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Real Cost-Benefit Analysis Is Needed in American Public Education

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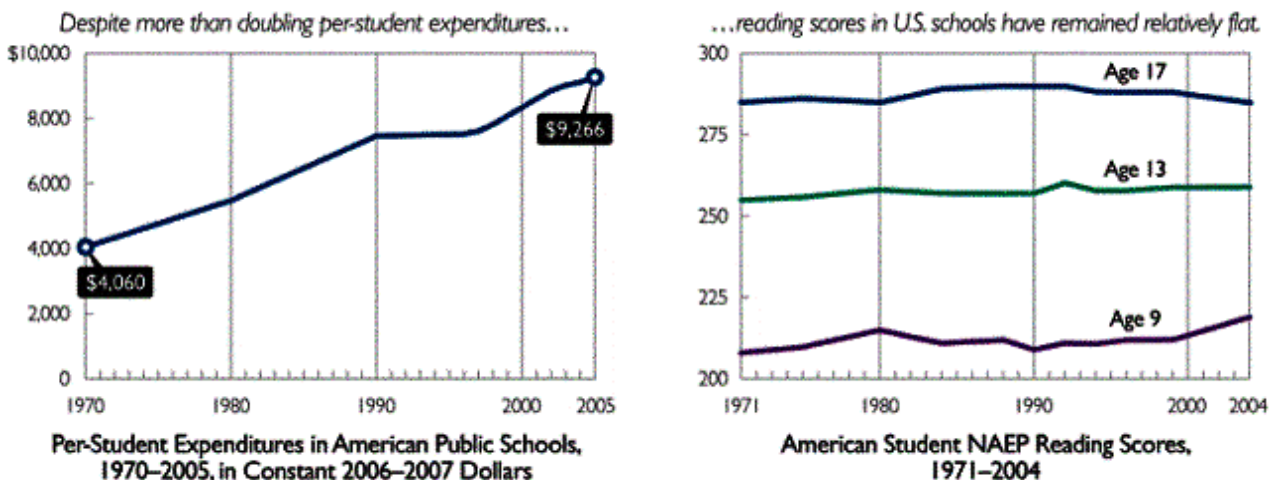
Public school critics often point to rising expenditures and relatively flat test scores to justify their school reform agendas. The claims are flawed because their analyses fail to account for the difference in data types between dollars (ratio) and test scores (interval). A cost-benefit analysis using dollars as a common metric for both costs and benefits can provide a good estimate of their relationship. It also acknowledges that costs and benefits are both subject to inflation. The National Center for Education Research administers a methods training program for researchers who want to know more about cost-benefit analyses on education policies and programs.

Spending Up, Achievement Flat

A Heritage Foundation article suggested that spending more on American public education would not likely improve academic performance (Lips, Watkins, and Fleming, 2008). The article compared long-term spending trends with long-term measures of student achievement, and challenged a common belief

that spending is correlated with achievement. Figure 1 displays a graphic from the article that compared real (i.e., inflation adjusted) per-student expenditures with American students test scores on the long-term National Assessment of Educational Progress (NAEP) reading examination from 1970 to 2005. While

The "Link" Between Education Spending and Student Performance



Sources: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, "National Trends in Reading by Average Scale Scores," updated July 6, 2005, at <http://nces.ed.gov/nationsreportcard/lttr/results/2004/nat-reading-scalescore.asp> (April 14, 2008), and *Digest of Education Statistics: 2007*, Table 174, at http://nces.ed.gov/ipeds/data/digest/d07/tables/dt07_174.asp (August 19, 2008).

Figure 1. Inflation adjusted per-pupil expenditures and student average test scores on the long-term National Assessment of Educational Progress (NAEP) reading examination from 1970 to 2005.

operational spending per-student had more than doubled, reading scores remained relatively flat.

The Heritage Foundation is not alone in comparing spending and NAEP scores. The Albertson Foundation published *Five Questions about Education Funding in Idaho* asking whether spending more on public education would improve student achievement. The foundation answered in the negative: "In Idaho's large school districts, there is no clear relationship between per-student spending and achievement. Similar patterns emerge at the national level. From 1960 to 2005, K-12 per-student spending nearly quadrupled, adjusting for inflation.... And yet the U.S. has not experienced a similar gain in student achievement...." (Albertson Foundation, 2014).

