DISTRICT CHARACTERISTICS: WHAT FACTORS IMPACT STUDENT ACHIEVEMENT?

Jay Pennington, Chief
Bureau of Planning, Research, Development and Evaluation Services

The Iowa Department of Education undertook a study to determine district characteristics that are associated with success on statewide-standardized tests. A district profile was created in order to determine if any association exists between districts characteristics and the test scores of 11th grade students.

This study examined the relation between district size and student achievement, using statewide student achievement data collected for AYP accountability decisions. Results of the study led to the conclusion that "there is more to student achievement than the number of students in a district". This provided a grounding context for additional studies in this issue.

Background—The Iowa Department of Education undertook a study to determine district characteristics that are associated with success on statewide-standardized tests. A district profile was created for each Iowa public school district to determine if any association exists between a particular district's characteristics and the test scores of 11th grade students. Contextual variables such as socioeconomic indicators, enrollment, and diversity in a district, were examined. Resource variables, such as teacher and administrator experience, as well as per pupil expenditures, were viewed to see how these might impact student achievement.

Recently, the media has made attempts at differentiating districts, such as trying to determine if patterns exist that can predict student success. These studies have not used statistical tools in order to measure the impact of the noted results. It is important to use sound methodology and rigorous analyses in order to be able to quantify the impact of such studies.

Research Questions:

- Is it possible to build a district profile which can provide insight into the factors that impact results of standardized tests?
- Does district size have a correlation with achievement?
- Do district demographic characteristics, such as minority percentage, number of English language learners or number of students with an individualized treatment plan, have an association?
- What impact does per-pupil expenditures by district have on student achievement?
- What role does a poverty indicator, such as free or reduced lunch have on levels of student achievement?

- Does more course opportunity make a difference in test results?
- Does access to more rigorous or higher-level courses have any relationship to success on standardized tests?
- Does teacher or principal experience play a role in achievement levels?

Methodology—A cross-section of variables was assembled that represents a profile of information about each district. All data were compiled for the 2005-2006 and 2006-2007 school years for each district. Multiple years were analyzed in order to verify results and ensure findings were not due to variability that could be determined by studying only one year of data.

Variables include:

- District score of 11th graders in math, reading, and science on the Iowa Test of Educational Development
- Number of math, reading, and science courses offered
- Number of higher-level math, reading and science courses offered
- Student enrollment
- Percent minority
- Percent of English language learners
- Percent of students with an individualized education plan (IEP)
- Percent free or reduced lunch
- Teacher experience in math, English, and science
- Principal experience
- Per pupil expenditures
- Location (Rural, Town, Suburban, Urban)

Iowa has multiple statewide testing periods, and each district selects its own date for testing. As a result of multiple testing periods, there are a different set of standard scores for each period: fall, midyear, and spring. In order to accommodate for the difference in scores and norms an overall district score was created. An average test result was computed and converted to a z-score to allow for comparisons across testing periods. A district score was generated for 2005-2006 and 2006-2007 for each subject area of math, reading, and science. The district score represents the achievement levels for the average student in a district.

A correlation matrix was used to determine, by the subject areas of math, reading, and science, if an association exists between district achievement score and other district characteristics. The matrix was examined to see which variables indicated a significant association with achievement levels. Significant correlations between independent variables are also reported. Six multiple regression models were created to see which variables could predict district success on statewide-standardized test results in math, reading and science. The district score by subject area was the dependent variable. Finally, in order to further explore the relationship between district variables and achievement, student level scores were analyzed.

Results—Table 1 includes correlations between the three dependent variables for the 2005-2006 and 2006-2007 school years. Each column represents the correlation between district score in math, reading and science and the contextual and resource variables. Results

marked with asterisks are statistically significant. All other variables did not produce significant correlations with district score.

Table 1—Correlation with Dependent Variables

2005-2006 SCHOOL YEAR	MATH	READING	SCIENCE
Contextual Variables			
a. District Size	0.05	0.05	0.11
b. Percent Free or Reduced Lunch	-0.43*	-0.37*	-0.42*
c. Percent IEP	-0.320*	-0.251*	-0.222*
Resource Variables			
d. Per pupil Expenditures	-0.32*	-0.24*	-0.22*
2006-2007 SCHOOL YEAR	**MATH**	**READING**	**SCIENCE**
Contextual Variables			
a. District Size	0.04	0.09	0.13*
b. Percent Free or Reduced Lunch	-0.47*	-0.41*	-0.45*
c. Percent IEP	-0.33*	-0.30*	-0.27*
Resource Variables			
d. Per pupil Expenditures	-0.19*	-0.21*	-0.18*

Source: Iowa Department of Education, Planning, Research, Development and Evaluation Services.
Note: *All correlations are statistically significant, ($p<.05$), Spearman

During the multiple school years studied, district percentage of free or reduced lunch (FRL) was significantly correlated with district scores in math, reading and science. The negative correlation indicates that as the percentage of students eligible for FRL goes down, average scores go up.

