Performance of Gifted and Talented High School Students in Jeffco

An Exploratory Data Analysis

February, 2012

The Issue

- In recent years, Jeffco has identified almost 9,000 students as gifted and talented, on the basis of state legislation and guidelines.
- Even a rough estimate suggests that, between parents and grandparents, over 20,000 adults are likely very interested in how well our schools are serving these children. Their interest is exactly analogous to the extra burden of responsibility felt by the parents who are told their child possesses exceptional artistic or athletic gifts. Every parent wants to make the best decisions possible for their child.
- Thus far, Jeffco has made substantial progress in improving gifted and talented education for elementary and middle school students. However, high school level programs for gifted and talented students have received much less attention. As Jeffco's high schools will soon see a very substantial increase in new students who have received specialized GT instruction since elementary school, it is very important that the parents of these students have a baseline understanding of how well Jeffco's high schools are serving GT students today.
- Clearly, this is a complicated issue that, at minimum, encompasses not only academic performance and growth, but also the extent to which these students are receiving the supportive emotional and social programming they need to fully develop their high potential (gifts) into the ability to reliably deliver superior performance (talent). In this analysis, we have focused solely on academic performance, as that is where we have comparative high school level data available.
- At this point, I would also like to address head-on one of the most common objections to spending money on gifted and talented education – "these kids will do just fine on their own." I disagree. I do not believe it is true that our most gifted artists and athletes will do just fine on their own, nor do I believe this is true of our most cognitively gifted children. All of them need additional support to develop their potential (gifts) into the ability to reliably deliver superior performance (talent), and learn to handle the emotional and social pressures that come with high potential. As a society, we readily dedicate school funding to programming for our gifted artists and athletes, because we recognize how we collectively benefit from the result – indeed, I am a very strong supporter of interscholastic sports, and would strongly resist any attempt to eliminate varsity teams in favor of expanded gym classes and intramurals. However, it is equally clear that we as a society benefit from the dedication of funding to the development of our most cognitively gifted students. In essence, this is a simple question of equity. Put differently, it is hypocritical to condemn GT programming as "elitist" without equally condemning varsity athletics and band competitions.
- However, beyond the equity argument, there is also a very practical economic argument for supporting GT programs in our schools.

- Over the past thirty years, two forces have raised the potential returns to a company that can attract, inspire, and retain world-class, superior talent. First, globalized competition has forced companies that want to maintain their location in high wage countries to either improve productivity or innovate faster than their competitors. Second, improvements in information and communication technology have created more "winner take all" markets, where small differences in organizational and individual capabilities and performance can produce much larger differences in economic returns. At the same time, demographic trends (fewer young people) and the worsening performance of America's K-12 education system relative to other countries (e.g., as measured by the OECD PISA tests) has reduced the pool of highly talented potential employees from which US-based companies can recruit.
- Here in Colorado, Governor Hickenlooper's "Colorado Blueprint" has recognized these trends. The Blueprint explicitly notes the importance to our future prosperity of "cultivating innovation and technology" and "educating and training the workforce of the future." More specifically:
    - One of the goals of the Blueprint is "to have Colorado be recognized as a nucleus of innovation, technology and economic growth…[and] the development of vibrant industry clusters in aerospace, bioscience and cleantech."
    - In order to achieve these goals, the Blueprint seeks "to ensure that a well-educated and well-trained talent pool is available and prepared to meet the needs of Colorado companies now and in the future."
    - Finally, Governor Hickenlooper seeks "to increase the effectiveness of the education system…leading to quality outcomes and meaningful careers for Coloradans" and to "identify programs and systems with proven results that can be replicated and expanded" and "to promote industry-driven career opportunities and talent development."
- Let me explicitly relate this to GT programs in Jeffco's schools. From a public policy perspective, I appreciate the importance and justice of the efforts our society has focused over the past few years on raising the basic level of our students' basic proficiency in core academic subjects. However, as any business leader can tell you, our companies' (and indeed, our economy's) future success also critically depends on our school systems' ability to nurture the development of children who possess exceptional cognitive talents. I believe that this logic was at the heart of the GT education legislation that was enacted in Colorado a few years ago, just as it has been explicitly addressed by other organizations like the National Research Council.
- From a practical business perspective, I cannot state too strongly how important it is to get GT right at the high school level, because our GT kids are not going to get their need for supportive emotional and social programming met in university, and then they're going find themselves in the world of work, where most organizations still struggle to attract, inspire, and retain top talent who often display traits such as these:
    - High energy;
    - Intense and passionate:
    - Learns rapidly;
    - Loves ideas and extended discussion;
    - Low tolerance for routine tasks or those that seem irrelevant;
    - Becomes bored easily;

