The Effect of State Funding on Standardized Test Scores in Idaho, 2007-2013

P. Christopher J. Daigle

Faculty Mentor: Dr. Christine Loucks

Boise State University

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1. Executive Summary

From 2008-2013, the State of Idaho decreased funding for K-12 education by 17.14 %, the fourth highest decrease in the nation. The purpose of this research is to determine whether the decreases in funding affected student outcomes. To test this hypothesis, I examine how the percentage of students who pass the Idaho Standards Achievement Tests (ISAT) in Math changes as state funding decreases from 2007-2013, at the school district level. Using control variables such as real per-pupil-expenditure, the proportion of students on free or reduced lunch, the proportion of students in poverty, and districts with 4-day school weeks, I find that decreases in state funding for schools in Idaho has negatively impacted student achievement.

2. Literature Review

There is an extensive body of literature which investigates the effects of school funding on student achievement. All of the research in this area employs a production function, which describes the relationship between output and input, where student achievement is the output and school funding is one of the inputs, to investigate this question. There is no definitive evidence that school funding affects student achievement. Below is a review of some of the notable literature that addresses the question of whether student achievement is affected by school funding.

Hanushek (1986) conducted seminal research on this subject. Hanushek reviewed 147 studies, from as early as 1966, that incorporated such measures as teacher-to-pupil ratio, teacher education level (measured in academic degrees completed at masters or above), teacher's experience (measured in years), teacher salary, and per-pupil-expenditure (PPE) to explain student achievement. Hanushek ultimately concluded that funding did not affect academic performance. The majority of research Hanushek surveyed found school funding was not

statistically significantly toward student achievement. Hanushek attributed the differences in student achievement to differences in teacher skills that defied detailed description (Hanushek, 1980, p. 1142). The studies Hanushek reviewed typically measured student achievement by using scores on the Scholastic Aptitude Test (SAT) and the Iowa Test of Basic Skills (ITBS).

In 13 out of 65 studies (20%) Hanushek investigated, per-pupil-expenditure was found to be positive and significant, while in 3 out of 65 studies (4.62%), per-pupil-expenditure was negative and significantly related to student achievement. Thus, in approximately 75% of the studies cited, there is no statistically significant relationship between school funding and student achievement. Teachers' experience was found to be positive and significant in 33 out of 109 studies (30.82%), while 7 out of 109 studies (6.42%) showed it to be negative and significant. In 9 out of 60 studies (15%), teachers' salary was found to be positive and significant. while 1 out of the 60 studies (1.67%) showed it to be negative and significant on influencing student achievement. The teacher-to-pupil ratio was found to be negative and significant in 14 out of 112 studies (12.5%), while 9 out of 112 studies (8.04%) found it to be positive and significant on student achievement. In 6 out of 106 studies (5.66%), teachers' education was found to be positive and significant, while 5 out of 106 studies (4.72%) found it to be negative and significant on student achievement (Hanushek, 1986, p. 1161).

Lopus (1990) examined how expenditures affected student achievement in high school economics classes by using scores on the National Center for Educational Statistics' Test of Economic Literacy (TEL) to measure student achievement. Lopus found, "[...] regardless of the measure used, increasing expenditures in the economics class did result in improved student performance" (Lopus, 1990, p. 278). Lopus utilized a data set from 1987 of national samples that included information related to students' families, their teachers, their schools and their

school districts. The data set incorporated spending at the state level, and Lopus generated a measure of per-pupil-expenditure from that information.

Lopus related student achievement, as measured by scores on the TEL, to gender, ethnicity, grade point average (GPA), whether the student was a high school senior, the student's peer group (percent of students likely to attend college), whether the student's parents completed college, the student's teacher's attitude toward teaching economics, and school funding. In different model specifications, school funding was measured by total per-pupil-expenditure, instructional per-pupil-expenditure, annual instructional per-pupil-expenditure, and total instructional cost per student in a school. Lopus also controlled for whether the teachers held a degree above a BA or BS, the number of years of teaching experience, the number of students in an economics class, whether the teacher employed audio or visual equipment, whether the teacher used software, whether the teacher used supplemental texts, and whether the teacher used consultants or services from the Joint Council on Economic Education (JCEE) or the Foundation for Teaching Economics (FTE).

Lopus found per-pupil-expenditure, being male, being white, the student's GPA, the teacher's attitude toward teaching economics, the total instructional cost per student, if the student's parents completed college, if the teacher held an advanced degree, and the likelihood of a student attending college (as reported by the student's teacher) as all being significant and positively related to student achievement. A student being a high school senior, the size of student's class, and the teacher's use of supplemental texts were all found to be statistically significant and negatively related to student achievement.

Verstegen and King (1998) examined 377 publications that covered 35 years of economic studies to observe whether funding affected student achievement. In the majority of research,

where student achievement was measured by scores on the American College Test (ACT), Verstegen and King found funding positively and significantly affected student achievement. The teacher-to-pupil ratio was found to be significant and positively related to student achievement in 42 out of 78 studies (54%), while 36 out of 78 studies (46%) found it to be significant and negatively related student achievement. The teacher's education was significant and positively related to student achievement in 15 out of 24 studies (64%), while 9 out of 24 studies (36%) found it to be significant and negatively related to student achievement. The teacher's experience was significant and positively related to student achievement in 60 out of 70 studies (85%) with 10 out of 70 studies found it to be significant and negatively related to student achievement. Teacher salaries were found, in 24 of 32 studies (74%), to be significant and positively related to student achievement, while 8 of 32 studies (26%) showed it to be significant and negatively related to student achievement. Per-pupil-expenditure was found to be significant and positively related to student achievement in 43 of 55 studies (79%), while 12 of 55 studies (21%) showed it to be significant and negatively related to student achievement (Verstegen and King, 1998, p. 251).

Payne and Biddle (1999) examined how poverty and school funding contributed to student achievement. Payne and Biddle found school funding affected student achievement. Payne and Biddle measured student achievement by average mathematics achievement scores on the Second International Mathematics Study (SIMS). The study covered the United States and utilized nation as well as school district level data.

In the model, student achievement was related to total annual per-student school funding, percent of children living in poverty, percent of nonwhite students, the average curricular instruction - as defined as five different levels of mathematics students were exposed to from

remedial curriculum to advanced algebra - and the average level of mathematics achievement. Total annual per-student school funding and average curricular instruction were both found to be significant and positively related to student achievement. The percentage of children living in poverty was found to be significant and negatively related to student achievement (Payne & Biddle, 1999).

Papke (2004) examined the effect of funding on student achievement on fourth-grade math tests in Michigan at the school level. Papke found school funding affected student achievement.

Student achievement was found to be significant and positively affected by variables capturing average per-pupil-expenditure, the percentage of students eligible to participate in the school lunch program at no or reduced cost, and the number of students enrolled in a school. Other variables found to be significant with a positive effect on student achievement were a series of instrumental variables which arose from the introduction of foundational grants in the school year 1994-1995[1]. The percentage of students eligible to participate in free or reduced lunch program, the logarithm of students enrolled in a school, the square of the logarithm of students enrolled in school, and the logarithm of per-pupil-expenditure, which measured the elasticity of funding on student achievement, for the year 1994 were found to be significant and negatively related to student achievement (Papke, 2004).

Papke and Wooldridge (2008) examined the effect of funding on student achievement, as measured by scores on fourth-grade math tests in Michigan, at the school district level utilizing panel data methods. Papke and Wooldridge found school funding affected student achievement[2].

[1] To use 1994-1995 as a base year for analysis, Papke generated instrumental variables composed of the logarithm of per-pupil expenditure interacted with a variable indicating if a year was 1996, 1997, or 1998. The different years took on the value of 1 when the observation occurs in its respective year.

[2] Panel data is a particular data type in which multiple cases (students, school districts, spending, etc.) are observed at two or more time periods. Panel data varies from time series data as it contains multiple cases of observations viewed over time and not

Papke and Wooldridge found the logarithm of real per-pupil-expenditure in a school district was significant and positively related to student achievement (Papke & Wooldridge, 2008).

Klein (2004) examined the effect of school funding on student achievement in the Nashville Tennessee Metropolitan Area. Klein found school funding did not affect academic performance while controlling for the number of students per school, the number of internet connected computers per student, and the percentage of students rated proficient or better in 4th grade math from the previous year, as well as the percentage of nonwhite students. Klein used a three-stage least squares regression method to estimate the effect of school funding, free or reduced lunch programs, and ethnicity on student achievement. He found student achievement was significant and negatively related to the percentage of students qualifying for free or reduced lunch (Klein, 2004).

Anderson and Walker (2012) examined whether the switch to 4-day school weeks affected student achievement in rural school districts in Colorado. Switching to 4-day school weeks was a strategy used by rural schools to deal with decreased school funding. Anderson and Walker found 4-day school weeks positively influenced student performance. Anderson and Walker utilized 4 models, with a difference-in-difference method and fixed effects methods, and measured student achievement by scores on 4th grade reading and 5th grade math test scores on the Colorado Student Assessment Program (CSAP).

From the existing research, there is no definitive answer whether school funding affects student achievement. However, at least 62 percent of states spend less on school funding now than they did before the Financial Crisis of 2007-08 (Leachman, Albares, Masterson, Wallace, 2016).

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just a single observation over time. Papke and Wooldridge utilized 5 different models and econometric methods of linear approximations as well as a fractional probit model.

Recently, the former Director of the Department of Commerce stated it was more important for the State of Idaho to invest in education to ensure Idaho's economic future than it was to invest in corporate tax decreases. Stating,

> The return for the state is not in lowering taxes. It's investing in talent [...] We're going to draw people to our states if we can produce high-paying jobs. Is the tax rate a factor? Maybe. But it's not near the factor as demonstrating to people that we're investing in our education system that we're investing in infrastructure, that we're providing high speed broadband in rural communities. Those are the kinds of things that are attracting people to our state, not a tax rate. (Dentzer, 2015)

The question of whether decreases in state funding have impacted student achievement is important, not just for the future of students whose educational experiences have been affected by the decreases in funding, but also for the future of the State of Idaho. In this research, I investigate the effects of state funding on student achievement in Idaho from 2007-2013. Like the other studies, I will employ a production function that relates student achievement, as measured by the average percentage of students achieving a score of proficient, on the ISAT Math exam to state school funding in Idaho. Also like other research in this area, I control for fixed and random effects by employing panel data techniques similar to Leslie Papke and Jeffrey Wooldridge. My contributions to the literature are investigating the effects of decreasing state funding on student achievement in a small Western state, accounting for inflation, following cohorts of students, and accounting for 4-day school weeks.

