be compared

within each state. This comparison allows for an assessment of the quality of school condition in Indian Impact Aid districts relative to that of other districts in the same state.

In Washington, only districts applying for a study and survey grant submit documentation of the condition of their school facilities. The districts that do participate in the study and survey grant program are required to provide matching funds, which in turn may indicate the ability to obtain school board or community approval to levy a bond. Of 29 Indian Impact Aid school districts, 9 have submitted building evaluation reports since 2003. Similarly, 109 of 266 other school districts statewide have completed and submitted an evaluation report for their district. Because less than one-half of the districts submitted evaluation data and the districts that did are self-selected, it is not known whether the assessed districts differ systematically from the nonassessed group. In addition, whether and how systematic differences between the assessed and nonassessed groups occur could be different for Indian Impact Aid districts and other districts in Washington. Differences in facility condition between Indian Impact Aid districts and other districts in Washington could be attributable to these underlying selection-related differences and not to any real differences between the two populations of school districts in Washington.

We selected two school districts in each of the four states to visit to obtain district officials' perspectives on factors that affect facility maintenance and to observe their facilities. We selected districts that provided variety on the basis of selection criteria, such as information about the relative condition of the school districts' facilities, the proportion of the school district's revenue composed of Impact Aid, proportion of students who are Indians, and number of students enrolled. (See table 2.)

Table 2: Characteristics of Site Visit School Districts

State	School district	State facility score	Impact Aid as a percentage of revenue 2005-06	Indians as a percentage of all students in 2006	Student average daily attendance in 2007
Arizona	Indian Oasis-Baboquivari	^a	28%	99%	1,042
	Sanders	^a	37	98	934
Montana	Dixon	8 ^b	19	50	84
	St. Ignatius	20 ^b	16	55	449
New Mexico	Central Consolidated	15 ^b	31	89	6,343
	Zuni	6 ^b	38	99	1,382
Washington	Mt. Adams	51 ^c	27	65	951
	Wapato	72 ^c	7	26	3,207

Source: GAO analysis of Department of Education and state data.

^aArizona did not identify a score. Selection was based on lists of deficiencies in the state's database, comments from state facility assessors, and other information.

^bFor Montana and New Mexico, a lower score indicates school facilities are in better condition.

^cFor Washington, a higher score indicates school facilities are in better condition.

To determine what is known about how school facilities affect student outcomes, we conducted a search for research studies that addressed this topic. We identified studies dating back to 1980 and selected those that were either from peer-reviewed journal articles or were methodologically rigorous studies from (or sponsored by) other sources, such as government institutions. Two GAO staffers, one analyst from the audit team and one methodologist from the research group, systematically reviewed each of the studies selected, evaluating the design, measurement strategies, and methodological integrity and entering this information into a database. From more than 100 studies that we initially selected, 24 were selected to be included in our review. We excluded studies because, for example, they did not provide sufficient detail on the analytical approach or failed to control for other plausible explanations for differences. The selected studies were sufficiently rigorous and included tests of hypotheses; measures of association; and multivariate techniques, such as ordinary least squares regression (see table 3).

Table 3: Number of Selected Research Studies on Selected Facility and Student Outcome Variables

Facility variable	Student outcome variables			
	Achievement test scores	Health and well-being	Student attendance and dropout rates	Student behavior
General condition or suitability	12	0	2	0
Lighting	3	2	3	1
Air quality, ventilation, and climate control	1	4	1	0
Crowding	2	0	1	0
Special equipment	1	0	0	0
Acoustics	1	0	0	1
Other	3	0	0	0

Source: GAO analysis of selected studies.

Note: A single study may have included more than one facility variable or more than one student outcome variable. For additional information about selected results of these studies, see appendix III.

In addition to these 24 studies, we reviewed 4 additional studies that focused on the relationship between facility condition and teacher outcomes rather than student outcomes. The selected studies were sufficiently rigorous and included tests of hypotheses; measures of association; and multivariate techniques, such as ordinary least squares regression.

