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ABSTRACT

This study examined the relationship between intensity of study (defined as more hours per week of class within a subject matter area) and student success. The researcher identified two possible methods for increasing the intensity of study: (1) Compression Hypothesis--shortening the length of terms and increasing the amount of time per week spent in class; and (2) Intensity Hypothesis--concurrently completing multiple classes within a subject matter area. In both hypotheses, the student would increase the number of hours per week spent within a subject matter. This paper presents evidence for the effectiveness of both the intensity and compression hypotheses and then examines the two together to see which one best explains student success. Data was collected on the performance of students in English, mathematics, and English-as-a-Second-Language (ESL) classes during a compressed summer term as well as from students enrolled in concurrent course sequences during spring and fall terms. It was found that both compression and intensity positively influence student success independently of each other. The implications of this research for course scheduling are discussed. (Contains 7 graphs, 8 tables, and 4 references.) (Author/RC)

Compression of Semesters or Intensity of Study: What is it that Increases Student Success?

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Compression of Semesters or Intensity of Study:
What is it that increases Student Success?

Abstract

Recent research into issues of scheduling has found that when courses are offered in shorter terms, students experience more success. At City College of San Francisco this is also the case, however, it has also been found that new students with recommended placement in multiple concurrent classes within a discipline who then take those classes concurrently also have greater success than students who do not. The impact on student success of compression of semesters on the one hand, and concurrent class enrollment on the other may not be unrelated phenomena. When courses are compressed in length, their hours per week increase. Likewise when students take multiple courses concurrently within a discipline, their hours per week within that discipline also increase. It may be that this common increase in hours per week referred to here as intensity of study may be the mechanism underlying both findings. This research paper presents evidence for both the intensity and compression hypothesis and then examines the two together to see which one best explains student success. It was found that both influence student success independently of each other. In an era that requires colleges to publicly account for student learning, the implications of this research for scheduling cannot be ignored. Many factors that influence college success are beyond the control of the educational institution. The few that are within institutional control must be closely examined to determine what if anything can be done to improve student success and the educational process.

Introduction

Geltner and Logan (2000) at Santa Monica College have found that session length is related to success. When students take similar courses in shorter time periods, they have increased success. Geltner and Logan hypothesize that courses offered in compressed semesters is the reason. Daniel (2000) conducted a review of the literature on time shortened courses and found that these courses 'often yield comparable and often superior learning outcomes in comparison with traditional semester or quarter-length courses' (page 303). She points out that these courses are becoming more common because they fit the needs of non-traditional students. At City College of San Francisco, I have found that when new students who are placed into concurrent classes take those classes simultaneously, they are more likely to succeed. I have attributed this increased success to an intensity of study factor resulting from taking more class hours per week within a discipline. In support of that hypothesis, McAllister (1998) found that when an intermediate Algebra course was changed in 1995 from three to five hours per week, the percentage of students passing that course increased seven percent - from 47% to 54%. Moreover, he found that student success in subsequent math courses increased as well. Combined, in all subsequent math classes, passing percent increased from 56% to 63%. These increases were statistically significant. In one last study, Adelman (2001) found that, for high school students, the best predictor of attainment of a bachelor's degree by age 30 was the academic intensity of their high school course work. The more rigorous their course work in high school, the more likely they were to get a bachelor's degree. Academic intensity was a better predictor than either test scores or class rank

The hypotheses of compressed semesters and intensity of study may not be unrelated; in fact, they may be merely different forms of the same phenomena.

Certainly, courses that are offered in compressed semesters, given that their unit value and hence the total number of instructional hours does not change, must result in more hours in class per week. Similarly, when students take more than one class per semester in a given subject matter area, they also must increase their hours in class per week in that subject matter area. The common factor in both hypotheses is an increase in the intensity of study defined here as more hours per week of class within a subject matter area. Figure 1 and 2 below present the different hypotheses.

