Summary Report on Exam Results from Dr. B's Physics Classes (07-08)

Using the extensive amount of information available to classroom teachers about students' prior performance (including CSAP & GPA)–in their 'Recent Academic Data' ('RAD') report–along with their demographic information in PowerSchool®, I analyzed student performance throughout the year (and tracked the post-test scores in the other four classes taught by two more teachers – yellow ▲ in figures). We measured student competence by their performance in "district" physics exams, still at use in Overland.

Figures 1 & 2 show student performance in the semester 1 and semester 2 exams. The figures show students' pretest and post-test scores for four classes taught by me. The trend lines display a pattern. Students made huge gains from pre-test to post-test in all the classes. The y-intercept on the trend lines show that:

- Performance gain (absolute) = 34% (first semester = 61 - 27)
- Performance gain (absolute) = 46% (second semester = 77 - 31)

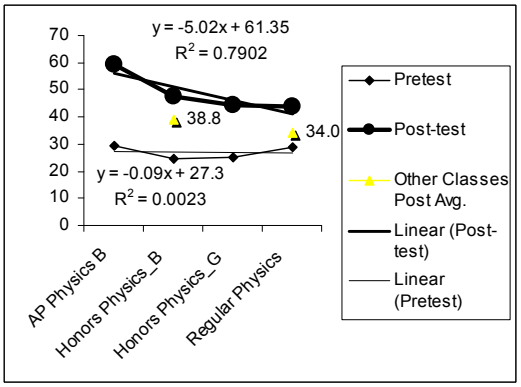


Fig. 1 Summary Results of Semester 1 Exam

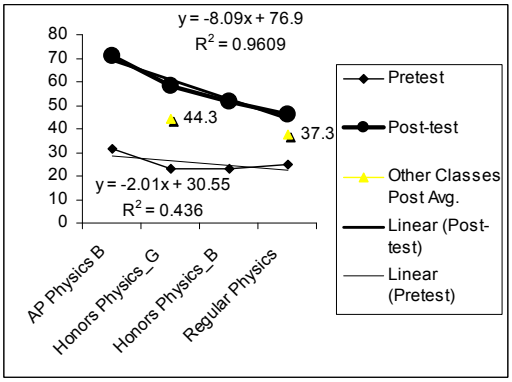


Fig. 2 Summary Results of Semester 2 Exam

Another way to look at this information is to calculate the normalized gains, instead of the absolute gains, with disaggregated data by gender, grade level, and ethnicity. All subgroups show significant normalized gains and their learning trajectory continued to grow through the year. The y-intercept on the trend lines show that:

- Knowledge gain (normalized) = 38% (first semester)
- Knowledge gain (normalized) = 53% (second semester)

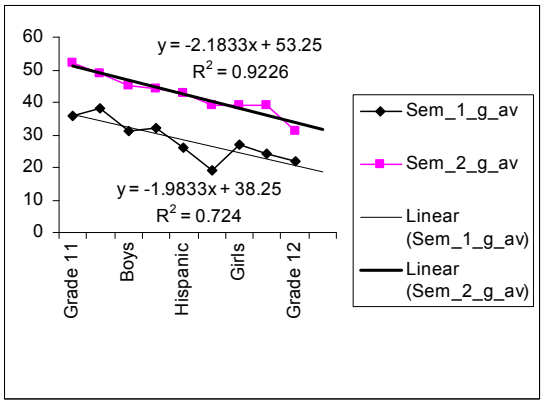


Fig. 3 Normalized gains for the different subgroups

Table 1. Normalized Gains by subgroups

Semester 1 & 2 Exams		
Subgroups	*Sem_1*	*Sem_2*
	g_av	g_av
Grade 11	36	52
Asian	38	49
Boys	31	45
Caucasian	32	44
Hispanic	26	43
African American	19	39
Girls	27	39
"STEM" Minority	24	39
Grade 12	22	31

The following page provides detailed analyses of student performance through the year, 2007-08. Page 3 presents another visual & chart of this analysis. Page 4 summarizes "ranked" factors influencing student performance & my teaching strategies.