District per pupil expenditures and percentage of students with an individualized education plan (IEP) were also negatively associated with success on standardized tests. It appears odd that as a district spends more dollars per student, test scores go down. However, districts with larger percentages of students with an IEP also have higher expenditures than those with a smaller percentage of students with an IEP. Thus, it is appears that there is an interaction effect between the number of students with an IEP and per pupil expenditures. Future studies will examine this phenomenon further by breaking out district expenditures on students with and without an IEP.

The size of a district appears to have mixed results in student achievement across the multiple years is studied. In 2006-2007, only science scores were correlated with district size. This suggests that district size needs to be studied further in order to determine the role it plays on results of statewide-standardized tests.

Next, multiple regression models were created in order to determine which contextual and resource variables could predict success on ITED in the subject areas of math, reading, and science. Appendix A displays the results of six regression analyses. A model was created for each subject area for both the 2005-2006 and 2006-2007 school years.

Consistently, across all regression models, the percentage of student eligible for free or reduce lunch predicted achievement results. In a few instances, the percentage of students with an IEP was also associated with achievement. However, the poverty indicator of free or reduced lunch was able to explain more of the variance in test scores than the percentage of IEP.

In 2006-2007, for both math and reading, per pupil expenditures was a statistically significant predictor of test results. Lastly, in one regression model examining 2005-2006 reading scores, the experience of the high school administrator also predicted achievement. This appears to be an outlier, and in all other models none of the other independent variables were predictive of district achievement.

Lastly, other district profile characteristics were examined in order to gauge their impact on achievement levels. A second correlation matrix was created in order to examine the association between independent variables. Table 2 shows the results. These were reported in order to examine if multi-colinearity exists between variables.

Table 2—Correlation between Select Independent Variables

VARIABLE 1	VARIABLE 2	RESULTS
District Size	Percent Minority	2005-2006 = 0.51 2006-2007 = 0.49
District Size	Percent Free or Reduced Lunch	2005-2006 = -0.16 2006-2007 = 0.49
District Size	Per Pupil Expenditures	2005-2006 = -0.35 2006-2007 = -0.32
District Size	Course Offerings	2005-2006 Math = 0.54 Reading = 0.56 Science = 0.62 2006-2007 Math = 0.55 Reading = 0.63 Science = 0.58
District Size	Higher Level Course Offerings	2005-2006 Math = 0.44 Reading = 0.43 Science = 0.52 2006-2007 Math = 0.48 Reading = 0.46 Science = 0.51
Percent IEP	Per Pupil Expenditures	2005-2006 = 0.33 2006-2007 = 0.35

Source: Iowa Department of Education, Planning, Research and Evaluation Services.
Note: *All correlations are statistically significant, (p<.05)

The size of a district was correlated with a number of other district characteristics. It is not surprising that the larger the district, the higher the percentage of minority students. Lastly, district size was negatively correlated with per pupil expenditures. Small districts have to spend more in order to meet the minimum accreditation standards required by law. District size was not correlated with the percentage of IEP.

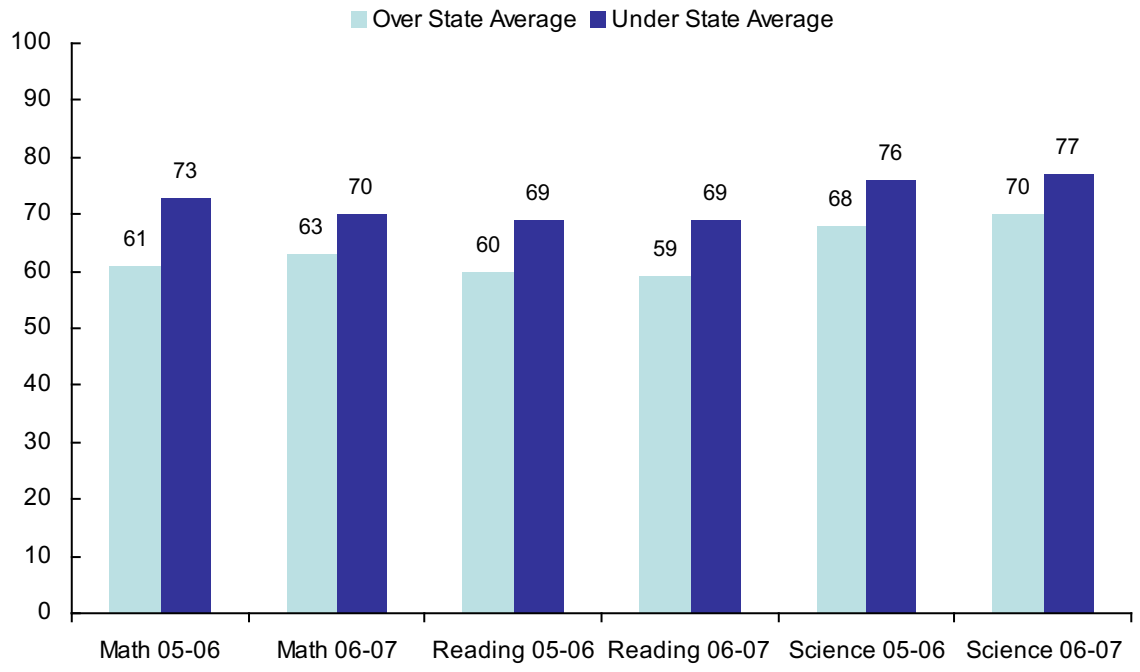
It also appears that students who attend larger districts have access to more course offerings as well as higher-level courses in the subject areas of math, reading, and science. However, access to more courses and rigorous courses in this study were not correlated and did not predict higher levels of achievement. A student must not only have access to courses but must take these courses in order to have an impact on achievement levels.