Each of these studies is subject to certain methodological limitations, which limit the extent to which the results can be generalized to school facilities in general or to school facilities in Indian Impact Aid districts. Many of the studies focus on comparisons of schools without information about the outcomes in schools before and after changes in school facilities. This makes it difficult to isolate the effects of improvements in school facilities. Some studies used small samples or had low response rates to surveys or had missing data for many schools in the original sample. Several studies focused on schools in other countries and the extent to which their results are applicable to schools in the United States is uncertain. In at least one case, the research was funded in part by a group—such as a building association—that may have had an interest in the results.

We conducted our work from September 2008 to October 2009 in accordance with all sections of GAO’s Quality Assurance Framework that are relevant to our objectives. The framework requires that we plan and perform the engagement to obtain sufficient and appropriate evidence to

meet our stated objectives and to discuss any limitations in our work. We believe that the information and data obtained, and the analysis conducted, provide a reasonable basis for any findings in this product.

Appendix II: List of School Districts That Received Indian Impact Aid in Fiscal Year 2009

Table 4 contains a list of the 25 states with public school districts that had received Indian Impact Aid for fiscal year 2009, as of August 2009. We use the term Indian Impact Aid to refer to school districts that qualify to receive Impact Aid basic support funding because they meet the minimum eligibility criteria, namely they have at least 400 students in average daily attendance who are federally connected, in this case who reside on Indian lands, or such students comprise at least 3 percent of the total number of students in the district. The table also lists for each district the total number of students living on Indian lands in average daily attendance for the previous school year, this number as a percentage of the total number of students in average daily attendance, and the amount of Impact Aid basic support payments each district received for students residing on Indian lands under section 8003(b) of the Elementary and Secondary Education Act of 1965, as amended. These amounts do not include basic support payments for other students with connections to other federal lands, children with disabilities, or construction grants under section 8007.

Table 4: States with School Districts Receiving Impact Aid for Students Residing on Indian Lands, Fiscal Year 2009 (as of August 2009)

State	Indian Impact Aid school districts ^a	Students living on Indian lands ^b	Percentage of all students living on Indian lands ^c	Basic support payments ^d
Alaska	31	11,746	52%	\$83,166,785
Arizona	63	29,772	15	149,112,370
California	39	4,947	11	13,878,219
Colorado	2	597	16	1,614,485
Idaho	5	991	17	3,683,788
Iowa	1	186	13	503,421
Kansas	2	264	19	880,380
Maine	3	188	98	1,311,219
Massachusetts	1	13	4	6,458
Michigan	12	980	13	3,787,902
Minnesota	21	3,564	24	15,899,283
Montana	60	7,344	52	38,805,035
Nebraska	5	1,020	73	6,938,529
Nevada	6	1,074	1	2,126,010
New Mexico	19	18,950	32	96,948,176
North Carolina	4	683	10	1,630,249
North Dakota	15	2,274	36	11,496,248
Oklahoma	195	10,053	9	27,027,156
Oregon	4	977	14	2,566,981

Appendix II: List of School Districts That Received Indian Impact Aid in Fiscal Year 2009

State	Indian Impact Aid school districts^a	Students living on Indian lands^b	Percentage of all students living on Indian lands^c	Basic support payments^d
South Dakota	26	5,730	48	33,141,042
Texas	1	115	24	336,410
Utah	4	2,011	16	7,759,813
Washington	28	5,501	13	18,804,996
Wisconsin	18	3,235	16	11,962,457
Wyoming	4	1,383	75	9,945,109
Total	569	113,599	17%	\$543,332,521

Source: GAO analysis of Department of Education data.

Note: These figures reflect payments to date on fiscal year 2009 basic support payments as of August 2009. At that time, with the eligibility of 31 applicants undecided, 92 percent of the approximately \$1.1 billion of appropriations for basic support payments had been paid. Education makes final payments of the remaining funds when final decisions are reached on all applications, which Impact Aid Office staff indicated typically occurs about 2 years after the appropriation year.

^aThis is a count, as of August 2009, of the school districts in each state that Education found to be eligible for fiscal year 2009 Impact Aid basic support payments because they have students living on Indian lands.