Results from national standardized assessments other than NAEP also have been used to conduct cost vs. test score comparisons as incomplete cost-benefit analyses. The CATO Institute, for example, has used SAT scores to publish cost-score comparisons for each state (Coulson, 2014).

This practice of linking of education spending and student test scores promoted by the Heritage Foundation and others has over the years has emerged as "gospel doctrine," not to be doubted or questioned. Spending vs. achievement comparisons have been employed to support the various school reform agenda.

Expertise Imbalance" Hurts Public Schools

Researchers and program evaluators have characteristically used *dollar data* correctly when examining the relationship between public school expenditures and student achievement, but not *psychometric data*. When it comes to statistical and psychometric characteristics of student achievement data, requisite knowledge and understanding generally seems to be absent or conveniently ignored. This *expertise imbalance* in practice has often led to mistaken conclusions about how poorly America's expensive public schools are performing; mistaken conclusions that are eagerly reported in the national and local media.

Confusing Interval and Ratio Scales

Interval Scale. NAEP scale scores like scale scores from other assessments are interval data. Interval data can be added and subtracted, but not multiplied or divided. Central tendency can be measured by mode,

median, or mean; standard deviation can also be calculated from interval data.

Ratio Scale. Dollars are ratio data. Ratio data can be meaningfully added, subtracted, multiplied, divided (ratios, percentages). Central tendency can be measured by mode, median, or mean; measures of dispersion, such as standard deviation and coefficient of variation can also be calculated from ratio data. (My Market Research Methods, 2012).

Placing the ratio chart side-by-side with the interval chart in Figure 1, invited the reader to wrongly conclude that the two data types may be compared. Indeed, together the proximity of the graphs and the narrative "more than doubling" of cost implied that benefits should exhibit a comparable increase.

NAEP Scale Scores Have Lower and Upper Limits

Expectations that the nation's standardized test scores should keep pace with increases in inflation-adjusted per-student expenditures are unwarranted. From 1970 to 2005, per-student costs increased 228 percent. In 1971, the public school average NAEP reading score was 285 for 17 year olds. Unlike dollars (ratio scale), a *percentage increase* in scale scores cannot be calculated for NAEP scale scores (interval scale). However, a *percent gain score* can be calculated for NAEP means and other interval scale scores. The calculator in Figure 2 is one of several available on the internet that estimates percent gain scores (CalculatorCat.com, 2015). The calculation displayed in Figure 2 estimated that to have obtained a 228 percent gain score over 1971 would have required the 2005 17-year-olds to have an average NAEP reading score of 935.



Percent Gain Calculation

Here you can calculate the percentage of increase or decrease between two units. A simple calculator but it can really come in handy!

Increase/Decrease From: To:

Percent Gain:

© 2002-2015: CalculatorCat.com/BlueMarmot, Inc.

Figure 2. A NAEP average reading score of 935 for 17 year olds in 2005 is a 228 percent gain over the NAEP average reading score of 285 for 17 year olds in 1971.

Applying Item Response Theory, NAEP created an interval scale for its reading assessments that ranged from 0 to 500 (National Center for Education Statistics, 2013). Figure 3 illustrates that a NAEP average score of 935 for reading is impossible because 935 is not even on the NAEP reading scale.

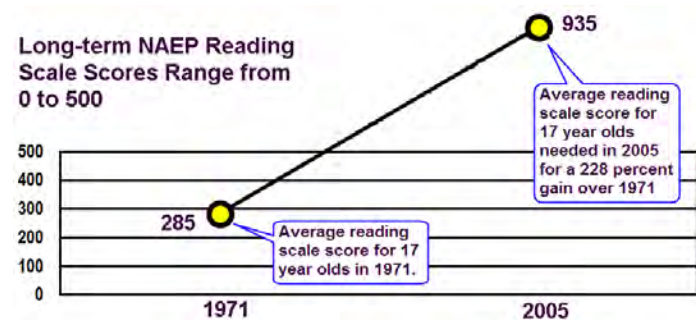


Figure 3. NAEP long-term reading scores (interval scale) do not support an expectation that percent gain scores in NAEP performance will keep pace with the percentage increase in per-student expenditures (ratio scale).