    - Can be argumentative and stubborn, and challenge authority;
    - Can become frustrated with others who think more slowly;
    - Sometimes has an unusual sense of humor;
    - Often feels out-of-sync with others.
- This list should sound familiar to anyone with experience parenting or teaching GT children – because GT students go on to become GT adults, and their essential traits and challenges don't change with age. It is therefore critical for our school systems to have effective GT programs in place, not just to academically challenge these students – the equivalent of scheduling games with strong opponents on the basketball court – but also to equip them with the emotional and social skills they need to turn their gifts into reliably superior performance in a cooperative team context, just as we help our most talented quarterbacks and violinists. This will help our GT children to have fulfilling lives as adults, help our Colorado companies to find the talent they need to expand (and help Governor Hickenlooper attract more companies to Colorado), and ultimately help our nation to grow out of our debt problems and deliver rising prosperity to our citizens in the decades ahead.
- In sum, GT education is not a luxury. In today's world, it is a necessary and critical investment in our collective future that promises very high returns if done right – and very painful consequences if it is not.

Methodology

- Essentially, we performed an exploratory data analysis, using information available on the Jeffco and Colorado Department of Education (School View and Data Lab) websites.
- We included the main Jeffco high schools, as well as Cherry Creek High School and high schools from the Boulder Valley school district in our analysis.
- We collected three types of information on each school: demographics, 10th grade CSAP test results, and growth scores for both GT and non-GT students.
- It is important to understand the difference between an achievement score and a growth score. The former measures, at a single point in time, the extent to which a student has mastered a body of knowledge in a given subject area – e.g., where they are on a novice to expert spectrum. Our analysis focused on the percent of students in each school who had scored in the "Advanced" category on the most recent Grade 10 CSAP tests for reading, writing, math and science. In contrast, growth scores measure how a child's mastery has changed over time. More specifically, a student's growth score in a given subject is calculated by comparing the results on CSAP tests that are taken in different years. The growth percentile reflects the change in a student's test score over a given period of time in comparison with other students who had the same store in the starting period. The median growth score for a school, or for a subgroup of students, reflects the midpoint of the distribution of growth scores for the population of students in the school or subgroup.
- It is also important to distinguish between scores on the Colorado growth model, and so-called "value added" scores used in other states. This latter methodology compares actual test scores to the scores predicted on the basis of the demographic characteristics of the students taking a test. This is not officially done in Colorado, though it can be done informally, and on the basis of limited data, using the information that CDE makes publicly available on the School View website.

- Having collected our data, we performed a variety of simple statistical analyses to compare the performance of different high schools in terms of both achievement and growth. We also used our analysis results to highlight issues that struck us as worthy of further investigation as Jeffco continues its efforts to improve GT high school programs.
- Last but not least, we should acknowledge two arguments that are frequently heard about the testing of GT students.
    - The first is that CSAP scores are depressed by the fact that students, particularly in elementary and middle school, are working at a higher grade level than the test – i.e., they are being tested on material they covered a year previously. If true, this hypothesis would logically depress the achievement scores a different points in time, but should have no effect on the growth score – the difference between the two achievement scores.
    - The second argument that we hear with respect to GT test results is that the CSAP tests are not challenging enough for GT students. The logical consequence of this argument could be lower growth scores than would otherwise be the case, provided that the result of the initial CSAP test were already very close to the top of the range (e.g., a group which started at 97 and a year later moved up to 99). The counter argument to this is that the growth scores are based on a normalized 0 to 100 scale, and not an absolute scale. In this case the 0 to 100 scale would cover the 2 point range in increased CSAP scores. For us the bottom line on these arguments is that they are both worth of further investigation.
- For now, however, we will proceed with our analysis while recognizing that some of our data may be noisy.

<u>Findings</u>

- The following table shows some basic demographic information for the different schools. At the bottom, I calculate an average, standard deviation, and bounds for the average plus or minus one standard deviation. Granted, with such a small data set, this is a crude technique; however, it helps to put the different schools into a relative context.
- The columns in the table show the following data:
    - The number of students at the school;
    - The percent of students who are classified as GT, based on the CDE data for the student population (not the split between GT and non-GT students as reported solely for Grade 10 CSAP results);
    - The percent of the student body classified as white or Hispanic;
    - The percent of the student body classified as English Language Learners and the percent on Free or Reduced Lunch;
    - The last column shows the reported number of out of school suspensions divided by the total number of students. It is not an indicator of the percent of students who have been suspended (as the same student could be suspended more than once); rather, it is a simple, albeit noisy, indicator of one aspect of the school environment.