3. Idaho

School districts in Idaho receive funding from three primary sources: local school district taxes, the State of Idaho, and federal funds. Funding for districts is decided by a state level

funding formula developed in, and not revised since, 1994 (Richert, 2016). With this, residents of districts are able to vote to adjust taxes to meet changes in spending should it be necessary.

Idaho is predominantly a rural state, with an average of 19 people-per-square-mile, containing a total of 158 school districts. Of these 158 school districts, 42 are charter schools. So, Idaho has a total of 116 distinct school districts when not accounting for charter schools.

In 2013, school district sizes, as measured by average daily attendance, ranged from 13,827 to 31,945 students in West Ada and from 12 to 1,186 students around Arbon. Of the 146 school districts in 2013, only 33 reported attendances of more than 1600 students. Because of this, a large amount of variation can be expected in spending between most districts and the few urban areas of Idaho. For example, the largest school district in 2013, West Ada, reported real state per-pupil-expenditure at $4,905.49, while on the smallest school districts, Arbon Elementary, reported real state per-pupil-expenditure at $11,944.04. West Ada is more urbanized than Arbon and has a greater concentration of residents. Thus, West Ada has a larger number of students-per-district and is able to spread school operating costs over the larger number of students.

Arbon, a rural district, falls into the first quartile, or the the first quarter of the distribution, of average daily attendance, in Idaho school districts. Arbon experienced a change in real state per-pupil-expenditure from $25,405.19 to $11,944.04, for a total decrease of $13,461.89, or 53%, over years 2007 to 2013. On average, school districts in the first quartile experienced a decrease of real state per-pupil-expenditure of $2071.51, or 22%, over years 2007 to 2013. West Ada, an urban district, falls into the fourth quartile, or the the 4th quarter of the distribution, of average daily attendance in Idaho school districts. West Ada experienced a change in real state per-pupil-expenditure from $5,506.36 to $4,905.49, for a total decrease of $600.87 or 11%, over years 2007 to 2013. On average, school districts in the fourth quartile experienced a decrease of

$967.43, or 16.5%, over years 2007 to 2013. It may seem unreasonable to compare school districts on either side of the distribution, but 57 of the 158 distinct districts that have existed in Idaho from 2007 to 2013, including charter schools, fall into the category of the first quartile of average daily attendance, which is 36% of all districts. Further, only 10% of the districts in Idaho have more than 4700 students, on average, in attendance. Thus, comparing these ends of the spectrum is not only reasonable, it's necessary for observing variations in districts.

During the financial crisis, Idaho experienced a decrease in the number of students attending public school. Likely, because of increases in unemployment, families left the state. Smaller districts, those in the 1st quartile, experienced an average decrease of 9% in student attendance, while larger districts, those in the 4th quartile, experienced only a 1% decrease in average attendance. Summarized, on average, each segment of districts by quartile shows a decrease in average attendance from 2007 to 2013, as seen in Table 3.1

In 2007, Idaho's GDP was $58,805 million, fell to $57,742 million in 2009, and rose to $64,825 million, in 2013 dollars (Bureau of Economic Analysis, 2016). The average unemployment rate in 2007 was 3.06%, rose to a high of 8.975% in 2010, and was 6.075% in 2013 (Bureau of Labor Statistics, 2016). Observing these numbers, it makes sense state funding decreased. With less labor, the rate of growth of GDP slowed, and in some cases fell, during the years 2007 to 2013.

These funding cuts in the smallest districts were often not able to be compensated for, which led to many small districts experiencing overall reductions in funding. In 2007, for districts in the 1st quartile, the average real state spending to average real federal spending was about 7.4, or about 7 state dollars to each federal dollar. In 2013, the average real state spending to average real federal spending was about 5.86, or about 6 state dollars to each federal dollar. In 2007, for

districts in the 4th quartile, the average real state spending to average real federal spending was about 0.14, or about 14 state cents to each federal dollar of funding. In 2013, for districts in the 4th quartile, the average real state spending to average real federal spending was about 0.18, or about 18 state cents to each federal dollar of funding. So, it can be shown that the proportion of funding changes were not uniform over school districts in Idaho from years 2007 to 2013.

By observing tables 3.1 through 3.5, it can be seen how 4-day school week schedules start being adopted by different sizes of districts. In 2007, 10% of the districts had 4-day schedules, but by 2013, that percentage rose to 26.71% of all districts throughout Idaho. Perhaps most telling, Table 3.2 shows how 15% of districts in the first quartile participated in 4-day school week schedules, but by 2013, that percentage rose to 40.91% of districts. Table 3.5 shows, from 2007 to 2013, 6% of districts in the fourth quartile participated in 4-day school weeks. Regardless of the reason, it is clear the adoption of 4-day school weeks was not uniform among all of the school districts in Idaho.

In Table 3.6, instead of viewing per-pupil-expenditure, a presentation of overall funding by quartiles is shown and demonstrates, again, the disparity in size among districts in Idaho. In Table 3.7, the rates of poverty for children 5-17 years old is presented. Unlike the other comparisons which have demonstrated vast differences between districts in different quartiles, the rates of poverty show little deviation between one quartile or another.

4 Day School Weeks											
Year	Total No. District	No. of Districts with 4 Day Schedule	% of Districts with 4 Day Schedule	Mean Attend. of all District	Mean Attend. of Schools with 4 Day Schedule	Mean of InfStatePPE	Mean of InfStatePPE 4-Day Dist.	Mean %Proficient of all Districts	Mean %Prof. 4-Day Dist.	Mean %Pass of all Districts	Mean %Pass 4-Day Dist
2007	130	14	11%	2084	656	7942	10994	44	47	76	79
2008	135	14	10%	2112	643	7777	10104	41	40	76	77
2009	137	14	10%	2105	706	7829	8615	39	37	72	71
2010	145	22	15%	2064	512	6573	8741	41	44	74	83
2011	148	34	23%	2034	534	7028	9330	39	42	74	81
2012	147	37	25%	1992	521	6344	8301	37	45	74	77
2013	146	39	27%	1999	518	6437	8387	39	42	75	78

Table: 3.1

4 Day School Weeks: Attendance in the 1st Quartile (0-25%)											
Year	Total No. District	No. of 4-Day Dist.	% of 4-Day Dist.	Mean Attend of Reg. Dist	Mean Attend. 4-Day Dist	Mean of InfStatePPE Reg. Dist	Mean of InfStatePPE 4-Day Dist.	Mean %Proficient Reg. Dist	Mean %Prof. 4-Day Dist.	Mean %Pass Reg. Dist.	Mean %Pass 4-Day Dist.
2007	33	5	15%	159	117	13154	17784	50	55	79	79
2008	36	5	14%	157	114	12596	1535	44	50	84	88
2009	37	4	11%	158	143	12191	11986	41	28	83	100
2010	41	10	24%	148	141	10719	11627	45	36	79	82
2011	43	14	33%	154	115	10450	3149	41	44	80	82
2012	45	16	36%	154	121	9185	11518	31	45	71	77
2013	44	18	41%	148	129	10056	11539	43	33	87	71

Table: 3.2

4 Day School Weeks: Attendance in the 2nd Quartile (26-50%)											
Year	Total No. District	No. of 4-Day Dist.	% of 4-Day Dist.	Mean Attend of Reg. Dist	Mean Attend. 4-Day Dist	Mean of InfStatePPE Reg. Dist	Mean of InfStatePPE 4-Day Dist.	Mean %Proficient Reg. Dist	Mean %Prof. 4-Day Dist.	Mean %Pass Reg. Dist.	Mean %Pass 4-Day Dist.
2007	30	2	7%	468	442	7736	8384	46	39	74	69
2008	34	2	6%	463	431	7831	8354	43	43	77	79
2009	35	2	6%	438	410	8026	8425	44	44	71	90
2010	34	4	12%	426	365	6686	7436	47	44	76	90
2011	34	8	24%	404	380	8000	7482	37	36	73	81
2012	35	8	23%	404	380	7479	6627	44	51	75	81
2013	37	7	19%	400	385	6462	6796	45	44	76	81

Table: 3.3

4 Day School Weeks: Attendance in the 3rd Quartile (51-75%)											
Year	Total No. District	No. of 4-Day Dist.	% of 4-Day Dist.	Mean Attend of Reg. Dist	Mean Attend. 4-Day Dist	Mean of InfStatePPE Reg. Dist	Mean of InfStatePPE 4-Day Dist.	Mean %Proficient Reg. Dist	Mean %Prof. 4-Day Dist.	Mean %Pass Reg. Dist.	Mean %Pass 4-Day Dist.
2007	29	7	24%	1255	1103	6534	6891	43	46	73	82
2008	30	7	23%	1278	1081	6497	6882	42	37	72	75
2009	30	8	27%	1216	1061	6623	6976	42	38	71	58
2010	32	8	25%	1161	1048	5522	5785	46	48	79	81
2011	32	10	31%	1102	941	5839	6225	40	43	68	81
2012	32	11	34%	1117	929	5239	5470	39	41	75	74
2013	32	12	38%	1120	938	5325	5418	38	48	73	82