Figure 1 – The Compression Hypothesis

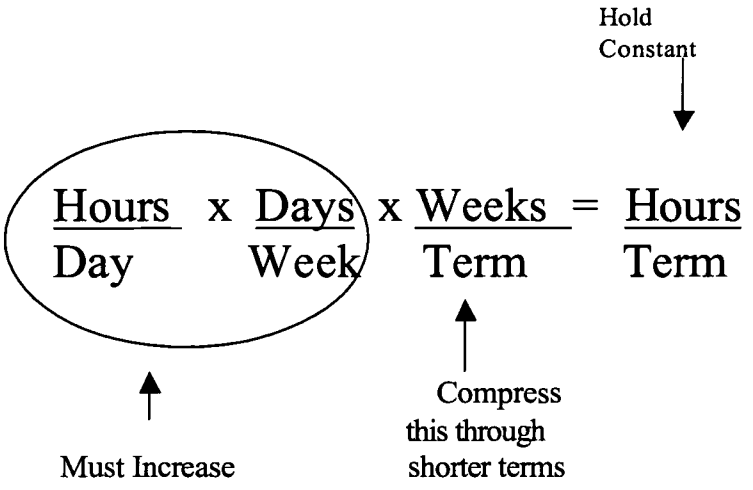
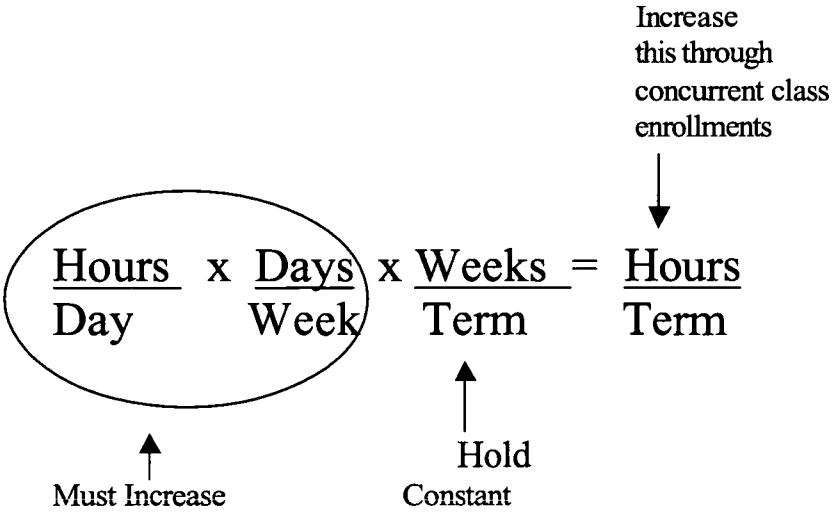


Figure 2 – The Intensity Hypothesis



The length of a class in hours per term can be calculated by multiplying the hours per day of the class by its days per week and weeks per term. Compressed semesters must necessarily increase the hours per week of the class if the total hours per term do not

change. Similarly when students take multiple classes within a subject matter area, they must necessarily increase their hours per week of class in that subject matter area if the term length is held constant. The commonality of each of these hypotheses is weekly class hours. Weekly class hours have been operatively defined as intensity of study.

Though a commonality exists between these hypotheses, and while that commonality is intensity of study, it is still possible that intensity of study is not the factor leading to increased success. It may be that compression of semesters is the factor that causes students' success to increase. It is this uncertainty that will be investigated in this paper. Is it the intensity of study or the compression of semesters or both that is increasing students' success?

In order to motivate the central question, data from City College of San Francisco that support the intensity of study hypothesis will be presented first. Following that, data that support the compression hypothesis will be presented. Last, the central question of which hypothesis best explains the data will be addressed.

Data in Support of the Intensity Hypothesis

Data will be presented from English, mathematics and ESL that support the intensity hypothesis. In all cases, the performance of new students who were placed into concurrent class sequences will be examined by the number of concurrent classes in which they enrolled. The data comes from enrollment in City College of San Francisco from Spring 1998 through Fall 2000.