School	Students	PCT GT School Census Data	PctWhite	PctHisp	PctELL	PctFRL	PctSuspend
ArvadaWest	1,726	8.8	78	17	5	27	10.5
BearCreek	1,893	7.8	59	30	10	31	6.1
Chatfield	1,924	13.8	85	9	2	8	6.1
Colombine	1,622	14.0	74	18	4	18	12.7
Conifer	914	21.4	90	6	1	11	9.4
DakotaRidge	1,504	13.0	80	14	4	14	8.4
D'Evelyn9-12	670	25.7	82	11	3	4	5.9
Evergreen	971	18.6	92	4	1	8	3.0
Golden	1,296	14.0	85	9	4	20	11.5
GreenMountain	1,251	12.3	76	16	7	19	6.6
Lakewood	2,007	27.4	64	24	12	28	6.3
Pomona	1,549	13.6	71	21	5	29	8.1
RalstonValley	1,666	13.2	84	10	2	8	1.9
StandleyLake	1,479	9.5	67	20	8	22	10.8
WheatRidge	1,321	10.5	67	28	6	38	13.0
Boulder	1,790	18.7	74	16	5	18	2.5
Fairview	2,065	24.3	77	7	3	7	2.6
Broomfield	1,329	13.7	80	11	2	13	3.0
Centaurus	1,008	11.8	63	29	6	32	5.5
Cherry Creek	3,556	14.1	76	9	6	9	11.1
Alameda	739	5.0	22	65	43	73	19.8
Arvada	1,039	6.9	55	35	17	59	18.2
Jefferson	598	3.0	14	79	45	88	47.7
Monarch	1,514	13.6	81	8	1	6	3.8
Avg	1,476	13.9	71	21	8	25	9.8
STD	613	6.2	19	18	12	21	9.4
Avg+1STD	2,089	20.1	89	39	20	46	19.1
Avg-1STD	864	7.8	52	3	(3)	3	0.4

- Another dimension on which you can compare schools is the percentage of students who scored in the Advanced category on the most recent Grade 10 CSAP tests:

School	*PctAdvRead*	*PctAdvWrite*	*PctAdvMath*	*PctAdvSci*	*PCT GT Census*
ArvadaWest	9	4	3	7	8.80
BearCreek	8	5	6	8	7.80
Chatfield	6	4	8	6	13.80
Colombine	9	7	7	8	14.00
Conifer	15	10	11	12	21.40
DakotaRidge	11	7	9	8	13.00
D'Evelyn9-12	27	18	31	34	25.70
Evergreen	18	7	14	17	18.60
Golden	10	6	8	9	14.00
GreenMountain	9	1	5	7	12.30
Lakewood	19	13	12	16	27.40
Pomona	9	5	6	8	13.60
RalstonValley	11	5	10	13	13.20
StandleyLake	5	6	5	6	9.50
WheatRidge	10	3	4	6	10.50
Boulder	19	15	16	22	18.70
Fairview	25	12	22	25	24.30
Broomfield	7	4	6	8	13.70
Centaurus	11	5	8	10	11.80
Cherry Creek	17	10	20	14	14.10
Alameda	2	1	1	1	5.00
Arvada	7	3	4	6	6.90
Jefferson	-	1	-	1	3.00
Monarch	15	11	17	11	13.60
Avg	11.61	6.81	9.72	10.99	13.95
STD	6.61	4.47	7.24	7.58	6.19
Avg+1STD	18.23	11.27	16.96	18.57	20.13
Avg-1STD	5.00	2.34	2.48	3.42	7.76
Correl GT PCT	0.89	0.84	0.78	0.84	
Correl FRL PCT	(0.64)	(0.57)	(0.65)	(0.58)	

- This table tells two stories that should be anecdotally and intuitively familiar to both GT parents and educators: as you can see in the second to the last row of the table ("Correl GT PCT"), the correlation between the percent of GT students in the population and the percent scoring at the advanced level on CSAP tests is positive and very strong. And as you can see in the last row ("Correl FRL PCT"), the correlation between the percentage of students scoring at the advanced level, and the percentage of students on free and reduced lunches, which is an indicator of family economic stress, is negative and

significant. Finally, the schools with the highest percentage of students scoring at the advanced level should also be familiar to GT parents and educators.