Table: 3.4

4 Day School Weeks: Attendance in the 4th Quartile (76-100%)											
Year	Total No. District	No. of 4-Day Dist.	% of 4-Day Dist.	Mean Attend of Reg. Dist	Mean Attend. 4-Day Dist	Mean of InfStatePPE Reg. Dist	Mean of InfStatePPE 4-Day Dist.	Mean %Proficient Reg. Dist	Mean %Prof. 4-Day Dist.	Mean %Pass Reg. Dist.	Mean %Pass 4-Day Dist.
2007	38	0	0%	6681	.	5856	.	43	.	75	.
2008	35	0	0%	6831	.	5895	.	35	.	69	.
2009	37	0	0%	6756	.	5977	.	33	.	69	.
2010	38	0	0%	6806	.	4999	.	40	.	76	.
2011	39	2	5%	6828	2041	5283	5516	37	46	73	88
2012	35	2	6%	6828	2041	4805	4840	34	39	72	76
2013	33	2	6%	6821	1965	4893	5028	33	47	69	83

Table: 3.5

Districts By Quartiles										
Year	Total No. District	Districts 1Q	Districts 2Q	Districts 3Q	Districts 4Q	Mean Attendance of Districts	Mean Attendance 1Q	Mean Attendance 2Q	Mean Attendance 3Q	Mean Attendance 4Q
2007	130	33	30	29	38	2084	175	456	1218	6509
2008	135	36	34	30	35	2112	174	442	1231	6701
2009	137	37	35	30	37	2105	175	424	1176	6607
2010	145	41	34	32	38	2064	166	417	1130	6679
2011	148	43	34	32	39	2034	161	403	1039	6429
2012	147	45	35	32	35	1992	162	407	1039	6403
2013	146	44	37	32	33	1999	158	398	1037	6398
Year	No. Districts 4 Day Schedules	No. Districts 4 Day Schedules 1Q	No. Districts 4 Day Schedules 2Q	No. Districts 4 Day Schedules 3Q	No. Districts 4 Day Schedules 4Q	Mean of Pass	Mean of Pass District 1Q	Mean of Pass District 2Q	Mean of Pass District 3Q	Mean of Pass District 4Q
2007	14	5	2	7	0	76	82	75	75	75
2008	14	5	2	7	0	76	82	80	77	68
2009	14	4	2	8	0	72	83	75	71	64
2010	22	10	4	8	0	74	77	78	75	69
2011	34	14	8	10	2	74	77	78	76	69
2012	37	16	8	11	2	74	74	78	76	69
2013	39	18	7	12	2	75	77	78	76	70
Year	Mean InfState	Mean InfState 1Q	Mean InfState 2Q	Mean InfState 3Q	Mean InfState 4Q	Mean of InfFed	Mean InfFed District 1Q	Mean InfFed District 2Q	Mean InfFed District 3Q	Mean InfFed District 4Q
2007	12700000	1630201	3385426	7538000	37400000	1986114	1630201	3385426	7538000	37400000
2008	14000000	1766894	3639894	8188311	40100000	2052029	1766894	3639894	8188311	40100000
2009	14100000	1769998	3505593	7892244	40000000	2143705	1769998	3505593	7892244	40000000
2010	11700000	1466755	2816982	6271060	33500000	4249071	1466775	2816982	6271060	33500000
2011	12400000	1472585	3072795	6292963	34000000	2797353	1472585	3072795	6292963	34000000
2012	11400000	1333207	2856736	5648746	31200000	2494477	1333207	2856736	5648746	31200000
2013	11600000	1398534	2588967	5643024	31700000	2204682	1398534	2588967	5643024	31700000

Table: 3.6

Poverty: Number of Children 5-17 Years Old										
Year	Mean Attend of Dist.	Mean Pov. of Idaho	Mean Pov. 1Q	% Pov 1Q	Mean Pov. 2Q	% Pov 2Q	Mean Pov. 3Q	% Pov 3Q	Mean Pov. 4Q	% Pov 4Q
2007	2084	352	33	19%	101	22%	220	18%	1020	16%
2008	2112	348	36	21%	102	23%	215	17%	987	15%
2009	2105	437	40	23%	120	28%	248	21%	1234	19%
2010	2064	474	37	22%	101	24%	265	23%	1382	21%
2011	2034	524	41	25%	114	28%	283	27%	1448	23%
2012	1992	542	41	25%	114	28%	288	28%	1502	23%
2013	1999	523	40	25%	103	26%	269	26%	1451	23%

Figure 3.7

4. Methodology

I use a production model to examine whether school achievement, as measured by attainment of level 3, or proficient, on the ISAT Math exam is related to real state school funding in Idaho. A production model explains differences in output caused from variation in inputs. Descriptions and explanation for the inputs of my model, as well as interpretations of their effects on output, can be found throughout the rest of this section on methodology. For my model, output will be student-testing performance measured by the proportion of students scoring in the passing range as deemed by Idaho's State Department of Education (SDE).

I examine performance on the ISAT by tracking groups of students over time at the school district level. The ISAT is given in Idaho to grades 3 through 12 and the thresholds for scores on the ISAT Math exam range from 2000 to 2718. The thresholds vary by grade, but for each grade, scores are segmented into 4 levels: Below Basic (1), Basic (2), Proficient (3), and Advanced (4). The ISAT consists of around 40 to 45 questions per subject tested, and examples of the types of questions asked can be seen in Appendix B. In Appendix C is a sample of the report parents receive from their children's examination.

Dolan and Schmidt (1987) give a detailed account of how to develop models that can account for and correct these data problems. Specifically, the model they suggest utilizes "regressions where weights are average daily memberships in the district." (Dolan & Schmidt, 1987, p. 287). Their data is from Virginia and uses a four-year cross-sectional panel aggregated at the school district level. This is similar to my data, which is also aggregated at the school district level, covering a time span greater than 4 years, with average daily attendance data. Thus, I utilize average daily attendance of the school district as my measure for per-pupil averaging to meet Dolan & Schmidt's suggestion.

Like Papke and Wooldridge (2008), I employ panel data to explore whether per pupil expenditures affect student performance on the ISAT. The data in this study is comprised of financial information, test scores, and different demographic features at the school district level for Idaho. This data was gathered from Idaho's State Department of Education through formal requests for information, the Bureau of Labor Statistics (BLS), the US Census Bureau (USCB), and Idaho Kids Count. A list of explanations, method of creation, and sources of relevant variables used in this research project are presented in Appendix A.

For the base model, I chose level 3, known as proficient, as my measure of student achievement because it is the lowest score on the scale indicating the student passed the exam. By utilizing the percent of students scoring proficient on the exam, I am able to estimate the effect state school funding has on the proportion of students moving in to the lowest score deemed passing by the SDE.

The Idaho State Department of Education provides ISAT data at the school and school district level. I chose to use the school district level for my analysis because of Idaho's reporting standards limiting any data with less than 10 students. As noted previously, Idaho is rural so there are many instances of missing data when school level data is utilized.

Cohorts of students were created in the data so as to measure the change in students scores over time. To create these cohorts, I assigned a distinct value to the year, district, and grade the students were present. As time progressed, the distinct value followed the students. For example, in year 2007, district 1, grade 3, the distinct value of 1 is assigned to the group of students. When the students in that year progressed to grade 4, the distinct value followed them to the next year. So, in 2008, district 1, grade 4, the distinct value is 1. This process was completed over the entire data set in all districts, grades, and years for a total of 2049 distinct

groups of students[3].

The baseline estimating equation is:

$$(1)\ \%Proficient_{ct} = \beta_1 log(InfStatePPE)_{ct} + \beta_2 FRLProp_{ct} + \beta_3 Day_{ct} + \alpha_c + u_{ct}$$

where the dependent variable, *%Proficient*, is the proportion of students, in a cohort *c*, who received a score of proficient on the ISAT over a year *t*.

The variable *InfStatePPE* indicates the amount of money spent per-pupil in a particular cohort in a particular year, inflated to the value of a dollar spent in the Idaho State Department of Education's (SDE) fiscal year 2013. Per-pupil-expenditure (PPE) is calculated by dividing the amount of inflated state revenue by the average daily attendance of the district, as reported by the SDE. The fiscal year (FY) inflator was generated from the Bureau of Labor Statistics' (BLS) reported measures of consumer price index (CPI) over the months July to June to coincide with Idaho's fiscal year calendar[4].

The coefficient of interest, β_1, represents the marginal effect of a percentage change in

[3] To see how students were likely to perform over time, it was necessary to create some method of tracking cohorts. The first step in creating the cohorts was to isolate observations for a particular district. Then, I isolated the first observation of a grade existing in the data set for that particular district. Next, I designate that particular district and grade with a distinct identifier – a counting number – and then designate that distinct identifier to be applied to the successive year and grade. Simultaneously, this method is performed on all districts, grades, and years to create a full set of cohorts for which to follow throughout the data.

To illustrate this method practically: grade 3 in district 1 in year 2007 is designated with the distinct identifier value of one, which is known as the cohort's designation. Next, grade 4 in district 1 in year 2008 is designated with the same distinct identifier value of one as the students in this observation were in grade 3 in district 1 in year 2007. This action is performed until the cohort, is no longer present in the data (which always happens when a cohort finishes 12th grade). For this example, the cohort's last observation would occur at year 2016 (2007 + 9 years for grades 3 through 12). As the data stops at, and includes, year 2013, this cohort never exits the data. As observations enter the data, such as grade 3 in district 1 in year 2008, distinct values are assigned to them that are not present in the year 2007 whatsoever.

[4] To change dollars into 2013 dollars, and inflate the previous years' spending, a method of utilizing FY 2013 as the base was necessary to generate. This was accomplished by taking the sum of all CPIs for the months July in the previous year to June of the year in question so as to follow the reports from the SDE. To illustrate, FY 2013's inflator was generated from the sum of CPI data from July 2012 to June 2013. Next, this sum was divided by 12 to create an annual average. This was completed for years 2006 to 2013 to capture all FYs. After the base was calculated, it was used to divide the average fiscal year CPI of each other year to create an inflator for each year. Finally, this inflator was multiplied by the amount of state revenue to show how much of the district's spending was real state funds. As an example, the base FY inflator is approximately 234 while FY 2012's average FY CPI is approximately 230. So, dividing 234/230 results in approximately 1.017. Thus, a single dollar spent in FY 2012 is equal to 1.017 dollars spent in 2013.