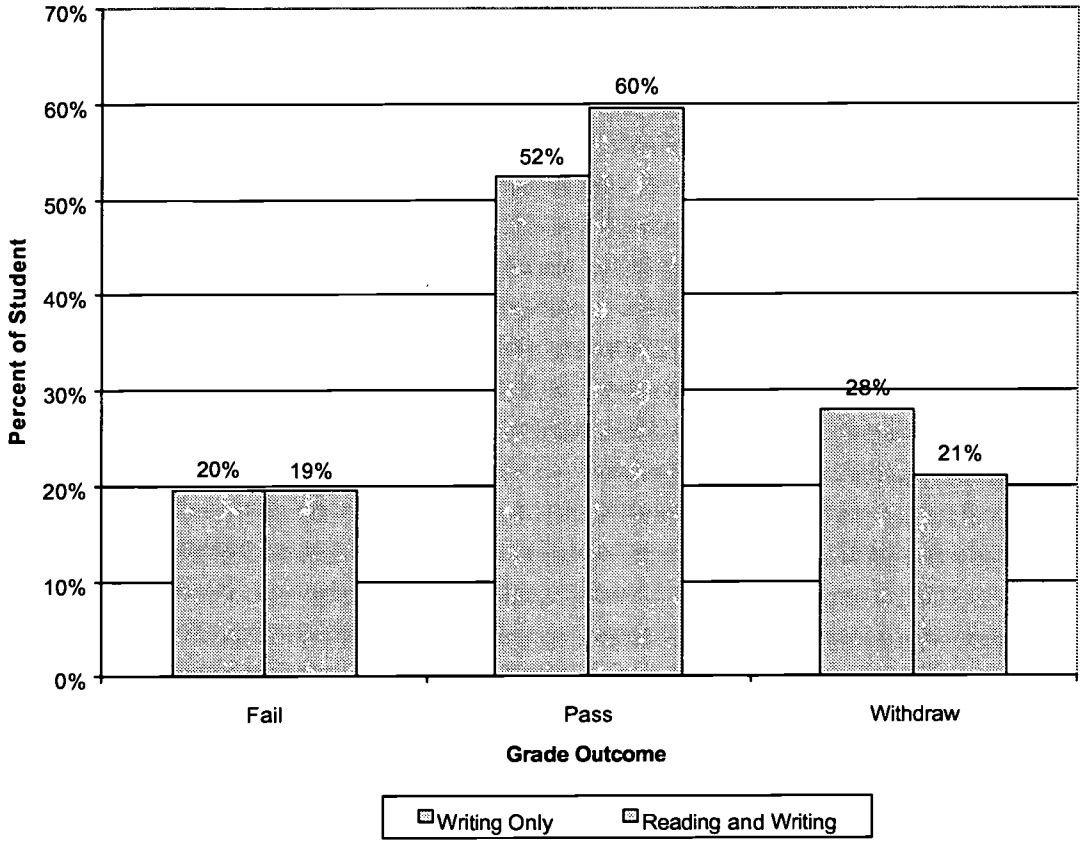
In the graphs below, grade outcome resulted from a categorization of grades into three classes. Grades of A, B, C, and CR were passing grades. D, F, and NC grades were failing. W and I grades were withdrawals. All other grades were ignored.

English

The second-in-the-sequence basic skills writing class in English (ENGL 90) has a recommended reading class (ENGL 9) to be taken concurrently. Data was collected on 956 new students who had received a concurrent enrollment placement. Of these 956, 324 enrolled concurrently. Success in the writing class was related to whether students enrolled in the reading class ($p < .05$). Graph 1 presents the results. 60 percent of students who enrolled in the reading and writing class concurrently passed the writing class versus 52 percent of those students who enrolled in the writing class alone.

Graph 1

Success In English Basic Skills Writing Given Concurrent Enrollment in a Basic Skills Reading Course



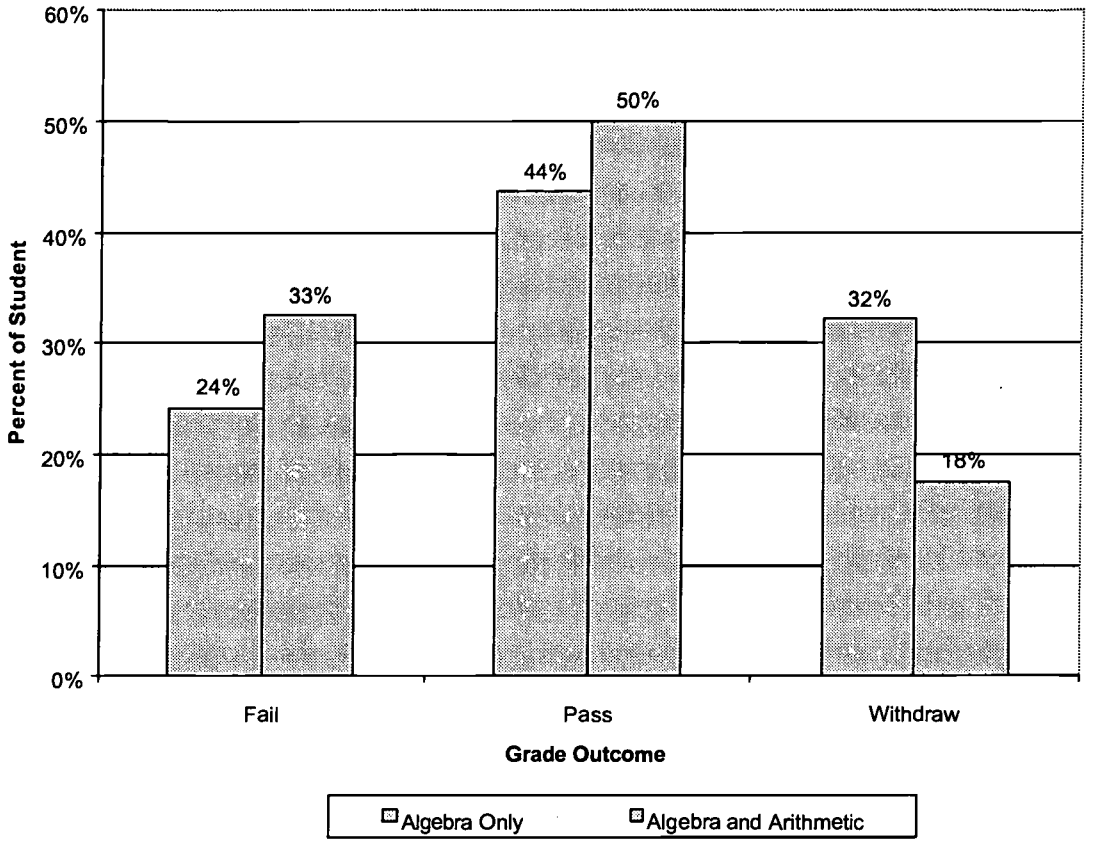
Similar passing percentages existed for students enrolled in the reading class. However, because of the smaller number of students taking only reading, the differences were not statistically significant.

Mathematics

In mathematics, 270 new students placed into elementary algebra and arithmetic concurrently were identified. 80 of them enrolled in both courses. 50 percent of the concurrent enrollees passed elementary algebra versus 44 percent of those students who enrolled in the algebra class alone. This difference in grade outcomes was significant at the .05 level.

Graph 2

Success in Elementary Algebra given Concurrent Enrollment in an Arithmetic Class



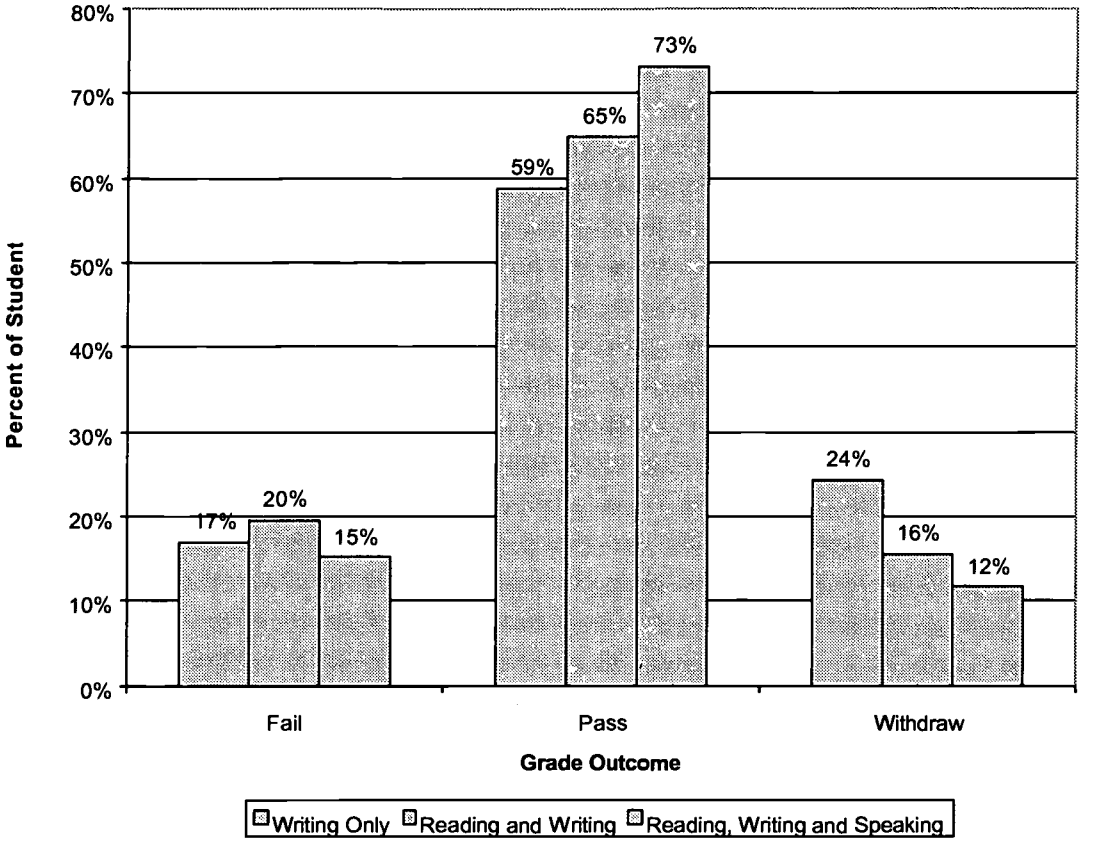
Concurrently enrolled students also did better in arithmetic, however, once again, the differences failed to be statistically significant.

ESL

545 new students placed into ESL basic skills reading, writing, and speaking classes were identified. Of these 148 took writing only. Another 199 took reading and writing, and an additional 198 took all three courses. The passing rates of these students are presented in Graph 3 below. They are once again statistically significant at the .05 level.

Graph 3

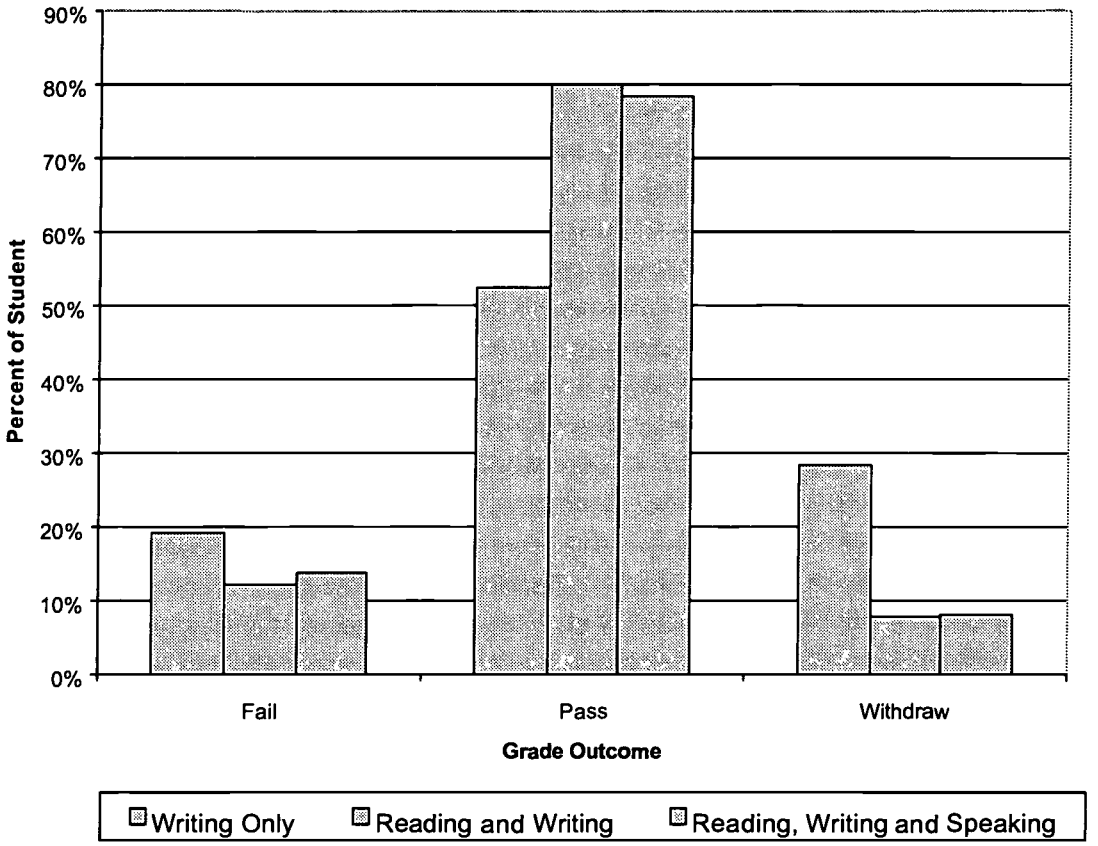
Success in Basic Skills ESL Writing Given Concurrent Enrollment in ESL Reading and Speaking Classes



Success in the concurrent reading and speaking classes was also checked. Success in reading was related to concurrent enrollment however, in the speaking class, while students enrolled in multiple concurrent classes did better, that difference was not statistically significant.

Graph 4

Success in ESL Intermediate Writing Given Concurrent Enrollment in ESL Reading and Speaking Classes



960 new students placed into the ESL 50 series (the first non-basic skills ESL class). Of these, 223 had enrolled in the writing class only. Another 539 had enrolled in both reading and writing. The remaining 198 enrolled in all three ESL classes. Graph 4 presents the success of these students by the concurrent classes in which they were enrolled. Once again, students enrolled in multiple classes in ESL had greater success than those enrolled in only one. In this case however, the differences in success were significant at the .0001 level.