- However, it would be a great mistake to let the story end here. Let me use music and sports analogies to explain why. Let's say that as a high school band director, I recruited a very high percentage of the best 8th grade musicians to attend 9th grade my school. And let's also say my colleague, the football coach, attracted an equally high percentage of the best 8th grade athletes. Given these assumptions, it would come as no surprise if my 9th grade band and football teams delivered excellent performances. However, whether that would also be the case four years later, when my musicians and athletes were in 12th grade, is another question. If I hadn't helped those talented 9th graders to continue to develop their high potential, while band directors and football coaches at other schools had been much more effective at this task, I could end up with a mediocre band and a mediocre football team – and lots of parents wondering why their children were faring poorly in the competition for college scholarships. The analogy to cognitive talent should be clear: It is one thing to attract a high percentage of GT students and brag about the high percentage of students at your school who score at the advanced level on the Grade 10 CSAPs. But the extent to which your school is helping these students to continue to develop their talents over four years – the result that the Colorado growth score seeks to measure – is something equally important and very different from the percent scoring at the advanced level on the CSAP.
- So let's move on to the growth score results, broken out separately by GT and non-GT students.
- The first point to make about the following tables is a statistical one. A few schools with larger student bodies break out their GT data to distinguish between students who are gifted in Language Arts and Math, and students who are gifted only in Math and students who are gifted only in Language Arts. To facilitate an "apples to apples" comparison between all the schools, our analysis is based on a comparison of the "gifted in both LA and Math" data. While not shown, it is interesting to note (as you can see in the CDE School View data) that most schools had higher growth scores for math for students only gifted in that subject than they did for students gifted in both language arts and math. Again, the reason for this is a subject worthy of further investigation.
- It is also important to highlight the number of schools and subjects where Jeffco high schools had growth scores above 50, the overall median for Colorado.
- Finally, to make it easier to interpret this table, we have highlighted scores more than one standard deviation above the average in green, and scores more than one standard deviation below it in red.
- Alameda, Arvada, Jefferson and Monarch did not report separate growth data for GT students (to protect privacy, public reporting required more than 20 GT students in a given GT category). As a result, our calculations do not include their scores.

School	GTGrowthRead	GTGrowthWrite	GTGrowthMath	Avg GT Growth	PCT GT School Census Data
ArvadaWest	52	49	59	53	8.80
BearCreek	43	49	62	51	7.80
Chatfield	39	50	53	47	13.80
Colombine	68	52	54	58	14.00
Conifer	61	56	53	57	21.40
DakotaRidge	54	45	63	54	13.00
D'Evelyn9-12	53	42	54	50	25.70
Evergreen	55	43	60	53	18.60
Golden	47	58	52	52	14.00
GreenMountain	41	32	42	38	12.30
Lakewood	53	53	47	51	27.40
Pomona	58	56	48	54	13.60
RalstonValley	52	54	65	57	13.20
StandleyLake	43	61	39	48	9.50
WheatRidge	74	55	62	64	10.50
Boulder	37	52	60	50	18.70
Fairview	47	45	55	49	24.30
Broomfield	38	51	61	50	13.70
Centaurus	49	58	63	57	11.80
Cherry Creek	56	49	59	55	14.10
Alameda					5.00
Arvada					6.90
Jefferson					3.00
Monarch					13.60
Avg	51.00	50.50	55.55	52.35	13.9
STD	9.73	6.75	7.24	5.17	6.2
Avg+1STD	60.73	57.25	62.79	57.52	20.1
Avg-1STD	41.27	43.75	48.31	47.18	7.8
Correl GT Pct	0.06	(0.20)	(0.17)		
Correl FRL Pct	0.22	0.40	(0.05)		

- As you can see, the performance of various high schools in helping GT students to grow in different areas is, to put it charitably, uneven, with considerable room for improvement.
- It is also very interesting to look at the correlations between the various growth scores and the percent of GT students and percent of students on free and reduced lunch in a given school. We were very surprised to see that two of the correlations between growth scores and the percentage of GT students at a school were negative. This is certainly a subject worth of further investigation, for which we offer two hypotheses. The first is that the scores are related to the different types of curriculum used at different high schools. For example, both D'Evelyn and Lakewood (in the IB program) use very highly structured curriculums, while the other high schools generally use a more flexible AP/Honors approach (the IB programs in other Jeffco high schools just started, and wouldn't affect this data set). The second hypothesis is that there is a critical mass of GT students, above which more complicated emotional and social effects begin to appear, which depress growth scores if they are not offset by supportive programming. We have certainly seen this phenomenon occur groups containing a high percentage of gifted artists and athletes, so it seems reasonable to observe the same phenomenon at work in groups with a high percentage of cognitively gifted students.