PPE on the percent of students scoring proficient on the ISAT Math exam for a cohort *c* in a year *t*[5]. The variable *FRLProp* is the proportion of students in a school district who receive free or reduced lunch in a year *t*. The coefficient of interest, β_2, represents the average marginal effect, ceteris paribus, of a district receiving free or reduced lunch on the percent of students scoring proficient on the ISAT Math exam for a cohort *c* in a year *t*. The variable *Day* indicates whether a four-day week schedule was in place in a district for a cohort *c* in a year *t*. The coefficient of interest, β_3, represents the average marginal effect, ceteris paribus, of a district having a four-day school week on the percent of students scoring proficient on the ISAT for a cohort *c* in a year *t*.

The school district fixed effects, known as the unobserved effect, are represented by α_c and u_{ct}, illustrates the error in a district over time caused by factors not considered in this model. School district fixed effects control for differences across school districts that are time-invariant or take a long period to change, such as parental involvement, geographical differences, and educational costs.

Potential for bias exists for students receiving free or reduced lunch based on nutritional differences and childhood development. If the only difference between one student and another is receiving free or reduced lunch, then it does not appear this will inflict bias. However, students receiving free or reduced lunch are admitted to these programs based on their parents' level of income. Because of that, this could create a potential for poor nutrition compared to those students not on the program. If students on free or reduced lunch programs miss meals at home, or incur some form of reduced essential nutrient consumption relative to those students

[5] The logarithm applied to spending is a common technique to scale spending among large variations in data. This method also delivers a potential for results of greater statistical significance than with using unscaled numbers. When the logarithmic function is applied to a variable, the coefficient on the variable is then interpreted as a percentage change in the outcome instead of a magnitude change.

not qualifying for the free or reduced lunch programs, then the estimates to free and reduced lunch will be biased. However, as the data utilized for this examination is aggregated, and not individual level, the potential for this bias is minimized.

As illustrated by Anderson and Walker (2012), "School fixed effects cannot account for unobserved time-varying factors that simultaneously influence student performance and the school's choice of schedule." (p. 16). Thus, school districts may be, in some way, forced to switch to a four-day-week schedule or change per-pupil-expenditure because of ISAT remediation being a portion of Idaho's school funding formula. My performance of panel data analysis addresses these issues.

From the literature reviewed [Anderson & Walker (2012) and Biddle & Payne (1999) and Klein (1997) and Neymotin (2010) and Papke (2004) and Papke & Wooldridge (2008) and Turner (200)], mathematic scores are known to produce a more economically and statistically significant results than reading scores. Therefore, data focused on math scores is utilized for this research.

5. Data

Table 5.1 contains a summary of the average daily attendance of school districts throughout the years of the data, 2007 to 2013. What can be seen is the level of decrease in attendance by nearly all quartiles of school districts' attendance. Table 5.2 contains a summary of the inflated state revenue per-pupil throughout the years of data by quartiles of spending. Together, these data show, from 2007 to 2013, average daily attendance has fallen by approximately 4.08% while over the same period, average real-state-PPE has fallen by approximately 12.39%. While the changes in average real spending and average attendance are not one-to-one, it is worth

reminding the reader that PPE is calculated by the district's spending over the average attendance. Thus, if spending were held constant, and average attendance were to fall, PPE would rise. From the data in Tables 5.1 and 5.2, for each 1% change in average attendance, a 3% change in spending occurred. The estimation technique I use assumes a normal distribution of data. From Table 5.1 and 5.2, it should not be expected that the data will be normally distributed, around the same mean, from one year to the next.

As show in in Figure 5.1, the density of Inflated PPE does not fit the normal bell-shaped distribution. Therefore, I transformed the inflated state PPE by a logarithmic function. Figure 5.2 illustrates the density of the logarithmically transformed inflated state PPE compared to the expected normal distribution. With this transformation, I have a better approximation of the normal density function. However, as shown in Figure 5.3, and from tests on the data, the data is characterized by heteroscedasticity[6]. Along with the logarithmic transformation, my method of applying panel data techniques corrects for errors related to heteroscedasticity.

Because districts with different average attendance levels are likely to have different levels of PPE, I segment spending by the size of districts to their interquartile ranges to deliver a closer look as to how the distribution by quartile appears. Scatter plots of each district's log of inflated state PPE (LInfStatePPE) can be seen in figures 5.4 to 5.7. Again, the issue of heteroscedasticity is present, but districts in the 4th quarter of membership seems to be most normally distributed of the quartiles.

Summaries of the proportion of students soring in proficient are presented in Table 5.3 along with a calculation of the percent change in the mean of students scoring proficient from one year

[6] Heteroscedasticity: Heteroscedasticity (also spelled heteroskedasticity) refers to the circumstance in which the variability of a variable is not equal across the range of values of a second variable that predicts it. More technically, the *variability* in an explained variable about its mean is not constant across all values of the variables explaining the variable; the variance in the error term, *u*, conditional on the explanatory variables, is the *not the same* for all combinations of outcomes of the explanatory variables.

to the next. In Table 5.4, a matrix of piecewise correlations is presented[7]. In Table 5.5, summaries of variables in the base model are shown by their cohorts over time.

[7] A piecewise correlation was chosen so as to not limit the data. A linear correlation accounts only for the correlation of variables when each has an observation. When there are missing observations, a linear correlation technique leads to a shrinking of the data observed. A piecewise correlation allows me to observe how each variable is correlated with every observation of the other variables in the dataset, regardless if one is missing observations or not. The piecewise correlation presented in figure 11 accounts for a minimum of 52 observations and a maximum of 7148 observations. The linear correlation of the same data, which is not presented, accounts for exactly 46 observations.

Average Daily Attendance (Number of Students in a District)							
Year	Min.	1-25%	25-50%	50-75%	75-99%	Max.	Mean
2007	3.29	282.81	750.97	1704.23	23356.13	29900.59	2083.734
2008	4.4	284.69	732	2011.2	23528.54	30972.16	2112.431
2009	9.67	285.4	708.52	2039.4	23322.19	31817.88	2105.429
2010	4.74	270.37	619.86	1727.82	23659.93	32501.54	2063.509
2011	5.13	251.56	593.01	1588.01	23885.83	33383.06	2034.138
2012	5.13	251.56	590.61	1516.98	23885.83	33383.06	1992.376
2013	9.52	253.44	590.41	1597.14	23982.48	31944.91	1998.717

Table 5.1. Source: Idaho State Department of Education

Inflated FY 2013 State Per-Pupil-Expenditure (USD, $)							
Year	Min.	1-25%	25-50%	50-75%	75-99%	Max.	Mean
2007	4942.095	5757.463	6641.715	8270.057	26496.28	35509.12	7652.469
2008	5358.633	6140.598	6973.113	8730.246	26362.65	30381.02	8060.967
2009	5271.104	6355.178	7073.126	8715.963	17652.32	26794.39	8021.607
2010	4516.024	5186.966	5924.457	7568.076	17596.09	27842.35	6700.992
2011	4749.087	5584.484	6316.022	7702.534	20290.82	24514.27	7320.262
2012	4430.158	5017.72	5632.09	7123.267	23371.93	23989.33	6685.824
2013	4345.542	5096.624	5696.624	7505.807	16503.63	23776.06	6704.398