Data in Support of the Compression Hypothesis

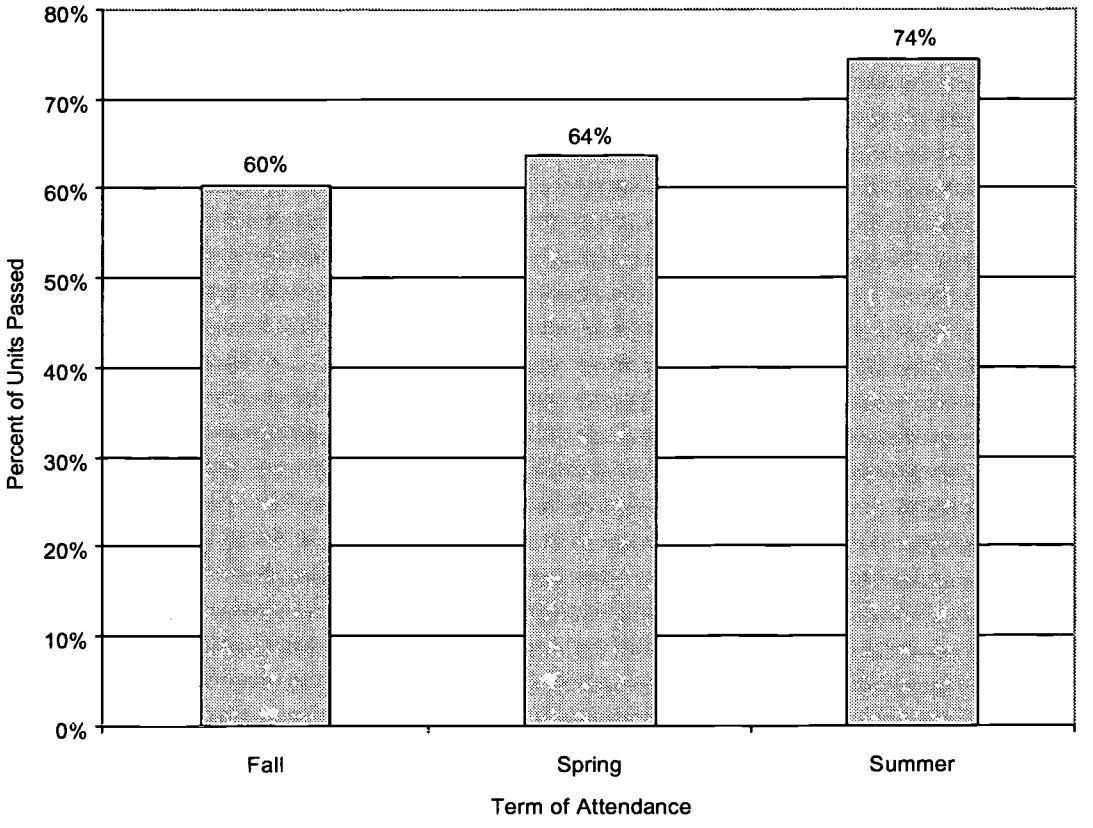
By looking at the performance differences of students between the 17.5 week regular (Fall and Spring) semesters and the six week summer session, it was possible to determine whether there was a relationship between student success and the shortened

summer time frame. One confounding influence in such a look is the difference in the makeup of students from regular to summer sessions. In the summer CCSF gets a number of students from San Francisco State University as well as other four-year schools who are trying to fulfill their general education requirements. It might be argued that these are more capable students and consequently that they would do better and lift the average of classes passed in comparison to regular-semester students. In response to this objection, I looked at only students *continuing* at CCSF and included them in graphs 5, 6, and 7. Graph 5 presents the success of continuing students taking English classes in the regular versus summer sessions. Graph 6 presents similar information in mathematics and graph 7 presents the ESL data.

Graph 5 presents the success of 29,233 English course enrollments given the semester of enrollment. Of these 2,458 were summer enrollments, 12,245 Fall, and 14,530 Spring. Success in English classes was greatest in summer with 74 percent of units passed.