- The correlations between the growth scores and the percentage of FRL students are also interesting, and appear to tell a very positive story – in reading and writing, some schools seem to have found a way to overcome the negative effects of the family stresses that their students are facing, and to deliver impressive growth in spite of them. Again, this is an issue well worth further investigation.
- The next table shows school growth scores for non-GT students:

School	NonGTGrowthRead	NonGTGrowthWrite	NonGTGrowthMath	Avg NonGT Growth
ArvadaWest	52	50	52	51
BearCreek	52	43	50	48
Chatfield	43	42	59	48
Colombine	59	49	55	54
Conifer	62	56	58	59
DakotaRidge	51	48	61	53
D'Evelyn9-12	52	40	61	51
Evergreen	56	50	60	55
Golden	49	47	47	48
GreenMountain	53	42	51	49
Lakewood	45	46	44	45
Pomona	53	54	62	56
RalstonValley	61	50	69	60
StandleyLake	51	56	51	53
WheatRidge	61	49	61	57
Boulder	47	54	62	54
Fairview	43	47	52	47
Broomfield	45	52	61	53
Centaurus	45	47	60	51
Cherry Creek	51	48	55	51
Alameda	48	37	45	43
Arvada	50	49	58	52
Jefferson	50	55	46	50
Monarch	47	55	64	55
Avg	51.08	48.58	56.00	51.89
STD	5.53	5.15	6.66	4.17
Avg+1STD	56.62	53.73	62.66	56.06
Avg-1STD	45.55	43.43	49.34	47.72
Correl GT Score	0.70	0.59	0.54	
Correl GT Pct	(0.08)	(0.04)	0.16	
Correl FRL Pct	(0.07)	(0.06)	(0.50)	

- As with the GT growth scores, the growth scores for non-GT students show that performance is uneven across schools, and there is much room for improvement. The good news is that there are clear examples of superior growth performance which can serve as the basis for further investigation and, hopefully, more transfer of best practices.
- Once again, the correlation data at the bottom of the table suggest topics for further investigation. "Correl GT Score" measures the extent to which the growth score for GT students in a given subject area is related to the growth score in that subject for non-GT students. As you can see, this relationship is

generally strong, particularly in reading. This seems to confirm what common sense suggests: great teaching benefits all students, both GT and non-GT alike.

- In contrast, "Correl GT Pct" measures the correlation between non-GT growth scores and the percentage of GT students in the student body – put differently, it is a noisy test for the existence of so-called "peer effects." As you can see, the evidence for such effects is either non-existent or, in the case of math, positive but quite weak. In the absence of great teaching, simply raising the percentage of GT students at a school does not seem to benefit the growth scores of the non-GT students.
- Finally, "Correl FRL Pct" measures the correlation between the percentage of students on free and reduced lunches and the growth scores achieved by non-GT students in different subject areas. In reading and writing, the great news is that these correlations show essentially no relationship at all – put differently, there is evidence that great teaching can triumph over challenging economic circumstances. Unfortunately, the correlation for math growth tells a more difficult story, indicating that in this subject area, economic challenges have a bigger impact on student growth, despite teachers' efforts. However, even in the case of math, there are still examples of high schools with relatively high percentages of FRL students that are still delivering impressive math growth. So even in math, there is hope. Again, our analysis raises important issues for further investigation.

Conclusions

- While they are most often the subject of anecdotes about different high schools, CSAP scores, and the percentage of students scoring at the advanced level, appear to have weak information value for parents trying to assess how well high schools are serving their GT students. There is a very strong relationship between Grade 10 CSAP advanced percentages, and the percentage of GT students. As noted above, recruiting talented musicians and athletes should result in strong performances for your Grade 10 band and football team; however, it may not deliver great results when these students reach Grade 12 if poor growth results have allowed other students to catch up. In sum, developing a good understanding of different high school's growth results, and the factors that drive them, is critical.
- Across a selection of Jeffco high schools, and a comparison set of highs schools from outside the district, there is a wide range of performance with respect to the growth achieved by GT and non-GT students in different subject areas. Without exception, there is room for every high school in this study to improve its performance.
- Going to a school with a high percentage of GT students may actually result in an inferior growth performance than going to a school with a lower percentage. The factors driving this result (including whether they are an artifact of GT students "topping out" on CSAP tests) need to be further investigated.
- Having a high percentage of GT students at a school does not, on its own, seem to have a significant impact on the growth performance of non-GT students. On the other hand, great teaching seems to improve the growth performance of both groups.
- Having a high percentage of students on free and reduced lunch does not consign a school to poor growth performance. Once again, the data highlight the positive impact of great teaching (even in math, which seems to face the most FRL based challenges). Developing a better understanding of the root causes of superior growth performance at schools with significant FRL populations merits further study.