Table 5.2. Source: Idaho State Department of Education

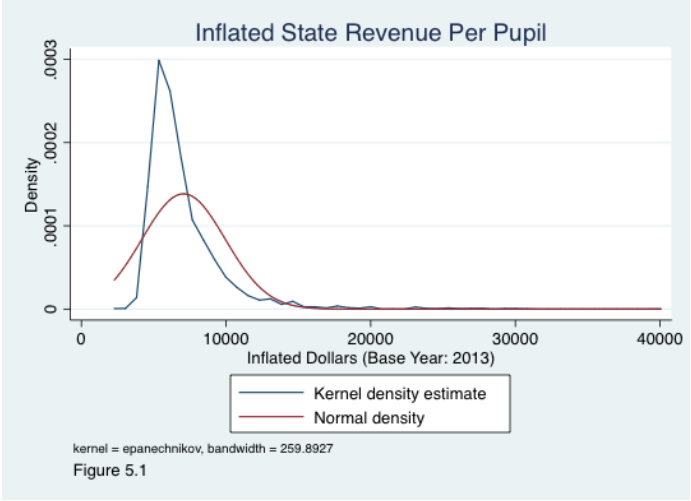

Figure 5.1

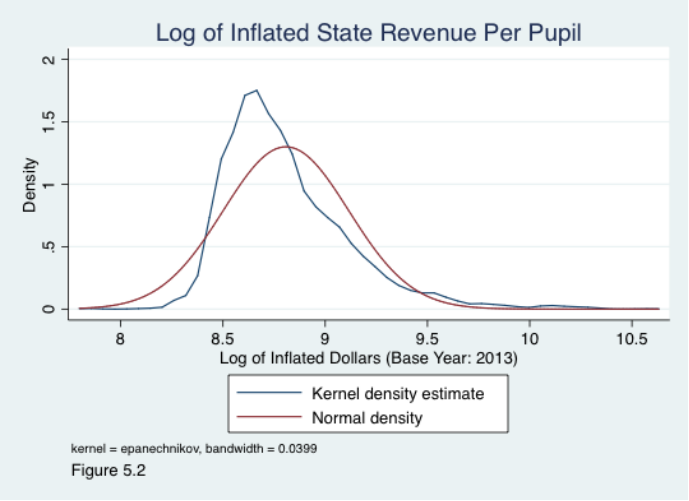

Figure 5.2

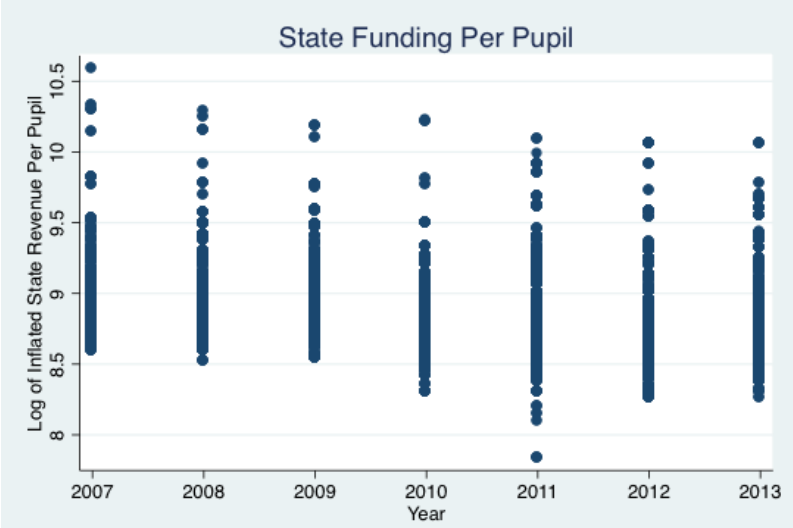

Figure 5.3

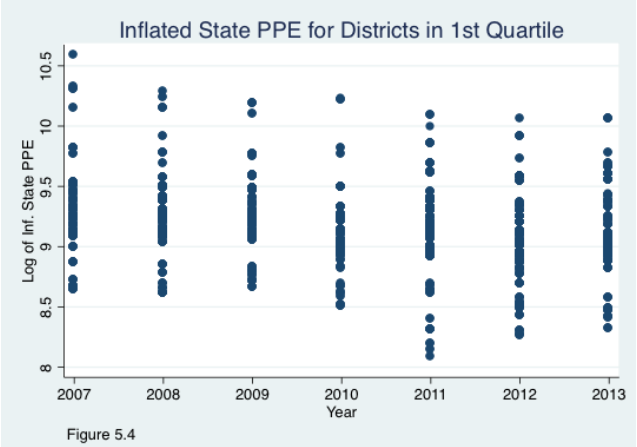

Figure 5.4

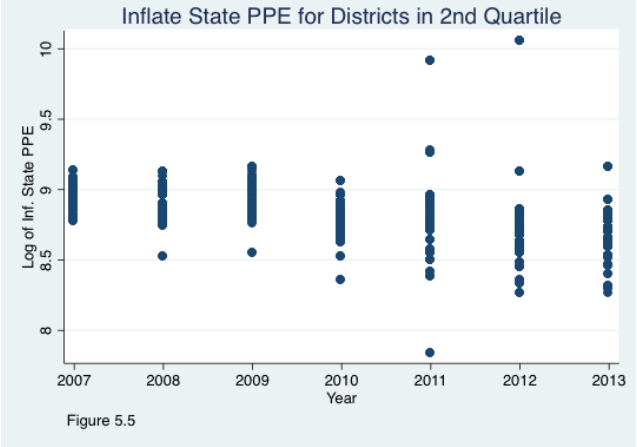

Figure 5.5

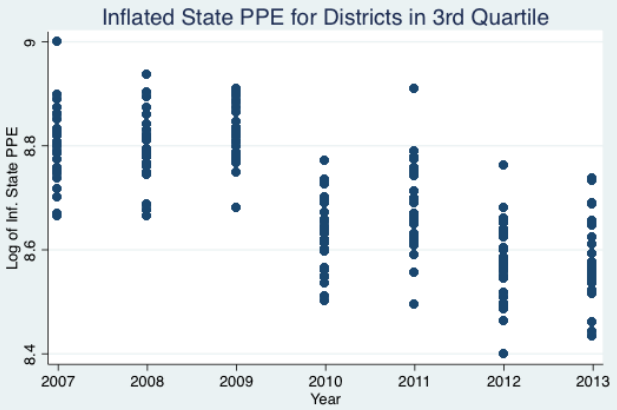

Figure 5.6

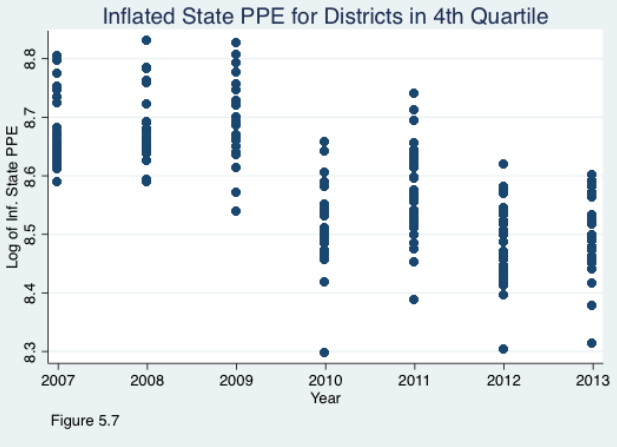

Figure 5.7

Proportion of Students Scoring Proficient on ISAT Math								
Year	Min.	1-25%	25-50%	50-75%	75-99%	Max.	Mean	% Change in Mean
2007	6.7	38.5	43.8	49.2	69.2	81.8	43.98345	.
2008	0	34.4	41.7	48	65.6	75	40.84239	-7.141%
2009	0	32.3	40.4	47.1	71.4	83.3	39.34164	-3.674%
2010	0	35.3	442	47.8	66.7	85.7	41.26305	4.884%
2011	0	33.3	40	46.2	65.5	80	39.23104	-4.925%
2012	0	30	38.1	44.3	63.2	75	36.90835	-5.921%
2013	0	31	38.9	46.7	70	90.9	38.60809	4.605%

Table 5.3.

Piecewise Correlation for Variables of Interest

	Pass	Prof.	Inf. Tot. PPE	Inf. State PPE	InfLclPPE	Pov	PovProp	FRL	FRLProp	Mem.	Male Prof.	Female Prof.	NatAm. Prof.	Asian Prof.	AfAm. Prof.	Pac. Isl. Prof.	White Prof.	H P
ass	1																	
rof	0.3747	1																
Tot. PE	0.0669	0.1017	1															
State PE	0.0734	0.1654	0.7138	1														
clPPE	0.0677	0.0032	0.7904	0.1887	1													
ov	-0.1589	-0.1962	-0.2383	-0.3336	-0.0232	1												
Prop	-0.123	0.0376	0.3235	0.3403	0.0954	-0.0257	1											
RL	-0.172	-0.1939	-0.2443	-0.3625	-0.0205	0.9829	-0.0769	1										
.Prop	-0.1591	0.044	-0.1325	-0.0311	-0.2951	-0.083	0.432	-0.091	1									
em.	-0.1165	-0.1293	-0.1657	-0.2678	0.0207	0.9091	-0.1687	0.9357	-0.2166	1								
ale of.	0.2376	0.8635	0.0906	0.1807	-0.0126	-0.2099	0.0331	-0.2103	0.054	-0.13	1							
nale of.	0.269	0.8582	0.0845	0.1321	0.0161	-0.1819	0.0441	-0.1767	0.0363	-0.1145	0.485	1						
Am. of.	0.5235	0.6025	0.0964	0.0378	0.1529	0.1188	0.0037	0.0988	-0.0675	0.0919	0.4605	0.4992	1					
ian of.	0.0193	0.4856	-0.0663	0.1478	-0.0946	-0.2149	-0.1005	-0.206	-0.057	-0.0739	0.4623	0.4676	0.069	1				
Am. of.	0.3627	0.3414	-0.1516	0.065	-0.1913	-0.2534	0.0551	-0.2597	0.0764	-0.2141	0.33	0.3193	0.1818	0.1959	1			
. Isl. of.	-0.0501	0.3147	-0.1854	-0.091	-0.1236	-0.1759	-0.3515	0.0453	-0.35	0.3365	0.309	0.3022	0.2988	0.2586	-0.0234	1		
hite of.	0.2014	0.949	0.0923	0.1671	-0.0039	-0.1898	0.0176	-0.1859	0.0125	-0.1185	0.8184	0.8063	0.1927	0.449	0.2412	0.3231	1	
isp. of.	0.5883	0.665	0.0788	0.1057	0.0238	-0.15	0.0551	-0.156	0.0654	-0.1202	0.5823	0.5802	0.4353	0.2494	0.3374	0.093	0.3459	

Table 5.4

Summary of Relevant Modeled Data							
Variable		Mean	Stand. Dev.	Min	Max		Observations
AllP	overall	39.90792	11.74975	0	90.9	N	6780
	between		9.563374	0	83.3	n	1803
	within		8.572127	-3.463509	74.62792	T-bar	3.7604
LogInfStatePPE	overall	8.808011	0.3070856	7.837716	10.59157	N	8101
	between		0.3122593	8.140233	10.43956	n	1958
	within		0.0993597	8.045302	9.596699	T-bar	4.13739
PovProp	overall	0.2374386	0.1015368	0.0670895	1.012292	N	7148
	between		0.0928692	0.0670895	0.893512	n	1654
	within		0.0516076	-0.079414	0.6021711	T-bar	4.32164
FRLProp	overall	0.5289006	0.1449145	0	1.078924	N	6848
	between		0.1409663	0	1.048041	n	1577
	within		0.0484852	0.3214344	0.7865206	T-bar	4.34242
Day	overall	0.2135271	0.4098253	0	1	N	7156
	between		0.37924	0	1	n	1662
	within		0.1908344	-0.6198062	1.07067	T-bar	4.30566

Table 5.5

6. Results

Table 6.1 contains the results of the base model as presented in the previous section.

Base Model						
Variable	Beta	Std. Err.	t	P	R-Squared	
LInfStatePPE	5.4860604	1.5221400	3.60	0.000	Overall	0.0156
FRLProp	-16.5313000	3.1912840	-5.18	0.000	Between	0.0017
Day	0.8947665	0.8109103	-1.10	0.270	Within	0.0021
Constant	1.5731040	14.0575700	0.11	0.911	N	5669
					Groups	1428
F(3,4238) = 22.42					Prob > F = 0.0000	

Table 6.1

As shown in Table 6.1, the log of real state spending per-pupil, LInfStatePPE**,** is positively and significantly related to average student district-level performance on the Math ISAT. Increasing real state PPE by one percent leads to an increase of about 5.49% students scoring proficient on the ISAT, on average, ceteris paribus. The spending variable is significant at all levels of the data in the model.