2007-2008 Nathan Balasubramanian's Physics Classes – Data Analysis

Class	Category	'N'	Mean %	'σ' %	Min. %	Max. %	Median %	g_av	Other Classes Avg (%)
Regular Physics	GPA	20	2.38±0.17	0.74	0.42	3.54	2.28	T1: Teacher 1	
	CSAP Consolidated	16	22.63±1.39	5.56	14.00	30.00	23.50	*T2: Teacher 2*	
	Sem. 1 Pretest	17	28.88±2.10	8.65	12.12	45.45	30.30		
p<0.0001; **t=5.17**	**Sem. 1 Exam**	17	43.85±3.82	15.75	21.21	75.76	39.39	22%	T1=35.2 *T2=32.7*
	Sem. 2 Pretest	13	24.65±1.56	5.63	13.64	34.09	23.86		
	Q3 Co. Assmt	15	45.14±3.43	13.28	28.57	71.43	45.71		T1=38.2 *T2=45.0*
p<0.0001; **t=5.41**	**Sem. 2 Exam**	13	45.98±4.06	14.65	27.3	77.3	39.75	28%	T1=34.2 *T2=40.3*
Honors Physics	GPA	21	2.85±0.17	0.77	1.08	3.92	2.92		
Green Day	CSAP Consolidated	17	25.18±1.21	4.99	16.00	31.00	26.00		
	Sem. 1 Pretest	18	25.25±2.96	12.56	6.06	51.52	24.24		
p<0.0001; **t=4.52**	**Sem. 1 Exam**	18	44.11±2.92	12.40	27.27	75.76	45.45	23%	T1=N/A *T2=38.8*
	Sem. 2 Pretest	23	23.22±1.68	8.10	11.36	38.64	22.73		
	Q3 Co. Assmt	20	58.57±2.91	13.03	28.57	80.00	57.14		T1=N/A *T2=51.6*
p<0.0001; **t=12.2**	**Sem. 2 Exam**	23	58.20±2.35	11.29	31.80	75.00	54.50	45%	T1=N/A *T2=44.3*
Honors Physics	GPA	18	3.16±0.16	0.70	1.25	4.00	3.39		
Blue Day	CSAP Consolidated	14	24.86±1.47	5.50	16.00	37.00	24.50		
	Sem. 1 Pretest	14	24.68±2.35	8.80	12.12	39.39	24.24		
p<0.0001; **t=5.60**	**Sem. 1 Exam**	14	47.84±3.62	13.56	21.21	72.73	48.48	30%	T1=N/A *T2=38.8*
	Sem. 2 Pretest	12	22.92±1.06	3.68	15.91	29.55	22.73		
	Q3 Co. Assmt	12	53.33±3.98	13.80	37.14	88.57	51.43		T1=N/A *T2=51.6*
p<0.0001; **t=5.85**	**Sem. 2 Exam**	12	51.70±4.55	17.05	27.30	88.60	47.70	37%	T1=N/A *T2=44.3*
AP Physics B	GPA	18	3.05±0.15	0.64	1.66	4.00	3.12		
	CSAP Consolidated	16	27.13±1.65	6.61	7.00	35.00	28.50		
	Sem. 1 Pretest	17	29.41±2.49	10.26	12.12	48.48	30.30		
p<0.0001; **t=8.07**	**Sem. 1 Exam**	17	59.35±4.66	19.22	12.12	87.88	62.12	44%	
	Sem. 2 Pretest	12	31.25±0.89	3.08	22.73	34.09	30.68		
	Q3 Co. Assmt	12	78.10±2.86	9.92	57.14	94.29	77.14		
p<0.0001; **t=13.5**	**Sem. 2 Exam**	12	70.83±2.92	10.11	56.80	86.40	70.50	58%	

Normalized Gains & Cohen's "d" Disaggregated by subgroups for Semester 1 (01/08) & Semester 2 (05/08) Exams