As expected, the district percentage of students with an IEP was positively correlated with per pupil expenditures. Districts that have more students with special needs generally have higher expenditures. Logically, it would make sense that higher expenditures would result in higher test scores. Future studies will separate general and special education expenditures in order to scrutinize these findings.

Student test scores were broken into two groups in order to illustrate the impact of free or reduced lunch eligibility on achievement levels. Group one represents test scores for students in a district that is above the statewide average for free or reduced lunch. Group two includes all student test scores for districts under the state average of free or reduced lunch eligibility. Test scores for students were averaged and converted to a percentile rank for each group. This method was completed for each testing period (fall, mid-year and spring) in order to account for the different set of norms used at each assessment time.

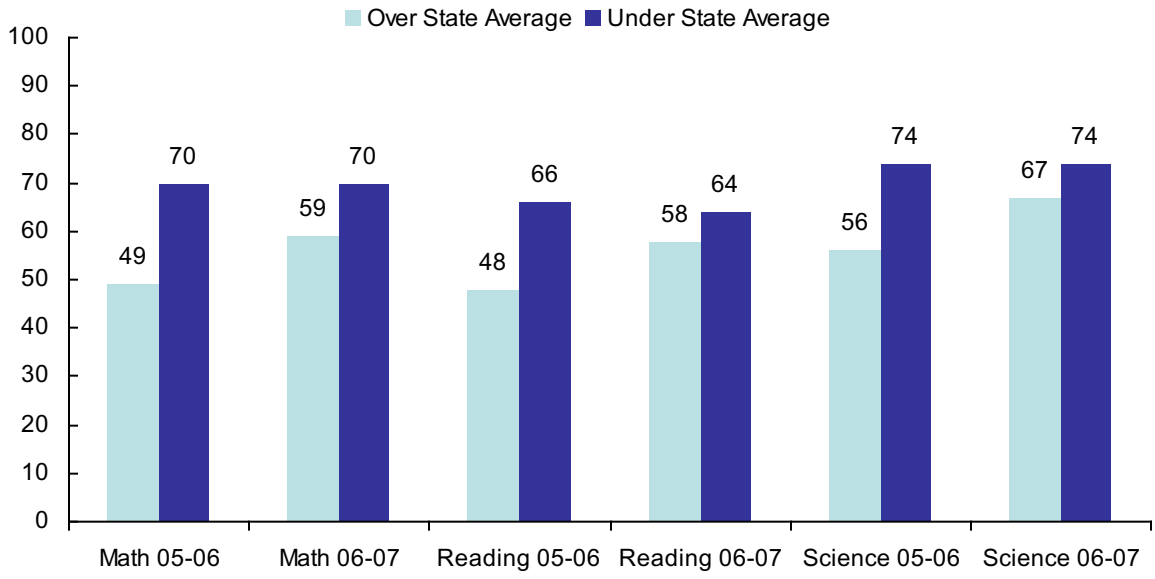
Figures 1, 2, and 3 show the difference between percentile ranks for students in a district that are over and under the state average of free or reduced lunch eligibility. The differences in the average test score rankings are apparent across subject areas, assessment time, and multiple years. The figures underscore the impact of indicators of socioeconomic status on student achievement. Students in districts that are under the state average percentage of eligibility for free or reduced lunch rank higher on statewide-standardized tests.