^bThis is the average daily attendance count of students living on Indian lands in the districts indicated. These counts come from the school year 2 years prior to the year the appropriation is available. For example, fiscal year 2009 basic support payments are based on student counts during the 2007-2008 school year.

^cThis is the average daily attendance count of students living on Indian lands as a percentage of the average daily attendance count of all students in the indicated districts.

^dThis is the total amount of Impact Aid basic support payments that the districts had received for students living on Indian lands as of August 2009. Overall, as of August 2009, 92 percent of appropriated basic support payments of all kinds for fiscal year 2009 had been disbursed.

Appendix III: Examples of Studies Examining School Facilities and Student Outcomes

Table 5 provides summary information about selected studies on broad measures of school facilities and student achievement.

Table 5: Examples of Studies on Broad Measures of School Facilities and Student Achievement

Author and year	School facility variable	Student achievement variable	Selected findings
Maureen M. Berner 1993 ^a	Condition of school building, excellent to poor	Comprehensive Tests of Basic Skills score	A school in fair condition could be expected to have average achievement test scores 5.45 points higher than a school in poor condition, on a scale of 0 to 100.
Jack Buckley and others 2004 ^b	Overall building compliance level with health and safety standards	California state achievement tests	Schools in the best condition compared with those in the worst condition had an estimated 36-point higher average composite score on student achievement tests with a 200 to 1,000 point scale.
Valkiria Durán-Narucki 2008 ^c	Condition of elementary school buildings based on independent consultant assessments	New York State and City mathematics and English achievement test results	Better school building conditions were associated with better student attendance rates, and these in turn were associated with better English and mathematics achievement.
Morgan Lewis 2001 ^d	Assessments of school condition by district staff and staff from the program architect	Wisconsin Student Assessment System test scores	Schools with better building conditions generally had better average achievement test results for each of four tests in 3 years, but the association was statistically significant in only 11 of 36 tests after taking other factors into account (with a one-tailed test of significance.) These 11 tests were for 1996 and 1997. None of the tests for 1998 were statistically significant.
Lorraine E. Maxwell 1999 ^e	Whether schools had recent renovation projects	New York Pupil Evaluation Program reading and math scores	Schools with recent renovations generally had better average math achievement test scores, but results showed no association with reading achievement scores.
Lawrence O. Picus and others 2005 ^f	Building quality scores by a consulting firm	Wyoming Comprehensive Assessment System scores	Facility conditions were not associated with better or worse achievement test scores after taking into account the percentage of students eligible for free or reduced price school lunch in each school.
PricewaterhouseCoopers 2003 ^g	Amount of capital expenditures to improve the suitability of the facilities	The percentage of students meeting reading, writing, math, and science standards in the United Kingdom	Schools with additional capital investment in facilities generally had better pupil performance, particularly for community primary schools and for investment in science laboratories and technology.
Mark Schneider 2002 ^h	Teachers' survey response grading the condition of schools' facilities	Stanford Achievement Test in District of Columbia schools and Iowa Test of Basic Skills in Chicago schools	Schools with facilities in the worst condition had lower percentages of students performing in the two highest achievement categories—an estimated 3 percent fewer compared with school facilities in the best condition in the District of Columbia, and 3 to 4 percent fewer in Chicago.

**Appendix III: Examples of Studies Examining
School Facilities and Student Outcomes**

Author and year	School facility variable	Student achievement variable	Selected findings
Kenneth Stevenson 2001 ¹	Principals' perceptions of school condition	SAT and South Carolina Palmetto Achievement Challenge Test scores	School facility conditions in better condition generally had higher average achievement test scores in some, but not all instances studied. After taking into account the percentage of students eligible for free or reduced-price lunch, better facilities were associated with better 7th and 8th grade reading and 6th and 7th grade math test scores, but not for any elementary grade test scores.
Cynthia Uline and Megan Tschannen-Moran 2008 ¹	Teachers' perceptions of the quality of school facilities	Factor based on two Virginia standards of learning test scores	Schools with better quality facilities generally had better test scores, but not after taking into account school attitudes, such as whether students admire others who get good grades and whether teachers are committed to students' education. The authors concluded that better quality facilities affect achievement indirectly—through their effect on school attitudes.
George A. Waller 1998 ⁸	State average measures of school facility conditions from a 1996 GAO survey of a sample of schools concerning school conditions in three categories: technology, environmental conditions, and building structures	Factor based on state average SAT and ACT scores	School facilities with better environmental conditions and technology generally had higher average achievement test scores. The adequacy of building structures was not associated with higher test scores.