The proportion of students participating in a district's free or reduced lunch program, as measured by FRLProp, is significant and negatively affects the proportion of students scoring proficient on the ISAT Math exam. A one percent increase in students on free or reduced lunch in a district leads to about 16.53% less students scoring proficient on the ISAT, on average,

ceteris paribus. The FRLProp variable is significant at all levels of the data in the model.

A school district participating in a 4-day school week, as measured by Day, is significant and positively affects students scoring proficient on the ISAT Math exam. If a school district has a 4-day school week, about 0.89% more students will score proficient on the ISAT Math exam, ceteris paribus. The Day variable is significant over about 73% of the data. As the F statistic shows, the model is significant at the 95% confidence interval.

Because the total level of funding for a district is composed of local, state, and federal funds, an adjustment to the model may be more informing. In reports from the SDE, what composed local funds was not clear[8], but the amount can be drawn out of the total expenditure as the SDE. Thus, a model is generated to estimate the proportion of students scoring in proficient with the base model's variables along with the log of real local spending PPE.

Base Model with Log of Inflated Local PPE						
Variable	Beta	Std. Err.	t	P	R-Squared	
LInfStatePPE	5.190941	1.532907	3.39	0.001	Overall	0.0015
LInfLclPPE	-0.0452202	0.3016837	-0.15	0.881	Between	0.0011
FRLProp	-16.98962	3.202287	-5.31	0.000	Within	0.0155
Day	-0.8409242	0.811265	-1.04	0.300	N	5625
Constant	4.684278	14.54365	0.32	0.747	Groups	1426
F(4, 4195) = 16.54					Prob > F = 0.0000	

Table 6.2

As shown in Table 6.2, the log of real state spending per-pupil, LInfStatePPE**,** is positively and significantly related to average student district-level performance on the Math ISAT exam. Increasing real state PPE by one percent leads to an increase of about 5.19% students scoring proficient on the ISAT Math exam, on average, ceteris paribus. The spending variable is significant over about 99.9% of the data in the model.

The log of real local spending per-pupil, LInfLclPPE**,** is negatively and insignificantly related to average student district-level performance on the ISAT Math exam. Increasing real local PPE by one percent leads to about 0.05% less students scoring proficient on the ISAT Math Exam,

[8] The main funding sources reported by the SDE were Taxes, Other Local Sources, State Sources, Federal Sources, Other Sources. It was never made clear how Other Sources, Other Local Sources, and Taxes were inputted to build a local funding variable.

ceteris paribus. The spending variable is significant over about 11.9% of the data in the model.

The proportion of students participating in a district's free or reduced lunch program, as measured by FRLProp, is significant and negatively affects the proportion of students scoring proficient on the ISAT Math exam. A one percent increase in students on free or reduced lunch in a district leads to about 16.99% less students scoring proficient on the ISAT, on average, ceteris paribus. The FRLProp variable is significant at all levels of the data in the model.

A school district participating in a 4-day school week, as measured by Day, is insignificant and negatively affects students scoring proficient on the ISAT Math exam. If a school district has a 4-day school week, about 0.84% less students will score proficient on the ISAT Math exam, ceteris paribus. The Day variable is significant over about 70% of the data. As the F statistic shows, the model is significant at the 95% confidence interval.

Moving forward one more step, I adjust the model to account for the effect of the control variables on the proportion of students passing the ISAT Math exam at any level, proficient or advanced.

Proportion of Students Passing the ISAT: All Levels						
Variable	Beta	Std. Err.	t	P	R-Squared	
LInfStatePPE	20.89238	2.03559	10.26	0.000	Overall	0.0447
LInfLclPPE	0.1963097	0.4006081	0.49	0.624	Between	0.0092
FRLProp	-45.84493	4.252341	-10.78	0.000	Within	0.0821
Day	-2.15597	1.077285	-2.00	0.045	N	5625
Constant	-85.4883	19.31262	-4.43	0.000	Groups	1426
F(4, 4195) = 93.77					Prob > F = 0.0000	

Table 6.3

As shown in Table 6.3, the log of real state spending per-pupil, LInfStatePPE**,** is positively and significantly related to average student district-level performance on the Math ISAT. Increasing real state PPE by one percent leads to an increase of about 20.89% students scoring in the passing range on the ISAT, on average, ceteris paribus. The spending variable is significant at all levels of the data in the model.

The log of real local spending per-pupil, LInfLclPPE**,** is positively and insignificantly related

to average student district-level performance on the ISAT Math exam. Increasing real local PPE by one percent leads to about 0.20% more students scoring in the passing range on the ISAT Math Exam, ceteris paribus. The spending variable is significant over about 37.6% of the data in the model.

The proportion of students participating in a district's free or reduced lunch program, as measured by FRLProp, is significant and negatively affects the proportion of students scoring in the passing range on the ISAT Math exam. A one percent increase in students on free or reduced lunch in a district leads to about 45.84% less students scoring proficient on the ISAT, on average, ceteris paribus. The FRLProp variable is significant at all levels of the data in the model.

A school district participating in a 4-day school week, as measured by Day, is significant and negatively affects students scoring proficient on the ISAT Math exam. If a school district has a 4-day school week, about 2.16% less students will score in the passing range on the ISAT Math exam, on average, ceteris paribus. The Day variable is significant over about 95.5% of the data. As the F statistic shows, the model is significant at the 95% confidence interval.

As funding is made up of three parts, it is worth examining how each of the sources affects students passing the ISAT.

Proportion of Students Passing the ISAT: All Levels						
Variable	Beta	Std. Err.	t	P	R-Squared	
LInfStatePPE	24.52106	2.124847	11.54	0.000	Overall	0.0435
LInfLclPPE	0.42782	0.4011502	1.07	0.286	Between	0.0095
LInfFedPPE	3.95728	0.691932	5.72	0.000	Within	0.0892
FRLProp	-49.71876	4.290168	-11.59	0.000	N	5625
Day	-1.921514	1.074019	-1.79	0.074	Groups	1426
Constant	-145.5756	21.92171	-6.64	0.000		
F(5, 4194) = 82.13					Prob > F = 0.0000	

Table 6.4

As shown in Table 6.4, the log of real state spending per-pupil, LInfStatePPE**,** is positively and significantly related to average student district-level performance on the Math ISAT. Increasing real state PPE by one percent leads to an increase of about 24.52% students scoring in

the passing range on the ISAT, on average, ceteris paribus. The spending variable is significant at all levels of the data in the model.

The log of real local spending per-pupil, LInfLclPPE**,** is positively and insignificantly related to average student district-level performance on the ISAT Math exam. Increasing real local PPE by one percent leads to about 0.43% more students scoring in the passing range on the ISAT Math Exam, ceteris paribus. The spending variable is significant over about 71.4% of the data in the model.

The log of real federal spending per-pupil, LInfFedPPE**,** is positively and significantly related to average student district-level performance on the ISAT Math exam. Increasing real federal PPE by one percent leads to about 3.96% more students scoring in the passing range on the ISAT Math Exam, on average, ceteris paribus. The spending variable is significant at all levels of the data in the model.

The proportion of students participating in a district's free or reduced lunch program, as measured by FRLProp, is significant and negatively related to average student district-level performance on the ISAT Math exam. A one percent increase in students on free or reduced lunch in a district leads to about 49.72% less students scoring in the passing range on the ISAT, on average, ceteris paribus. The FRLProp variable is significant at all levels of the data in the model.

A school district participating in a 4-day school week, as measured by Day, is insignificant and negatively affects students scoring in the passing range on the ISAT Math exam. If a school district has a 4-day school week, about 1.92% less students will score in the passing range on the ISAT Math exam, on average, ceteris paribus. The Day variable is significant over about 92.6% of the data. As the F statistic shows, the model is significant at the 95% confidence interval.

To evaluate the time spending takes to have an impact on student achievement, lag variables are introduced into the model.

Proportion of Students Passing the ISAT: All Levels						
Variable	Beta	Std. Err.	t	P	R-Squared	
LInfStatePPE	14.6107	4.312496	3.39	0.001	Overall	0.0434
LInfLclPPE	-0.6712446	0.8068757	-0.83	0.406	Between	0.539
FRLProp	-16.02595	9.650636	-1.66	0.097	Within	0.1366
Day	1.100977	2.228671	0.49	0.621	N	2004
L1 LInfStatePPE	10.23436	3.802487	0.69	0.007	Groups	728
L2 LInfStatePPE	23.31958	3.716551	6.27	0.000	Sigma u	33.133606
L3 LInfStatePPE	28.60319	4.41477	6.48	0.000	Sigma e	12.530601
Constant	-587.6762	58.89771	-9.98	0.000	Rho	0.87487291
F(8, 1268) = 25.07					Prob > F = 0.0000	

Table 6.5

Table 6.5 demonstrates the same model as 6.3, but includes year lags, or how a previous year affected student achievement, for LInfStatePPE. The log of real state spending per-pupil, LInfStatePPE**,** is positively and significantly related to average student district-level performance on the ISAT Math exam. Increasing real state PPE by one percent leads to an increase of about 14.61% students scoring in the passing range on the ISAT Math exam, on average, ceteris paribus. The spending variable is significant over about 99.9% of the data in the model.

The log of real local spending per-pupil, LInfLclPPE**,** is negatively and insignificantly related to average student district-level performance on the ISAT Math exam. Increasing real local PPE by one percent leads to about 0.67% less students scoring in the passing range on the ISAT Math Exam, ceteris paribus. The spending variable is significant over about 59.4% of the data in the model.

The proportion of students participating in a district's free or reduced lunch program, as measured by FRLProp, is insignificant and negatively affects the proportion of students scoring proficient on the ISAT Math exam. A one percent increase in students on free or reduced lunch in a district leads to about 16.03% less students scoring in the passing range on the ISAT, ceteris paribus. The FRLProp variable is significant over about 90.3% of the data in the model.

A school district participating in a 4-day school week, as measured by Day, is insignificant and positively affects students scoring in the passing range on the ISAT Math exam. If a school district has a 4-day school week, about 1.10% more students will score in the passing range on

the ISAT Math exam, on average, ceteris paribus. The Day variable is significant over about 37.9% of the data.