Figure 1—Free or Reduced Lunch Fall Testing - National Percentile Rank



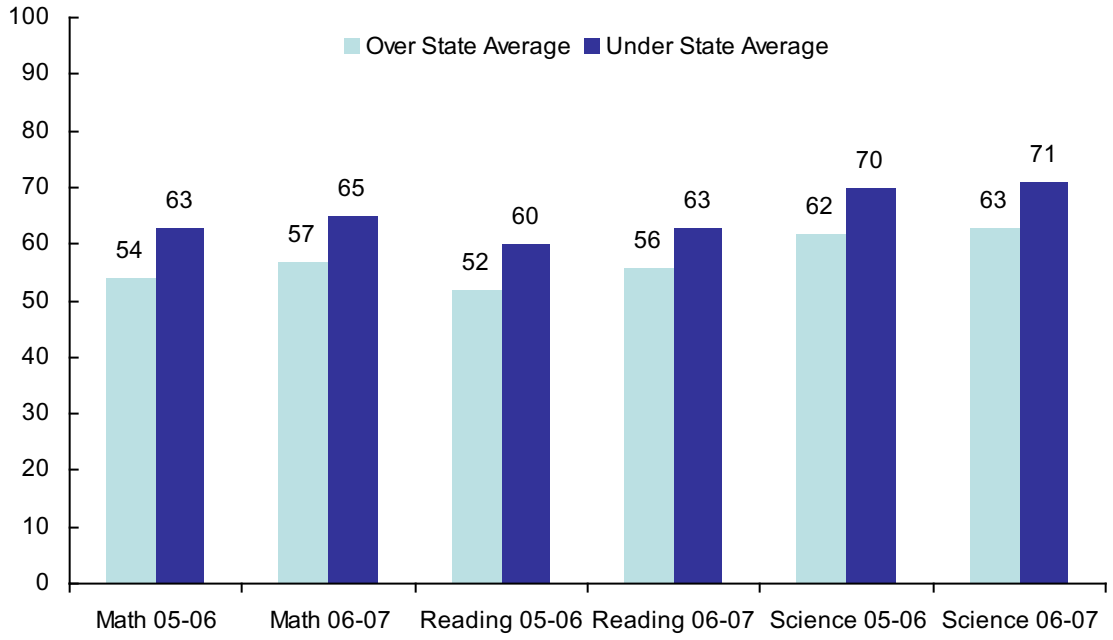
Source: Iowa Department of Education.

Figure 2—Free or Reduced Lunch Mid-Year Testing - National Percentile Rank



Source: Iowa Department of Education.

Figure 3—Free or Reduced Lunch Spring Testing - National Percentile Rank



Source: Iowa Department of Education.

Conclusion—This study examined district traits across multiple years in order to determine their impact on student achievement levels. Overwhelmingly, the poverty indicator of free or reduced lunch appeared to have the most impact on test score levels. Interestingly, expenditures were negatively correlated with achievement levels. This study confirmed results of other studies which have reported the relationship between school characteristic and resources and student achievement (Greenwald, Hedges, Lane, 1996; Fetler, 2001; Wiggan, 2007).

In relation to test scores, the size of a district had mixed results in both 2005-2006 and 2006-2007 school years. In both years, district size was not significantly correlated with ITED mathematics scores. However, in 2006-2007, both science and reading test scores were significantly correlated with the size of a district. These mixed results suggest that district size characteristics must be studied in further detail.

To determine how spending and programs can positively impact student achievement, it is important look to at other characteristics, such as examining the support within a school district. Further, there are Iowa schools districts that have poverty levels that do well. It is important to examine these examples and replicate their success.

Further, future studies must examine characteristics at the student level as well as at the district level. Examining individual student traits in the appropriate milieu is critical to understanding what can impact student achievement. These results will assist educators, district administrators, and policy makers in implementing appropriate interventions.

This study was undertaken as the beginning in a series of research papers that examine these issues in depth. The results of this study do not suggest that there is a “silver bullet” which can explain the characteristics of a district and how these impact student achievement. Ostensibly, this study is the foundation of a line of inquiry to assist in furthering the discussion on what characteristics are important to achieving student success.

REFERENCES

Fetler, M. (2001). *Student Mathematics Achievement Test Scores, Dropout Rates, and Teacher Characteristics.* Teacher Education Quarterly, Winter, 151-168.

Greenwald, R., L. Hedges, R. Laine, (1996). *The Effect of School Resources on Student Achievement, Review of Educational Research*, v66 n3 p361-96.

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APPENDIX A

Table 3—2005-2006 Mathematics Regression (F =8.15, DF = 11, R^2 = 0.23)

PREDICTORS	RAW	STANDARDIZED
Free or Reduced Lunch	-3.739*	-0.410*
Percent IEP	-5.437*	-0.170*
Percent LEP	-0.011	-0.051
Percent Minority	0.983	0.087
District Size	0.021	0.025
District Location	-0.010	-0.014
Per pupil Expenditures	0.000	0.053
Number of Math Courses	-0.028	-0.068
Number of Higher Level Math Courses	0.011	0.012
Teaching Experience	0.012	0.087
Principal Teaching Experience	0.004	0.038
Intercept	1.346	0

Source: Iowa Department of Education.
Note: *p < .05

Table 4—2006-2007 Mathematics Regression (F =9.93, DF = 11, R^2 = 0.27)

PREDICTORS	RAW	STANDARDIZED
Free or Reduced Lunch	-4.583*	-0.533*
Percent IEP	-2.903	-0.101
Percent LEP	-0.007	-0.014
Percent Minority	1.175	0.115
District Size	-0.006	-0.007
District Location	-0.060	-0.048
Per pupil Expenditures	0.000	0.059
Number of Math Courses	0.002	0.006
Number of Higher Level Math Courses	0.021	0.025
Teaching Experience	-0.003	-0.010
Principal Teaching Experience	0.003	-0.070
Intercept	1.417	0