Source: GAO analysis of selected studies.

¹Maureen M. Berner, "Building Conditions, Parental Involvement, and Student Achievement in the District of Columbia Public School System," *Urban Education* 28(1) (April 1993), 6-29.

²Jack Buckley, Mark Schneider, and Yi Shang, "LAUSD School Facilities and Academic Performance," (National Clearinghouse for Educational Facilities, Washington, D.C.: 2004).

³Valkiria Durán-Narucki, "School Building Condition, School Attendance, and Academic Achievement in New York City Public Schools: A Mediation Model," *Journal of Environmental Psychology* 28 (2008), 278-286.

⁴Moran Lewis, "Facility Conditions and Student Test Performance in the Milwaukee Public Schools," (Scottsdale, Arizona: Council of Educational Facility Planners, International, 2001). See <http://www.cefpi.org/issuetraks.html> (last accessed on Sept. 29, 2008).

⁵Lorraine E. Maxwell, "School Building Renovation and Student Performance: One District's Experience" Council of Educational Facility Planners International (Scottsdale, Ariz.: 1999).

⁶Lawrence O. Picus, Scott F. Marion, Naomi Calvo, and William J. Glenn, "Understanding the Relationship Between Student Achievement and the Quality of Educational Facilities: Evidence from Wyoming," *Peabody Journal of Education*, 80(3) (2005), 71-95.

⁷PricewaterhouseCoopers, Department for Education and Skills, "Building Better Performance: An Empirical Assessment of the Learning and Other Impacts of Schools Capital Investment," Research Report RR407 (Nottingham: DFES Publications, 2003).

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School Facilities and Student Outcomes**

^lMark Schneider, "Public School Facilities and Teaching: Washington, DC and Chicago," Twenty-First Century School Fund (Washington, D.C.: 2002).

Kenneth R. Stevenson, "The Relationship of School Facilities Conditions to Selected Student Academic Outcomes: A Study of South Carolina Public Schools," University of South Carolina, College of Education, Department of Educational Leadership and Policies (2001).

^jCynthia Uline and Megan Tschannen-Moran, "The Walls Speak: the Interplay of Quality Facilities, School Climate, and Student Achievement," *Journal of Educational Administration* 46(1) (2008), 55-73.

^kGeorge A. Waller, "For Want of a Modem and a Comfortable Chair: A Research Note," *American Journal of Political Science* 42(2) (April 1998), 705-708.

Table 6 provides summary information concerning other studies on school facilities and student outcomes—including those on specific school facility characteristics and various student outcomes, including achievement, attendance, and behavior and health.

Table 6: Examples of Other Studies on School Facilities and Student Outcomes.

Author and year	School facility variable(s)	Student outcome variable	Selected findings
David Branham 2004 ^a	Presence of structural problems in school facility and temporary buildings	Student attendance and dropout rates	A secondary school with 1,000 students could expect 10 to 13 more dropouts a year and fewer students in attendance if the school had structural problems. The use of temporary buildings was also associated with lower attendance rates.
Warren E. Hathaway 1995 ^b	Use of four different types of light fixtures in school classrooms	A comparison of scores on Canadian Test of Basic Skills taken in 1987 and 1989, attendance rates, measures of physical development and dental health	Attendance, achievement, health, and development measures were better in schools with full-spectrum lights compared with those in schools with high-pressure sodium vapor lights.
Lisa Heschong and others 2002 ^c	Researchers' classification of the amount of daylight in the classroom	Student attendance rates in each school district; Iowa Test of Basic Skills in Seattle, Washington; and other standardized tests in Fort Collins, Colorado, and Capistrano, California	In each of the three school districts, the availability of more daylight was associated with higher achievement. After taking into account additional factors, such as teacher characteristics, more daylight continued to be associated with higher achievement. The amount of daylight was not associated with attendance rates.