Dollar Value of a NAEP Average Scale Score?

A cost-benefit analysis determines whether an educational program or policy is worthwhile. It dissects the target activity to determine which is greater: costs or benefits. A simple cost-benefit analysis looks only at financial costs and financial benefits. A more complete analysis also attempts to estimate a financial value for intangible costs and benefits. (U.S. Legal, 2009).

Hypothetical Finish to an Incomplete Analysis

The analysis in Figure 1 presented the history of per-student expenditures and NAEP average reading scores then stopped. No effort was made to assign real dollar values to the NAEP scores. There is apparently nothing in the literature indicating that anyone has ever made an effort to this end.

To provide a hypothetical finish to the Heritage analysis let's assume that the average NAEP scale score qualifies a high school senior for a minimum wage job. Some may prefer different estimations such as average wage for high school graduates, or average wage for all American workers, or perhaps still other estimations of dollar value. They are invited to prepare their own hypothetical finish to Figure 1. Keep in mind that this use of the minimum-wage is not an actual cost-benefit analysis but a possible, however unlikely, finish to the Heritage analysis. The intent is only to illustrate how easy it is to understand a graphic displaying a complete

analysis; no tax payer viewing the graphic has to guess whether he is getting his money's worth.

As indicated in Table 1, the 1971 federal minimum wage was \$1.63, and the 2005 minimum wage was \$5.15 (U.S. Department of Labor, 2015).

Table 1. History of federal minimum wage rates under the U.S. Fair Labor Standards Act.

Year	Rate	Year	Rate	Year	Rate
1968-73	\$1.63	1979	\$2.90	1996	\$4.75
1974	\$2.00	1980	\$3.10	1997-06	\$5.15
1975	\$2.10	1981-89	\$3.35	2007	\$5.85
1976-77	\$2.30	1990	\$3.80	2008	\$6.55
1978	\$2.65	1991-95	\$4.25	2009 --	\$7.25

Assuming that the job pays the minimum wage for 40 hours a week, 50 weeks a year, the dollar value of the NAEP average scale score benefit would be \$3,260 in 1971 and \$10,300 in 2005. In Figure 4, this change in benefits is plotted against the change in costs presented in Figure 1. Remember, the observed results displayed in Figure 4 are hypothetical. Nonetheless, this analysis, as it would be the case in an actual cost-benefit analysis, clearly illustrates that inflation impacts both public school costs and benefits.

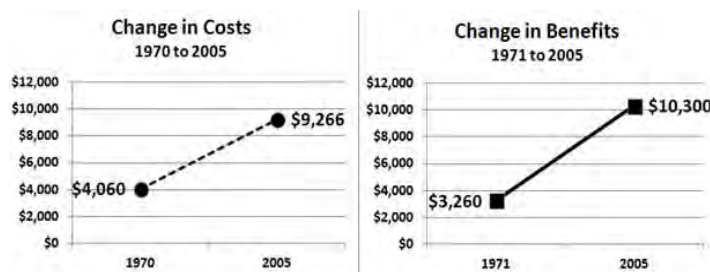


Figure 4. In a cost-benefit analysis of public school education where both costs and benefits are valued in dollars, inflation impacts both the costs and benefits.

National Center for Education Research

It would be useful if future studies about the relationship between education expenditures and outcomes focus on conducting more sophisticated cost-benefit analyses where the identical metric is used to describe both the costs and the benefits. To this end, the U.S. Department of Education has recently announced its *first ever* methods training through the Center for Benefit-Cost Studies of Education at

Teachers College, Columbia University. The National Center for Education Research oversees this tuition-free training program for researchers and program evaluators about applying real cost-benefit analysis to education policies and programs (National Center for Education Research, 2014).

A Necessary Task

What is the dollar value of a NAEP average scale score? The past value? The present value? The future value? All expressed in today's dollars? The answers to these questions are necessary for a sound understanding of both the costs and benefits of American public education. It will be no easy task even for a non-partisan team of research, economic, psychometric, statistic, sociology, and education experts working for consensus -- acting independently of any particular school reform agenda -- to accurately identify the several benefits of an American public education and to estimate a real dollar value for each benefit.

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