Cohen's "d" with Hedges Adjustment for 'N' in table		Semester 1			Prctl.	Semester 2			Percentile
		'N'	**'g_av'(%)**	"d"	Stndg.	'N'	**g_av(%)**	"d"	Standing
African American	Consol. CSAP = 23.14	16	**19**	1.2	88	14	**39**	2.7	>99
Caucasian	Consol. CSAP = 27.91	32	**32**	2.0	97.7	23	**44**	2.7	>99
Hispanic	Consol. CSAP = 25.00	7	**26**	0.94	83	4	**43**	2.1	>98
Asian	Consol. CSAP = 22.60	8	**38**	1.9	97.1	5	**49**	3.1	>99.9
Boys	Consol. CSAP = 25.59	41	**31**	1.5	93.3	31	**45**	2.9	>99.8
Girls	Consol. CSAP = 25.68	25	**27**	1.7	95.5	29	**39**	2.6	>99
Grade 11	Consol. CSAP = 28.29	29	**36**	2.0	97.7	24	**52**	3.7	>99.9
Grade 12	Consol. CSAP = 22.19	33	**22**	1.4	91.9	21	**31**	2.4	>99
"STEM" Minority	Consol. CSAP = 24.89	36	**24**	1.3	90	27	**39**	2.6	>99

Key:

p-value (e.g. p<0.0001), implies the gain in students' post-test scores were *statistically significant* – less than 0.01% probability that the observed increases happened by chance – and therefore the increase in student performance can be quantified as an upward trend and student achievement definitely improved over the year.

t-value (e.g., 5.17), like a signal-to-noise ratio, is an estimate of the difference in pre-post scores (signal – difference between the means) *relative to* the variability of pre-post scores (noise – standard error ± of mean).

'**N**' = number of students

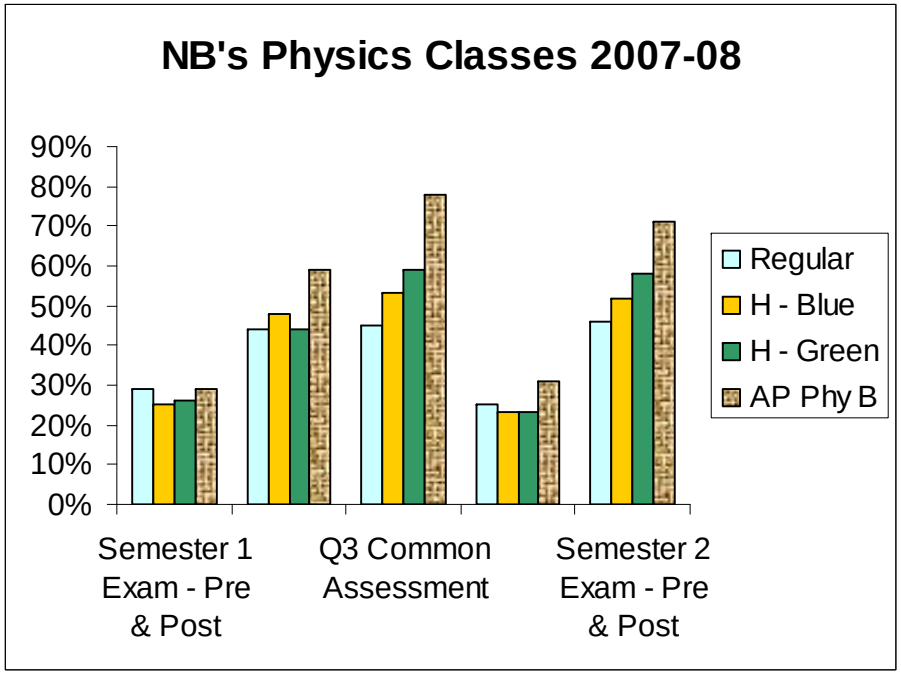
'**σ**' = standard deviation, a measure of the spread or variability of the scores around the mean of the sample

'**g_av'** = average of the **normalized gains** of the group, where normalized gain is a measure of "**how much**" knowledge an individual student/class have learned. It is calculated using the formula ['g'] = (post – pre)/(100 – pre)

"**d**" = Cohen's 'd' with Hedges Adjustment is a measure of "effect size," quantifying the size of the difference in means

Analyzed & Updated by Nathan Balasubramanian
May 23, 2008

The preceding page summarizes a wealth of information. Here is another visual, showing the trends in student achievement.