The log of real state PPE, one year prior to the ISAT Math exam, is significant and positively affects students passing the ISAT Math exam. An increase in real state PPE by one percent, one year prior to the ISAT Math exam, leads to an increase of about 10.23% students scoring in the passing range on the ISAT Math exam, ceteris paribus, over about 99.3% of the data analyzed.

The log of real state PPE, two years prior to the ISAT Math exam, is significant and positively affects students passing the ISAT Math exam. An increase in real state PPE by one percent, two years prior to the ISAT Math exam, leads to an increase of about 23.32% students scoring in the passing range on the ISAT Math exam, on average, ceteris paribus. The two year lagged spending variable is significant at all levels of the data in the model.

The log of real state PPE, three years prior to the ISAT Math exam, is significant and positively affects students passing the ISAT Math exam. An increase in real state PPE by one percent, three years prior to the ISAT Math exam, leads to an increase of about 28.60% students scoring in the passing range on the ISAT Math exam, on average, ceteris paribus. The three year lagged spending variable is significant at all levels of the data in the model. As the F statistic shows, the model is significant at the 95% confidence interval.

Proportion of Students Passing the ISAT: All Levels						
Variable	Beta	Std. Err.	t	P	R-Squared	
LInfStatePPE	13.212	4.325421	3.05	0.002	Overall	0.39
LInfLclPPE	-0.3287455	0.8127518	-0.04	0.686	Between	0.0242
LInfFedPPE	4.668755	1.582473	2.95	0.003	Within	0.1263
FRLProp	-12.7407	9.685467	-1.32	0.189	N	1993
Day	1.825257	2.235405	0.82	0.414	Groups	727
L1 LInfStatePPE	3.735841	4.384374	0.85	0.394	Sigma u	19.79828
L2 LInfStatePPE	20.59383	3.81868	5.39	0.000	Sigma e	12.642966
L3 LInfStatePPE	27.46948	4.418074	6.22	0.000	Rho	0.71033016
Constant	-523.3763	62.63256	-8.36	0.000		
F(8, 1258) = 22.72					Prob > F = 0.0000	

Table 6.6

Table 6.6 demonstrates the same model as 6.4, but includes year lags, or how a previous year affected student achievement, for LInfStatePPE. The log of real state spending per-pupil,

LInfStatePPE**,** is positively and significantly related to average student district-level performance on the ISAT Math exam. Increasing real state PPE by one percent leads to an increase of about 13.21% students scoring in the passing range on the ISAT Math exam, on average, ceteris paribus. The spending variable is significant over about 99.8% of the data in the model.

The log of real local spending per-pupil, LInfLclPPE**,** is negatively and insignificantly related to average student district-level performance on the ISAT Math exam. Increasing real local PPE by one percent leads to about 0.33% less students scoring in the passing range on the ISAT Math Exam, ceteris paribus. The spending variable is significant over about 31.4% of the data in the model.

The log of real federal spending per-pupil, LInfFedPPE**,** is positively and significantly related to average student district-level performance on the ISAT Math exam. Increasing real federal PPE by one percent leads to about 4.67% less students scoring in the passing range on the ISAT Math Exam, ceteris paribus. The spending variable is significant over about 99.7% of the data in the model.

The proportion of students participating in a district's free or reduced lunch program, as measured by FRLProp, is insignificant and negatively affects the proportion of students scoring proficient on the ISAT Math exam. A one percent increase in students on free or reduced lunch in a district leads to about 12.74% less students scoring in the passing range on the ISAT, ceteris paribus. The FRLProp variable is significant over about 81.1% of the data in the model.

A school district participating in a 4-day school week, as measured by Day, is insignificant and positively affects students scoring in the passing range on the ISAT Math exam. If a school district has a 4-day school week, about 1.83% more students will score in the passing range on the ISAT Math exam, ceteris paribus. The Day variable is significant over about 58.6% of the data.

The log of real state PPE, one year prior to the ISAT Math exam, is insignificant and

positively affects students passing the ISAT Math exam. An increase in real state PPE by one percent, one year prior to the ISAT Math exam, leads to an increase of about 3.74% students scoring in the passing range on the ISAT Math exam, ceteris paribus, over about 60.6% of the data analyzed.

The log of real state PPE, two years prior to the ISAT Math exam, is significant and positively affects students passing the ISAT Math exam. An increase in real state PPE by one percent, two years prior to the ISAT Math exam, leads to an increase of about 20.59% students scoring in the passing range on the ISAT Math exam, on average, ceteris paribus. The two year lagged spending variable is significant at all levels of the data in the model.

The log of real state PPE, three years prior to the ISAT Math exam, is significant and positively affects students passing the ISAT Math exam. An increase in real state PPE by one percent, three years prior to the ISAT Math exam, leads to an increase of about 27.47% students scoring in the passing range on the ISAT Math exam, on average, ceteris paribus. The three year lagged spending variable is significant at all levels of the data in the model. As the F statistic shows, the model is significant at the 95% confidence interval.

7. Concluding Remarks: Policy Implications and Further Research

From the results, it is shown state funding in Idaho from 2007 to 2013 affected student achievement. Specifically, state funds in Idaho have a positive and significant impact on students passing the ISAT Math exam. As state funds have fallen over the years, other sources of funding have been varied to account for the offset, but not, on average, very successfully. As far as policy implications go, increasing funding is likely to increase student achievement on the ISAT Math exam; decreasing funding will likely have the opposite effect on student achievement on ISAT Math exam.

Further research could look at the ISAT Reading exam over the same period (2007 – 2013).

If an analysis of the ISAT Reading exam were to take place, with the same methods utilized in this research, then the results of the ISAT Math exam could be compared and the popular sentiment of mathematic scores being a better indicator could be examined explicitly.

Moving from ISAT, observing another state with a similar composition to Idaho, over this same period (2007 – 2013), could help to build an idea of how rural states have reacted to, and fared since, the financial crisis of 07 – 08. A limiting factor of this analysis is in locating a data source that covers a region for an extended amount of time. Often, sources can be found, but at some point, the metrics and administration processes of an examination undergo fundamental changes which makes comparing their previous results to more recent results ineffective. So, a word of caution in pursuing this as finding a method of measurement, over time, which is consistent at all points during that time, is imperative to proper explication.

Rarely, if ever, is a problem as simple to solve as throwing more money at it; there are other facets of interest toward this problem. The first that comes to mind is the efficiency of money in Idaho public school districts. It might take some time to see the effect of student achievement from changes in finances. From Table 6.5 and 6.6, it seems to take about 3 years for the money to have the largest impact on student achievement. This doesn't seem unreasonable, but perhaps there is some way to optimize the spending so the funding takes effect more quickly.

All said, these results unequivocally show that throwing money at this problem is an option likely to lend positive results toward student achievement on the ISAT Math exam. It would be in the interest of students to receive more funding toward passing the ISAT Math exam and policy makers should evaluate the level of finance changes, by district, necessary to address this issue.

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Appendix A

Variable Explanations

Variable Title	Description	Creation Method	Source
Day	Binary variable indiciating if a district had a 4-day school week schedule	Reported	Idaho Kids Count
Af. Am. Prof.	Percent of proficient for Black / African American tested	Reported	Idaho SDE
AllA	Percent of advanced for all tested	Reported	Idaho SDE Formal Request
AllB	Percent of basic for all tested	Reported	Idaho SDE Formal Request
AllBB	Percent of below basic for all tested	Reported	Idaho SDE Formal Request
Prof.	Percent of proficient for all tested	Reported	Idaho SDE Formal Request
Asian Prof.	Percent of proficient for Asian or Pacific Islander tested	Reported	Idaho SDE
Fail	Percent of failing (scoring basic or below basic) for all tested	AllB + AllBB	Idaho SDE Formal Request
Female Prof.	Percent of proficient for Females tested	Reported	Idaho SDE
FRL	Number of students participating in a district's free or reduced lunch program	Reported	Idaho Kids Count
FRLProp	Proportion of students participating in a district's free or reduced lunch program	FRL / Mem	Idaho Kids Count & Idaho SDE Formal Request
Hisp. Lat. Prof.	Percent of proficient for Hispanic or Latino tested	Reported	Idaho SDE
InfFed	Federal revenue inflated to FY13 (Jul-Jun) dollars	InfFY13 * Federal Revenue	Idaho SDE Formal Request & Bureau of Labor Statistics
InfFY13	Index for Inflation in a fiscal year with fiscal year 2013 as the base year (Jul-Jun)	Average CPI for FY13 divided by the average CPI for the year in question	Bureau of Labor Statistics
InfState	State revenue inflated to FY13 (Jul-Jun) dollars	InfFY13 * State Revenue	Idaho SDE Formal Request & Bureau of Labor Statistics
InfStatePPE	State revenue inflated to FY13 (Jul-Jun) dollars, per-pupil	(InfFY13 * State Revenue) / Mem	Idaho SDE Formal Request & Bureau of Labor Statistics
InfTotPPE	Total district expenditure inflated to 2013 dollars, per-pupil	(InfFY13 * Total Expenditure) / Mem	Idaho SDE Formal Request & Bureau of Labor Statistics
LInfFed	Logarithm of federal revenue inflated to FY13 (Jul-Jun) dollars	log(InfFY13 * Federal Revenue)	Idaho SDE Formal Request & Bureau of Labor Statistics
LInfFedPPE	Logarithm of federal revenue inflated to FY13 (Jul-Jun) dollars, per-pupil	log((InfFY13 * Federal Revenue) / Mem)	Idaho SDE Formal Request & Bureau of Labor Statistics
LInfState	Logarithim of state revenue inflated to FY13 (Jul-Jun) dollars	Log(InfFY13 * State Revenue)	Idaho SDE Formal Request & Bureau of Labor Statistics
LInfStatePPE	Logarithim of State revenue inflated to FY13 (Jul-Jun) dollars, per-pupil	log((InfFY13 * State Revenue) / Mem)	Idaho SDE Formal Request & Bureau of Labor Statistics
Male Prof.	Percent of proficient for Males tested	Reported	Idaho SDE
Mem	Average daily attendance in a district	Reported	Idaho SDE Formal Request
MemIQR1	Average daily attendance of students in districts distributed in the first quartile of the data	Stata programming (available in appendix B)	Idaho SDE Formal Request
MemIQR2	Average daily attendance of students in districts distributed in the second quartile of the data	Stata programming (available in appendix B)	Idaho SDE Formal Request
MemIQR3	Average daily attendance of students in districts distributed in the third quartile of the data	Stata programming (available in appendix B)	Idaho SDE Formal Request
MemIQR4	Average daily attendance of students in districts distributed in the fourth quartile of the data	Stata programming (available in appendix B)	Idaho SDE Formal Request