Source: Iowa Department of Education.
Note: *p < .05

Table 5—2005-2006 Reading Regression (F =5.34, DF = 11, R^2 = 0.16)

PREDICTORS	RAW	STANDARDIZED
Free or Reduced Lunch	-3.206*	-0.348*
Percent IEP	-3.592	-0.111
Percent LEP	0.000	-0.002
Percent Minority	0.645	0.056
District Size	-0.083	-0.097
District Location	-0.051	-0.069
Per pupil Expenditures	-0.000	-0.020
Number of English Courses	0.010	0.029
Number of Higher Level English Courses	0.022	0.037
Teaching Experience	-0.005	-0.032
Principal Teaching Experience	0.012*	0.108*
Intercept	1.727	0

Source: Iowa Department of Education.
Note: *p < .05

Table 6—2006-2007 Reading Regression (F =10.39, DF = 11, R^2 = 0.27)

PREDICTORS	RAW	STANDARDIZED
Free or Reduced Lunch	-3.448*	-0.379*
Percent IEP	-3.603*	-0.116*
Percent LEP	-0.021	-0.110
Percent Minority	2.312	0.208
District Size	-0.051	0.059
District Location	-0.009	0.007
Per pupil Expenditures	-0.000*	-0.163*
Number of English Courses	0.019	0.002
Number of Higher Level Reading Courses	0.042	0.022
Teaching Experience	0.019	0.126
Principal Teaching Experience	-0.002	-0.019
Intercept	2.216	0

Source: Iowa Department of Education.
Note: *p < .05

Table 7—2005-2006 Science Regression (F = 6.67, DF = 11, R^2 = 0.19)

PREDICTORS	RAW	STANDARDIZED
Free or Reduced Lunch	-3.803*	-0.380*
Percent IEP	-2.891	-0.089
Percent LEP	-0.019	-0.092
Percent Minority	1.414	0.124
District Size	0.004	0.006
District Location	-0.030	-0.040
Per pupil Expenditures	0.000	0.022
Number of Science Courses	-0.017	-0.039
Number of Higher Level Science Courses	0.016	0.017
Teaching Experience	0.002	0.018
Principal Teaching Experience	0.003	0.026
Intercept	1.444	0

Source: Iowa Department of Education.
Note: *p < .05

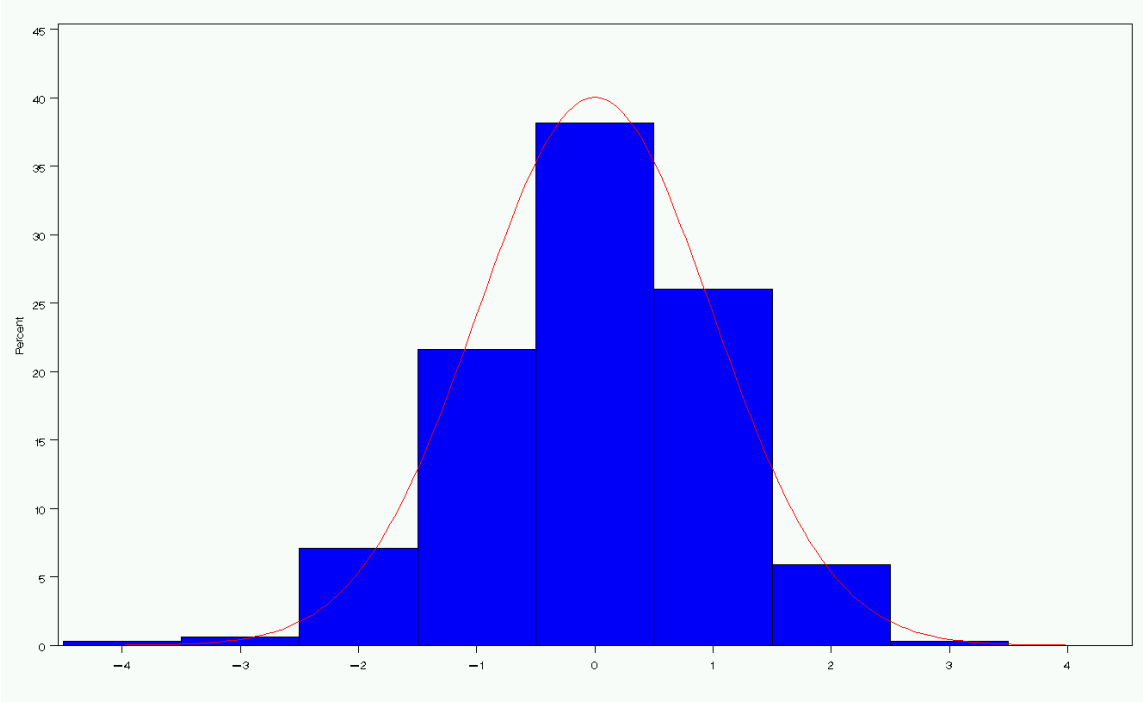
Table 8—2006-2007 Science Test Results (F = 8.99, DF = 11, R^2 = 0.25)

PREDICTORS	RAW	STANDARDIZED
Free or Reduced Lunch	-4.320*	-0.468*
Percent IEP	-3.917*	-0.125*
Percent LEP	-0.000	-0.002
Percent Minority	0.467	0.042
District Size	0.010	0.012
District Location	-0.027	-0.020
Per pupil Expenditures	0.000*	0.157*
Number of Science Courses	0.009	0.020
Number of Higher Level Science Courses	0.124	0.141
Teaching Experience	0.004	0.032
Principal Teaching Experience	-0.007	-0.058
Intercept	0.298	0

Source: Iowa Department of Education.
Note: *p < .05

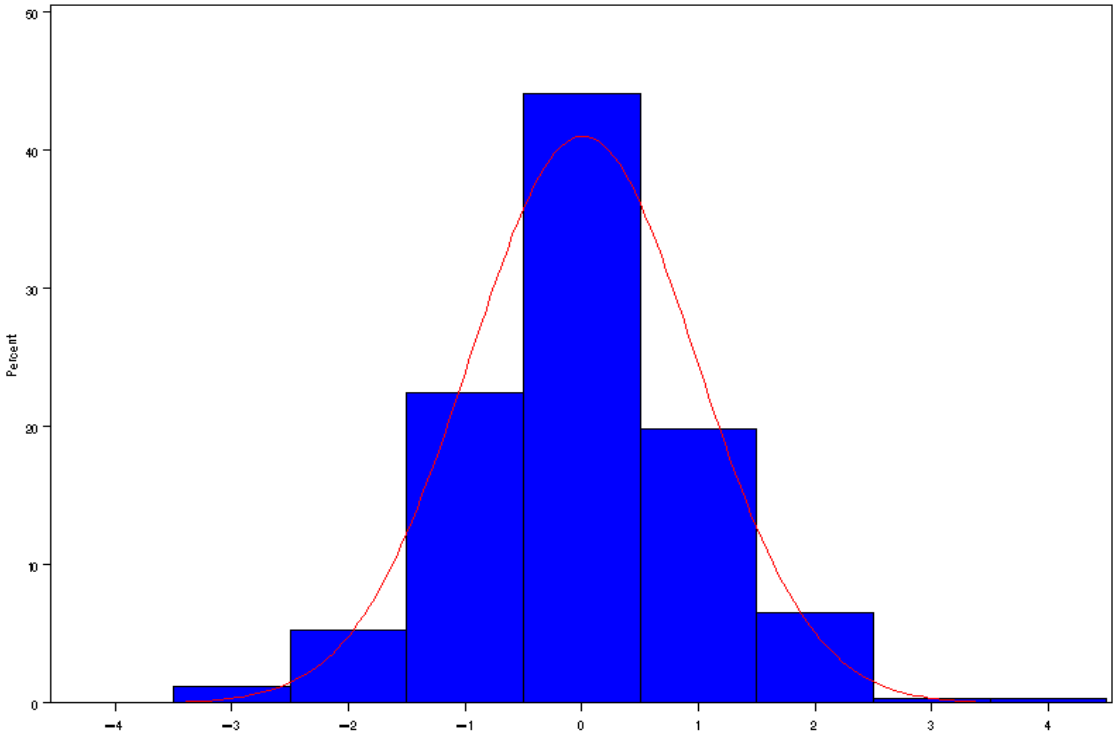
APPENDIX B

Figure 4—2005-2006 Mathematics Score Distribution (x =.002, sd = .998)



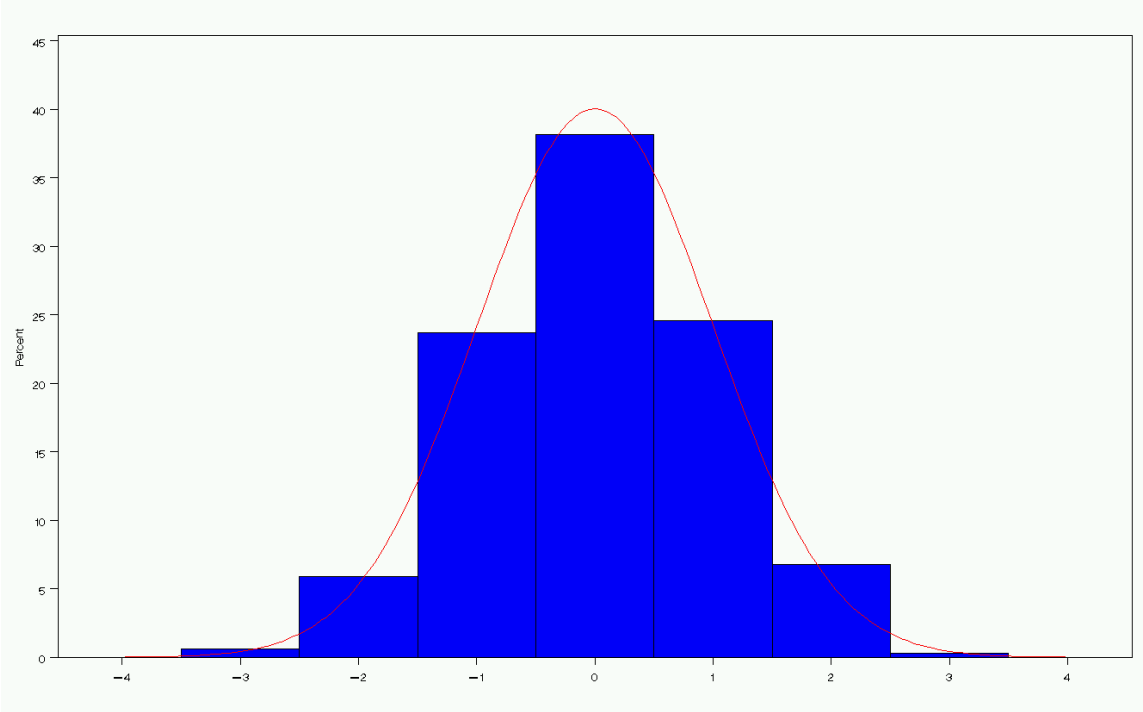
Source: Iowa Department of Education.

Figure 5—2005-2006 Reading Score Distribution (x = .012, sd = .974)



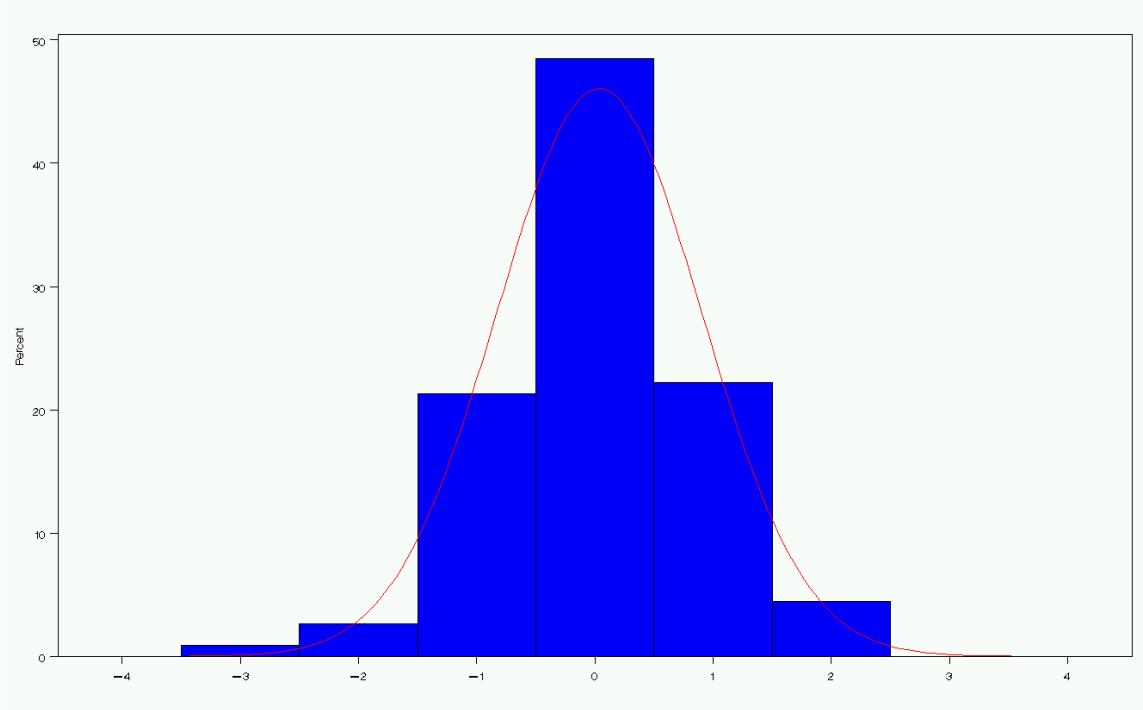
Source: Iowa Department of Education.

Figure 6 —2005-2006 Science Score Distribution (x = .002, sd = .998)



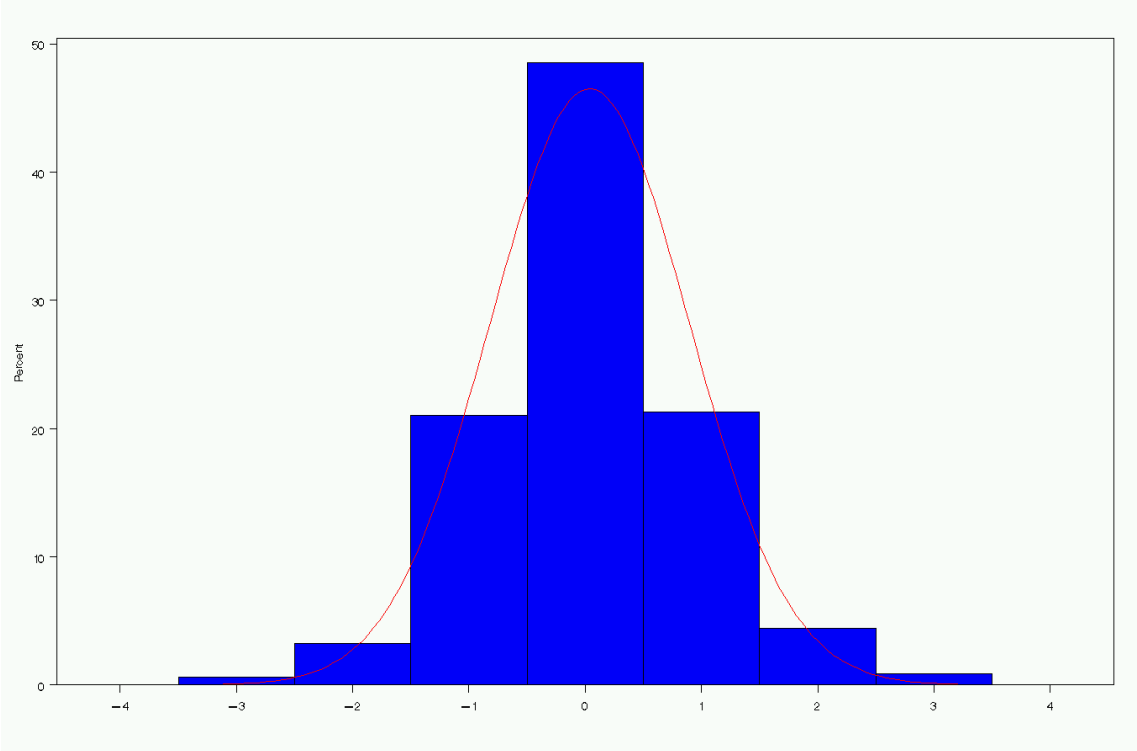
Source: Iowa Department of Education.

Figure 7—2006-2007 Mathematics Score Distribution (x = .038, sd = .868)



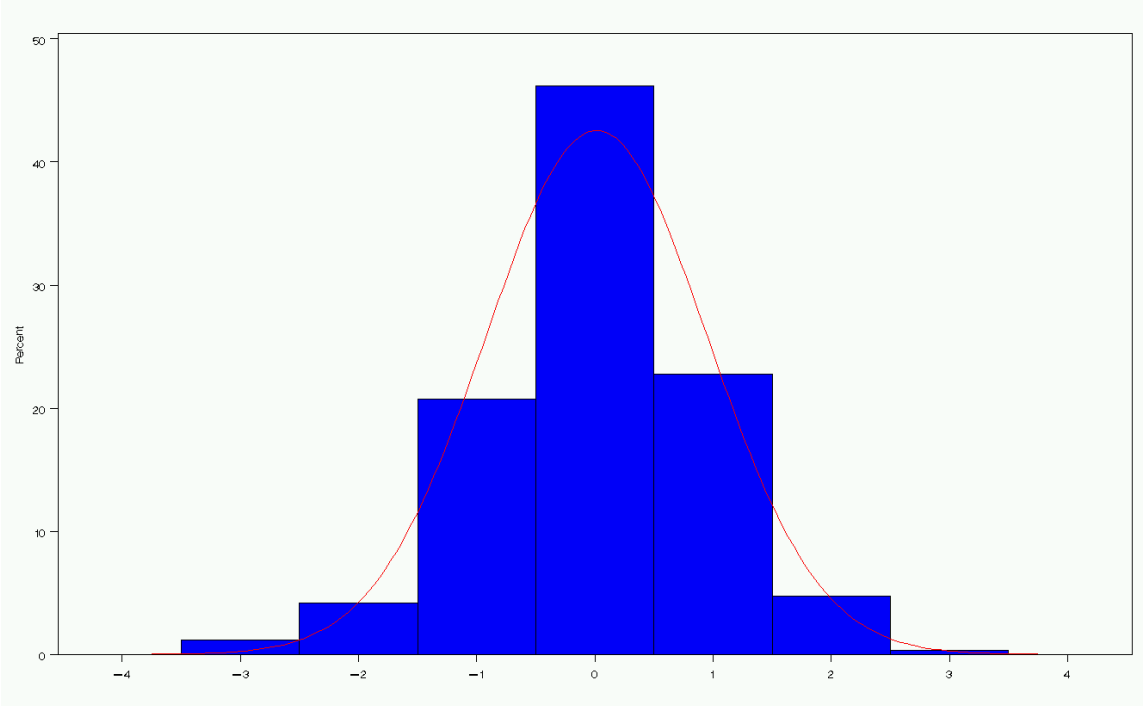
Source: Iowa Department of Education.

Figure 8—2006-2007 Reading Score Distribution (x=.039, sd = .859)



Source: Iowa Department of Education.

Figure 9—2006-2007 Science Score Distribution (x=.015, sd = .939)



Source: Iowa Department of Education.