**Appendix III: Examples of Studies Examining
School Facilities and Student Outcomes**

Author and year	School facility variable(s)	Student outcome variable	Selected findings
Rikard Küller and Carin Lindsten 1992 ^d	Amount of natural daylight and fluorescent light in classrooms	Student attendance, sociability, and sick leave use	Classrooms that lacked natural or simulated daylight had marked delays in rise of a natural hormone, cortisol. The ability to concentrate was higher in the classrooms with overhead daylight and artificial warm white tube lighting. Sociability was higher with windows or fluorescent daylight tubes.
Lorraine E. Maxwell and Gary W. Evans 2000 ^e	The installation of sound absorbent panels in classroom ceilings to reduce noise levels	Tests of preschool children's number and letter recognition, letter-sound correspondence, and rhyming skills; and teachers' evaluations of children's language skills before and after installation of sound absorbent panels	Scores were higher after installation of sound absorbent panels for (1) recognition of numbers, letters, and simple words and (2) teachers' evaluation of children's language skills. Differences were not statistically significant for rhyming or letter-sound correspondence.
Teija Meklin and others 2002 ^f	Presence of moisture problems in school buildings and levels of airborne microbes	Respiratory health survey responses	Children in schools with moisture problems reported respiratory symptoms more often than in schools without such problems. This was also the case among buildings with concrete or brick construction, but the association was not statistically significant among schools with wood construction.
Douglas E. Mitchell and Ross E. Mitchell 1999 ^g	Reductions in class size from a typical 28 to 32 to a maximum of 20 students in kindergarten through third-grade classrooms	Reading, math, and language achievement test scores	Smaller class sizes were associated with higher test scores for reading, math, and language. The effects were small after taking into account student demographics, including gender, income, ethnicity, language used at home.
Francisco L. Rivera-Batiz and Lilian Marti 1995 ^h	Overcrowding in schools measured as the number of students compared with the schools design capacity	Degrees of Reading Power test scores and New York Pupil Evaluation Program Test in mathematics	Among schools with high proportions of poor students, overcrowding was associated with lower student achievement. Among schools with lower proportions of poor students, overcrowding was associated with higher achievement, as schools with high achievement attract more students.
Karl G. Rosén and George Richardson 1999 ⁱ	Indoor air quality as measured by levels of airborne particles in schools with and without electrostatic air cleaning systems in operation	Student attendance rates	When the electrostatic air cleaning systems were in operation, average attendance rates rose, although this was not statistically significant at the smaller day-care center.
Greta Smedje and Dan Norbäck 2000 ^j	Ventilation measured as the flow of outside air into the school buildings	Responses to student surveys concerning asthmatic symptoms	Lower incidence of any asthmatic symptoms was associated with improved ventilation.

**Appendix III: Examples of Studies Examining
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Author and year	School facility variable(s)	Student outcome variable	Selected findings
C. Kenneth Tanner 2008 ^k	School building design characteristics, including the availability of space to accommodate students' movement and circulation, meeting in large groups, day lighting and views, and space of instructional neighborhoods	Iowa Test of Basic Skills	Schools designed to accommodate students' movement and circulation were more likely to have higher student achievement. This was also true for the presence of the other design characteristics, but these accounted for less of the variation in achievement (2 percent compared with 7 percent for designs accommodating movement and circulation).
Taina Taskinen and others 1999 ^l	The presence of moisture problems in elementary schools and indoor air quality	Parents' responses to a survey concerning respiratory symptoms	In the school with moisture problems, parents noted higher incidence of children with repeated wheezing and prolonged coughing and incidence of respiratory infections leading to emergency room visits and use of antibiotics.
Pawel Wargocki and David P. Wyon 2006 ^m	Outdoor air supply rate and classroom temperatures	The speed at which students completed various mathematics, reading comprehension, and proofreading tasks	Increasing the outdoor air supply rate and reducing elevated classroom temperatures significantly improved student performance, primarily how quickly students completed tasks.