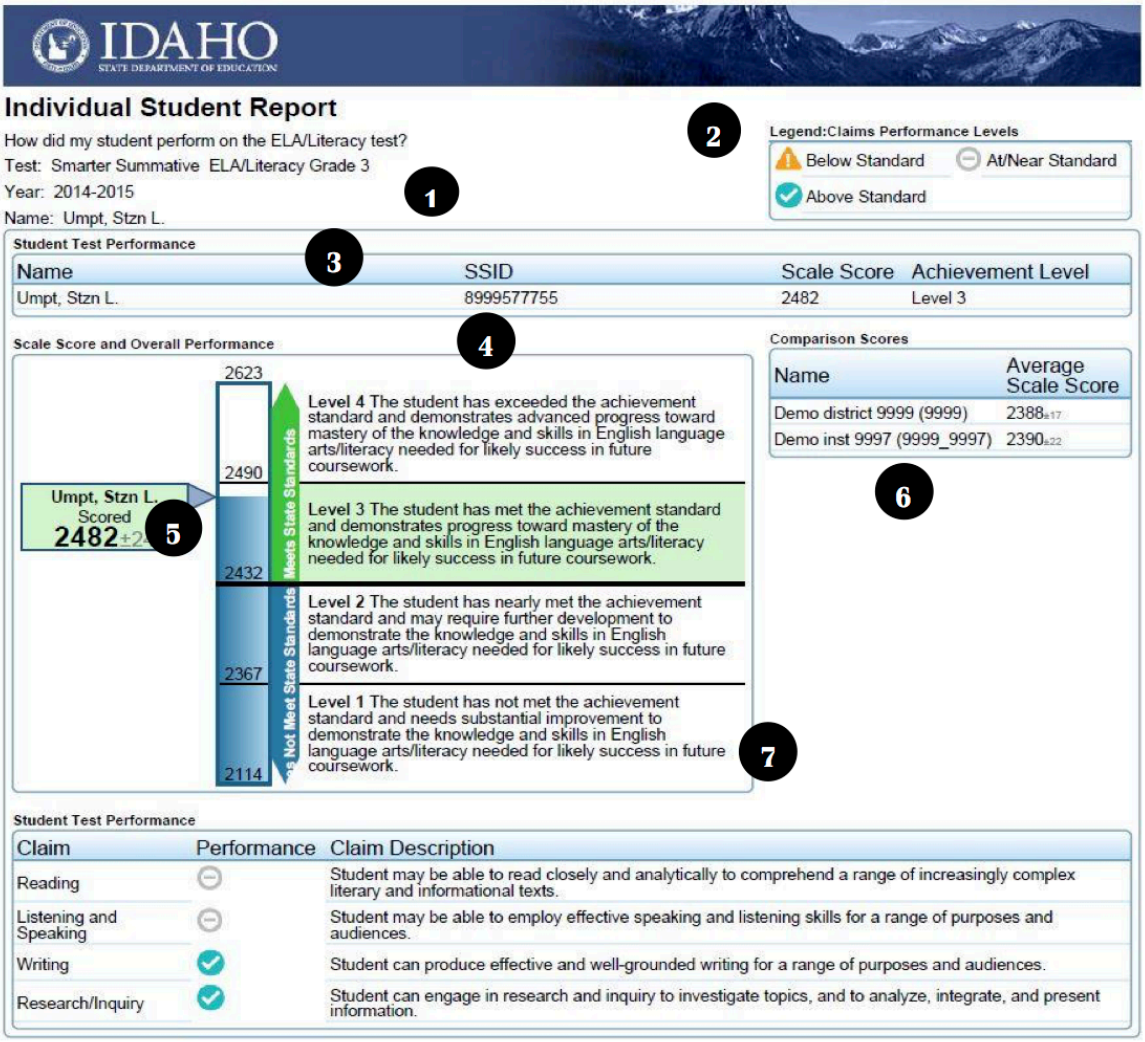
Variable Title	Description	Creation Method	Source
Nat. Am. Prof.	Percent of proficient for American Indian or Alaskan Native tested	Reported	Idaho SDE
Pac. Isl. Prof.	Average scaled score for all Native Hawaiian / Other Pacific Islander tested	Reported	Idaho SDE
Pass	Percent of passing (scoring proficient or advanded) for all tested	AllA + AllP	Idaho SDE Formal Request
Pov	Estimate from US Census of the population aged 5 to 17 years living in poverty in a district	Reported	US Census Bureau
PovProp	Proportion of students in poverty in a district	Pov / Mem	US Census Bureau & Idaho SDE Formal Request
White Prof.	Percent of proficient for White tested	Reported	Idaho SDE

Appendix B

Threshold Achievement Level Descriptors Grade 3 Mathematics: Proficient Questions	
CONCEPTS AND PROCEDURES Targets A, B, C, and D: Operations and Algebraic Thinking	• Select the appropriate operation to solve one-step problems involving equal groups and arrays. • Use the properties of operations to multiply within the 10 by 10 multiplication table. • Fluently multiply within 100. • Solve two-step problems using addition and subtraction with numbers larger than 100 and solutions within 1,000.
CONCEPTS AND PROCEDURES Target E: Number and Operations – Base Ten	• Fluently add within 1,000, using strategies or algorithms based on place value understanding, properties of arithmetic, and/or the relationship between addition and subtraction.
CONCEPTS AND PROCEDURES Target F: Number and Operations– Fractions	• Represent a fraction on a number line with partitioning.
CONCEPTS AND PROCEDURES Targets G and I: Measurement and Data	• Estimate liquid volumes and masses of objects using standard units of grams, kilograms, and liters. • Find the area of a rectilinear figure by multiplying side lengths and by decomposing a rectilinear figure into non-overlapping rectangles and adding them together.
CONCEPTS AND PROCEDURES Targets H and J: Measurement and Data	• Generate measurement data by measuring length using rulers marked with quarter- inch intervals and represent the data on a line plot marked with quarter-inch intervals. • Solve word problems involving perimeters of polygons.
CONCEPTS AND PROCEDURES Target K: Geometry	• Draw examples of quadrilaterals that do not belong to given subcategories by reasoning about their attributes.
PROBLEM SOLVING & MODELING AND DATA ANALYSIS	• Use appropriate tools to accurately solve problems arising in everyday life, society, and the workplace. • Apply mathematics to solve problems by identifying important quantities and mapping their relationship and by stating and using logical assumptions.
COMMUNICATING REASONING	• Use stated assumptions, definitions, and previously established results and examples to identify and repair a flawed argument. • Use previous information to support his or her own reasoning on a routine problem.

Appendix C

Parent Brochure



IDAHO
STATE DEPARTMENT OF EDUCATION

Individual Student Report

How did my student perform on the ELA/Literacy test?
Test: Smarter Summative ELA/Literacy Grade 3
Year: 2014-2015
Name: Umpt, Stzn L.

1

2

Legend:Claims Performance Levels
Below Standard
At/Near Standard
Above Standard

Student Test Performance

3

Name	SSID	Scale Score	Achievement Level
Umpt, Stzn L.	8999577755	2482	Level 3

Scale Score and Overall Performance

4

2623
2490
2432
2367
2114

Meets State Standards
Does Not Meet State Standards

Umpt, Stzn L. Scored 2482±22

5

Level 4 The student has exceeded the achievement standard and demonstrates advanced progress toward mastery of the knowledge and skills in English language arts/literacy needed for likely success in future coursework.

Level 3 The student has met the achievement standard and demonstrates progress toward mastery of the knowledge and skills in English language arts/literacy needed for likely success in future coursework.

Level 2 The student has nearly met the achievement standard and may require further development to demonstrate the knowledge and skills in English language arts/literacy needed for likely success in future coursework.

Level 1 The student has not met the achievement standard and needs substantial improvement to demonstrate the knowledge and skills in English language arts/literacy needed for likely success in future coursework.

7

Comparison Scores

6

Name	Average Scale Score
Demo district 9999 (9999)	2388±17
Demo inst 9997 (9999_9997)	2390±22

Student Test Performance

Claim	Performance	Claim Description
Reading	=	Student may be able to read closely and analytically to comprehend a range of increasingly complex literary and informational texts.
Listening and Speaking	=	Student may be able to employ effective speaking and listening skills for a range of purposes and audiences.
Writing	✓	Student can produce effective and well-grounded writing for a range of purposes and audiences.
Research/Inquiry	✓	Student can engage in research and inquiry to investigate topics, and to analyze, integrate, and present information.

Understanding the ISAT Math and ELA/Literacy Individual Student Report

1. Displays the name of the test, year and student's name
2. Displays the legend for the Performance Levels of the Claims; Claims are related to groups of Standards
3. Displays a summary of the student's name, student identification number, date of testing, scale score, standard error of measurement (+), and overall achievement level.
4. Graphic shows the four achievement levels and descriptions, with the individual student score.
5. Student scale score and the standard error. The *standard error of measurement* shows the difference expected if a student tested multiple times with the same assessment.
6. Comparison scores show this student's proficiency, in comparison to their school, district, and the state.
7. Displays the Claim title, this student's assessment claim performance, and claim description. The performance levels shown by ✓, =, or ! indicate the degree to which this claim contributed to the overall scale score. A claim at or above the standard contributes more positively to a higher scale score and proficiency level.

NOTES

Notes from defense: