LITERACY, NUMERACY, & SCIENCE LITERACY: ANALYSIS USING CSAP

SUMMARY

At our last professional development day meeting, I mentioned my study of student achievement in reading, math, and science using CSAP data. In the brief descriptions that follow, I share with you my preliminary findings. The **results show statistically significant correlations between science and reading achievement**.

RESULTS USING STATE & BVSD SUMMARY (N = 45) FROM 2000 – 2003

A quick analysis of Grade 8 students' performance in the State and our district (N = 45) in reading, math, and science achievement (using proficient & advanced category) shows expected high correlations: math & reading = 0.9, math & science = 0.94, and reading and science = 0.97. The scatter plots are almost straight lines with a *positive slope*, i.e., *improving student performance in one will result in the increase in the performance of the other*. A one-way ANOVA shows that the average performance (based on proficient & advanced categories) has improved but *not* "statistically significantly." Statistically significant means, although we see some increase in the average performance across the State (or our school), this change in performance cannot yet be quantified as an upward (or downward) trend or we cannot yet "truly" say that student achievement has improved (or worsened) over the years. The average performance in 2000, 2001, 2002, and 2003 are: Reading - **78** (53), **81** (63), **82** (55); Math - **67** (26), **67** (39), **69** (35), **70** (26); and Science - **58** (33), **58** (32), **58** (43), **60** (33). *The numbers in parenthesis are Angevine's average performance in the proficient & advanced category.*

Regression Analysis

Regression (or "driver analysis," to sound cool!) analyses are usually used to show how one variable (say science achievement) might be **predicted** from two or more variables (say reading and math achievement). Caveat: Regression analyses do not show cause-and-effect relationships! For instance, although all my results show statistically significant correlations between science and reading achievement, they do not show any causal relationships. (I am hoping, I can show this causal relationship using SEM "structural equation modeling" in the coming months).

A linear regression analysis with the State & BVSD data shows $R^2 = 0.96$. This means there is a 96% overlap between the variables, or we can account for 96% of the variance in science achievement from students' reading and math achievement. No surprise! The standardized coefficients (β) for math and reading are + 0.35 and + 0.65 respectively. These are slopes in the regression equation. In layman terms, *reading is 65%* (0.65/0.65 + 0.35) *more important in increasing science scores than math, which is 35%*, across these 45 subjects. Changing gears now to my own thesis (and bias): science learning and achievement can facilitate reading and math achievement significantly. Martin, Sexton, & Gerlovich (2001), have elaborated on the **remarkable similarities between the fundamental thinking skills used in science and reading**.

I now discuss the results of Angevine, Casey, and Summit Middle School's.

RESULTS USING ANGEVINE, CASEY, AND SUMMIT MIDDLE SCHOOLS

Fascinating Results

To carry my thesis forward, I analyzed Angevine (AMS), Casey (CMS), and Summit (SMS) middle schools' results, together and alone. AMS and CMS have somewhat similar populations and SMS is widely known to emphasize science learning. Ideally, I should take the individual results of the students in these schools, but to discover the general pattern, the overall school results would be sufficient.

Since socio-economic status is often cited as a factor that determines student achievement, I added the "free and reduced lunch" (FRL) data to the analysis. Although R^2 was 0.95, only reading and math achievement were statistically significant to predict science achievement. Switching science and reading as independent and dependent variables, I found R^2 was 0.96, and only FRL and science achievement were statistically significant. Analyzing all other permutations and combinations, with linear and partial correlations, it was surprising to see that science achievement alone shared a 98% overlap with reading achievement in these three schools!

At Angevine and Casey, only science achievement showed up statistically significant in the linear regression analysis. R^2 for Angevine was 0.90, Casey 0.99, and Summit, 1.00. This means, we can account for 90%, 99%, and 100% of the variance in the reading achievement at Angevine, Casey, and Summit using science achievement. Is Summit's science focus helping students make significant gains in reading and math?

Out of curiosity, I was also interested in Angevine students' performance over the past several years in CSAP as they moved from Grade 6 through Grade 8. One-way ANOVA results show measurable *upward trends* in the *science "partially proficient"* category and *downward trends* in the *math "unsatisfactory*" category. There were no measurable changes in reading.

More importantly, for Angevine the standardized coefficients (β) for math and science were + 0.97 and - 0.06 respectively. This means, ***science achievement is 106% more important in increasing reading achievement scores*** *than math, which* (for unexplained reasons) *decreases reading achievement by 6 %* ***for Angevine****.*

Some Questions

These results have left me wondering if students could have made more gains if our policy makers (including those responsible for NCLB), helped schools focus on "science literacy" and "numeracy" instead of "literacy" and "numeracy?" By focusing on "literacy" and "numeracy," several elementary schools conveniently skipped "science literacy" and instead concentrated on students' "literacy" and "numeracy." Science (according to NCLB) is going to be tested like language and math from 2007, and will impact schools' "AYP." Meanwhile, are we shortchanging our students?

Thank you Dave, Isobel, Mike, and Trina for letting me discuss some of these ideas with you during the past week, and thank you all for listening.

REFERENCE

Martin, R., Sexton, C., Gerlovich, J. (2001). *Teaching science for all students* (3rd ed.). Boston: Allyn and Bacon. p. 6, pp. 96-99, p. 351.