Graph 5

Percent of Units Passed in English by Semester of Attendance

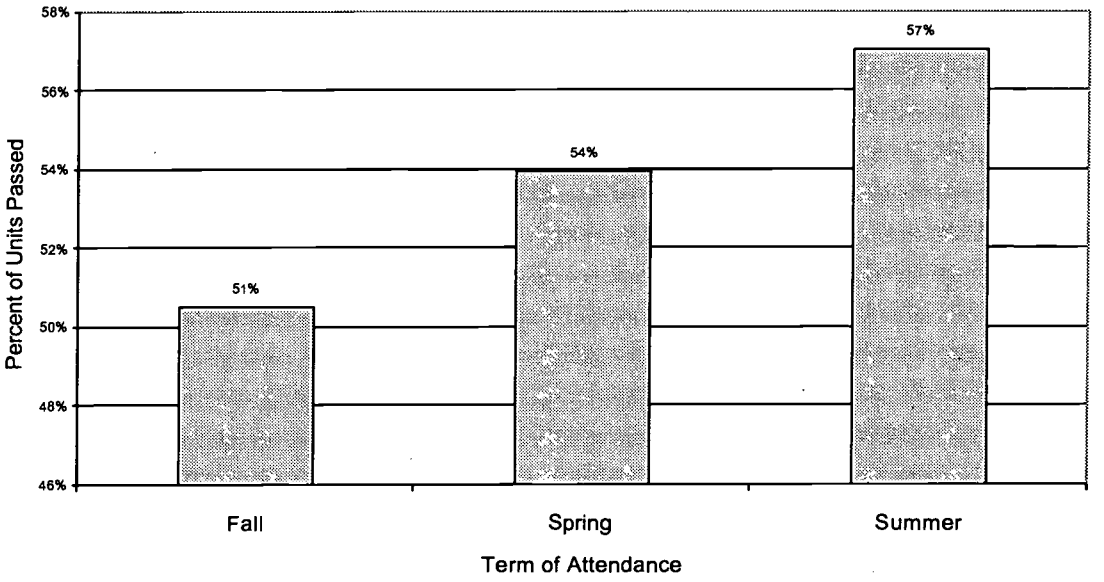


Mathematics

In mathematics the situations was similar. 25,758 student enrollments were collected of which 3006 were summer, 10,426 Fall, and 12,326 Spring. Graph 6 below presents the success of students in these terms. Percent of Units passed was highest in the summer though in comparison to English, the difference is much less substantial.

Graph 6

Percent of Units Passed in Mathematics by Semester of Attendance

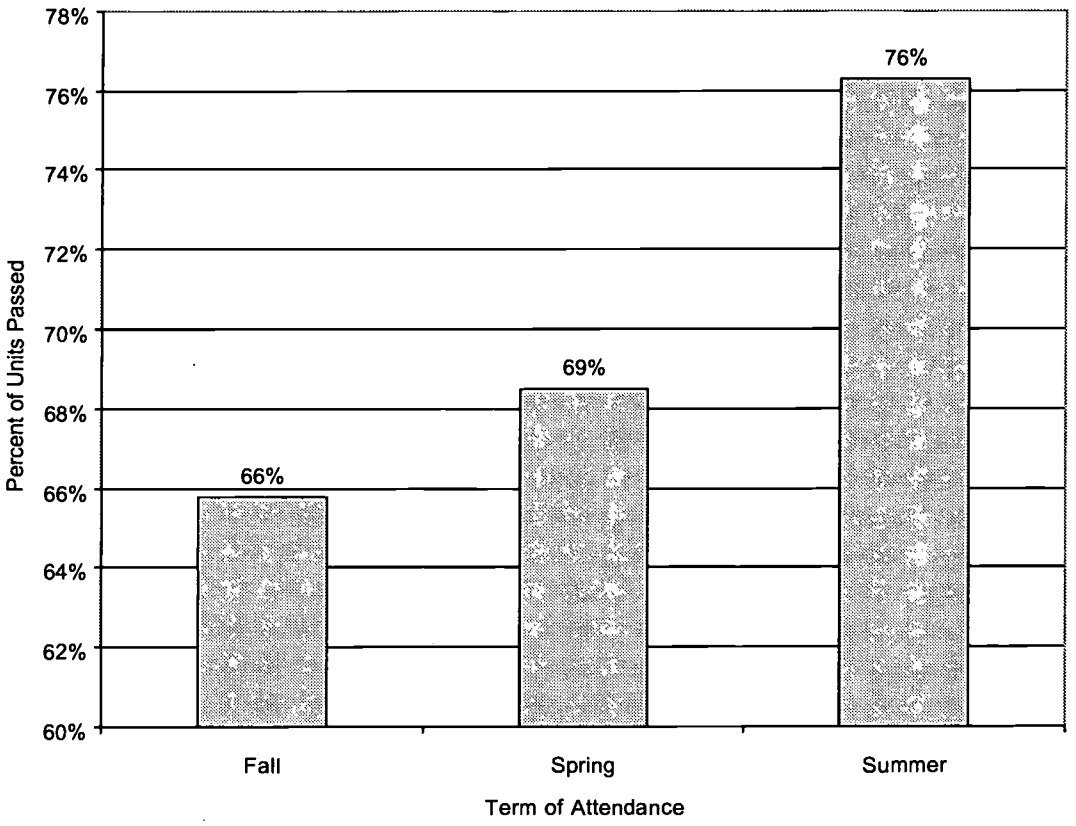


ESL

16,916 ESL enrollments were also examined. 2,277 of these were summer, 6765 were Fall and 7,874 were Spring enrollments. As with the other disciplines, summer performance surpassed Fall and Spring. All of this data is in line with the compression hypothesis.

Graph 7

Percent of Units Passed in ESL by Semester of Attendance



Is it Compression or Intensity?

The question remains, is the increase in success during the summers a result of the increased intensity of study or is it a result of the compression of the schedule found in the summer term? In order to answer this question, weekly class hours of students and their term of attendance was collected in English, ESL and mathematics. Weekly class hours for each student was aggregated by discipline consequently students who took two or more classes generally had more weekly class hours than students who took only one class. The number of students taking multiple classes differed greatly by discipline. Only about 5 percent of students in English and mathematics took more than one class a semester in the respective discipline. In ESL over a third of students took multiple classes. Table 1, 2 and 3 below present the number of students and their success by their weekly class hours in regular versus summer sessions. Note that Fall and Spring terms are grouped together. Weekly class hours are rounded to the nearest even number.