Source: GAO analysis of selected studies.

^kDavid Branham, "The Wise Man Builds His House upon the Rock: The Effects of Inadequate School Building Infrastructure on Student Attendance," *Social Science Quarterly* 85(5) (December 2004), 1112-1128.

^lWarren E. Hathaway, "Effects of School Lighting on Physical Development and School Performance," *The Journal of Educational Research* 88(4) (March-April 1995), 228-242.

^mLisa Heschong, Ihab Elzeyadi, and Carey Knecht, "Re-Analysis Report: Daylighting in Schools, Additional Analysis, Tasks 2.2.1 through 2.2.5" Heschong Mahone Group, (Fair Oaks, Calif.: 2002). See <http://www.newbuildings.org/pier/overview.htm> (last accessed Sept. 29, 2008). This is a reanalysis of results from Lisa Heschong, "Daylighting in Schools: An Investigation into the Relationship between Daylighting and Human Performance," Heschong Mahone Group, (Fair Oaks, Calif.: July 1999).

ⁿRikard Küller and Carin Lindsten, "Health and Behavior of Children in Classrooms with and without Windows," *Journal of Environmental Psychology* 12 (1992),305-317.

^oLorraine E. Maxwell and Gary W. Evans, "The Effects of Noise on Pre-School Children's Pre-Reading Skills," *Journal of Environmental Psychology* 20 (2000), 91-97.

^pDouglas E. Mitchell and Ross E. Mitchell, "The Impact of California's Class Size Reduction Initiative on Student Achievement: Detailed Findings from Eight School Districts," California Educational Research Cooperative, University of California, Riverside (1999).

^qTeija Meklin, T. Husman, A. Vepsäläinen, M. Vahteristo, J. Koivisto, J. Halla-Aho, A. Hyvärinen, D. Moschandreas, and A. Nevalainen, "Indoor Air Microbes and Respiratory Symptoms of Children in Moisture Damaged and Reference Schools," *Indoor Air* 12(3) (2002), 175-183.

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^hFrancisco L. Rivera-Batiz and Lilian Marti, "A School System at Risk: A Study of the Consequences of Overcrowding in New York City Public Schools," Institute for Urban and Minority Education, Teachers College Columbia University, (New York: January 1995).

^kKarl G. Rosén and George Richardson, "Would Removing Indoor Air Particulates in Children's Environments Reduce Rate of Absenteeism—A Hypothesis," *The Science of the Total Environment* 234 (1999), 87-93.

^lGreta Smedje and Dan Norbäck, "New Ventilation Systems at Select Schools in Sweden—Effects on Asthma and Exposure," *Archives of Environmental Health* 55(1) (January/February 2000), 18-25.

^cC. Kenneth Tanner, "Explaining Relationships among Student Outcomes and the School's Physical Environment," *Journal of Advanced Academics* 19(3) (Spring 2008), 444-471.

^tTaina Taskinen, A. Hyvärinen, T. Meklin, T. Husman, A. Nevalainen, and M. Korppi, "Asthma and Respiratory Infections in School Children with Special Reference to Moisture and Mold Problems in the School," *Acta Paediatrica* 88(12) (1999), 1373-1379.

^mPawel Wargocki and David P. Wyon, "Research Report on Effects of HVAC on Student Performance," ASHRAE Journal 48(10) (October 2006), 22-28 (American Society of Heating, Refrigerating, and Air-Conditioning Engineers).

Appendix IV: GAO Contacts and Staff Acknowledgments

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In addition to the contacts named above, Kathryn A. Larin and Maria D. Edelstein, Assistant Directors; Pamela R. Davidson; Gail F. Marnik; John W. Mingus, Jr.; Benjamin P. Pfeiffer; James M. Rebbe; Kimberly M. Siegal; Larry S. Thomas; Kathleen L. van Gelder; and Walter K. Vance made key contributions to this report.

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