Other Classes Average – **Post %**		
	Reg.	Hon.
Semester 1	34%	39%
Q3 Com. Assmt.	42%	52%
Semester 2	37%	44%
NB's Classes		
	g_av	**g_av**
Sem. 1	22%	27%
	% GAINS	
Sem. 2	28%	41%

Fig. 4 Comparison of gains in NB's classes with the post-test scores from the other classes

Conventional wisdom might suggest that students' would do better in the first semester than the second. Grade 11 students concurred and they reasoned as follows:

> Things start out easy & gradually get harder . . . students come in more motivated and more willing to do work and go to class since they have had the summer off . . . are more enthusiastic about school first semester . . . students are ready to work after break . . . people start off fresh and start with straight A's . . . they carry a positive attitude . . students have more time to study outside of class and don't have as much pressure . . . they need to prove to a teacher that they take the class seriously . . . and don't have to remember everything from a different semester.

The observed trend in student performance in my physics classes is clearly different. What factors might have contributed to this difference? The following page summarizes and ranks these factors – as Grade 11 students, the most successful student group (52% gain), saw it.

Grade 11 Student Perceptions

Understanding students' learning trajectory (N = 33) – Nathan's Grade 11 Physics Students						
No.	**Student Effort**	**% Agree**		**No.**	**Teacher Effort**	**% Agree**
1	Willing to do work	97.0		1	Reviewing things from the day before*	97.0
2	Being prepared	96.9		2	Hands-on activities	96.9
3	Don't want to fail	94.0		3	Explained the concepts efficiently	93.9
4	Taking notes	93.9		4	Work out problems on the board	93.9
5	Listening more in class	93.9		5	Visuals, like simulations	90.9
6	Working through examples & problem sets	93.9		6	Explained things in further depth when asked	87.9
7	Done my assignments	90.9		7	Presented & reviewed information effectively	87.9
8	Focusing on board	90.6		8	Using physical representations in the classroom	87.8
9	Coming to class	89.4		9	Presented scenarios we can understand	84.9
10	Pay attention	87.9		10	Offered good and detailed notes	84.9
11	Asked questions	87.9		11	Encouraging success	84.9
12	Reviewing my notes	87.9		12	Experiments	81.9
13	Completing homework	87.9		13	Moving through topics slower*	81.8
14	Participated	84.9		14	Make-up work	81.3
15	Try to get ready for college	84.9		15	Example problems in class	78.8
16	**Studying more this semester**	**81.8**		16	Enthusiastic	72.7
17	*Like to challenge myself*	78.8		17	*Fun*	66.7
18	Looking at my notes before class	78.8		18	Opened up classroom for students to come in	66.7
19	GPA	75.7		19	*Relate to real life experience*	63.7
20	Reading the textbook	63.6		20	*Interesting*	60.6
21	*Try to get ready for career*	51.5		21	Comparing us to your other classes	45.5
22	I got better at math	45.4				
					*Intentional changes made during 2nd semester	
					Personal surprises italicized	
The above stems are students' descriptions of factors that helped them learn well. Students (Grades 9-12 in my physics classes) attributed their success to these factors after their third quarter common assessment. The list above is Grade 11 students' ranking of these influential factors (on 05/27 & 05/28/2008).						

Grade 11 students' ranking order champions Vince Lombardi's popular quote.

"Dictionary is the only place that success comes before work. Hard work is the price we must pay for success. I think you can accomplish anything if you're willing to pay the price" - Vince Lombardi