Table 1

Number of Students and their Success in English at Various Weekly Class Hours by Semester of Attendance

Semester	Weekly Class Hours	Number of Students	Percentage Passing
Regular	2	44	48%
	4	26428	58%
	6	1843	66%
	8	7	14%
	10	68	56%
	12	24	83%
	16	1	0%
Regular Total		28415	58%
Summer	6	382	73%
	8	1791	71%
	10	17	94%
	14	3	67%
	16	12	100%
Summer Total		2205	71%
Grand Total		30620	59%

In English few students were enrolled in more than 6 weekly class hours during the regular semesters and few students were enrolled in fewer than 8 hours during the summer terms. The lack of overlapping enrollment hours in English from the regular to summer sessions makes it extremely difficult to disentangle the relationship between compression and intensity. This will be discussed at greater length later. Nonetheless, there seems to be a pattern of success both within hours per week across terms. Overall, students in summer terms have a higher passing percentage of their English classes (71% in summer versus 58% in the regular terms). Within the regular terms success seems to increase as weekly hours increase. Students enrolled in English courses 2 hours per week pass 48% of the time versus 66% for students enrolled in 6 hours per week.

Table 2

Numbers of Students and Their Success in Mathematics at Various Weekly Class Hours by Semester of Attendance

Semester	Weekly Class Hours	Number of Students	Percentage Passing
Regular	2	3079	33%
	4	9247	54%
	6	15458	53%
	8	494	63%
	10	721	56%
	12	6	50%
	14	5	80%
	16	20	15%
Regular Total		29030	52%
Summer	6	603	40%
	10	1282	62%
	12	1700	57%
	14	432	61%
	16	15	53%
	18	12	58%
	20	21	62%
	22	17	65%
	24	3	33%
	26	1	100%
	28	1	100%
	34	1	0%
	36	1	100%
Summer Total		4089	57%
Grand Total		33119	52%

In mathematics as in English, there is little overlap in weekly class hours from regular to summer terms. During the summer terms students are enrolled in 10 or more weekly hours of mathematics. In the regular terms, the heaviest enrollment is at six and fewer hours. Because of the non-overlap in hours per week it is impossible to reach a conclusion about the significance of compression versus intensity of study. Nonetheless, students in the summer terms seem to have somewhat more success (57% to 52%) and within the regular and summer terms students at higher hours per week seem to have a greater success rate.

Table 3

Numbers of Students and Their Success in ESL at Various Weekly Class Hours by Semester of Attendance

Semester	Weekly Class Hours	Number of Students	Percentage Passing
Regular	2	142	61%
	4	9452	66%
	6	6269	70%
	8	1972	75%
	10	984	74%
	12	741	78%
	14	651	80%
	16	118	81%
	18	5	40%
	20	731	69%
	22	1	0%
	24	4	25%
	26	2	50%
Regular Total		21072	70%
Summer	6	441	73%
	8	1648	78%
	12	1	100%
	14	49	78%
	16	321	83%
	22	3	100%
Summer Total		2463	78%
Grand Total		23535	70%

Because more ESL students take multiple classes, their weekly class hours are more dispersed than in English or mathematics in the regular terms consequently, more of an overlap in hours from the regular to the summer sessions exists. This makes possible the comparative analysis of term length versus weekly class hour. That analysis is presented below.

The Effect of Weekly Class Hours and Term Length on Student Success in ESL

The question of the statistical significance of this data was examined by means of logistic regression. In a logistic regression equation, both semester of attendance and weekly class hours were used to predict the dichotomous variable of passing or failing students' English, ESL or mathematics class or classes. For students enrolled in multiple courses, passing was arbitrarily defined as passing more than 50% of their units. In both English and mathematics, because of the missing cells (the non-overlapping distribution of weekly hours from regular to summer terms) the model did not fit the data.

Consequently, no conclusions could be drawn about whether the operative factor was compression or intensity. Nonetheless, both factors were significant in predicting success in both disciplines. In ESL the situation was different. Because of the many students enrolled in more than one ESL class, the fit of the model to the data was acceptable. The logistic output is presented below in table 7.

Table 7

The CATMOD Procedure

Maximum likelihood computations converged.

Maximum Likelihood Analysis of Variance

Source	DF	Chi-Square	Pr > ChiSq
Intercept	1	1.46	0.2266
Semester	1	15.26	<.0001
Weekly hours	1	132.40	<.0001
Weekly hours*weekly hours	1	93.87	<.0001
Likelihood Ratio	15	20.42	0.1564

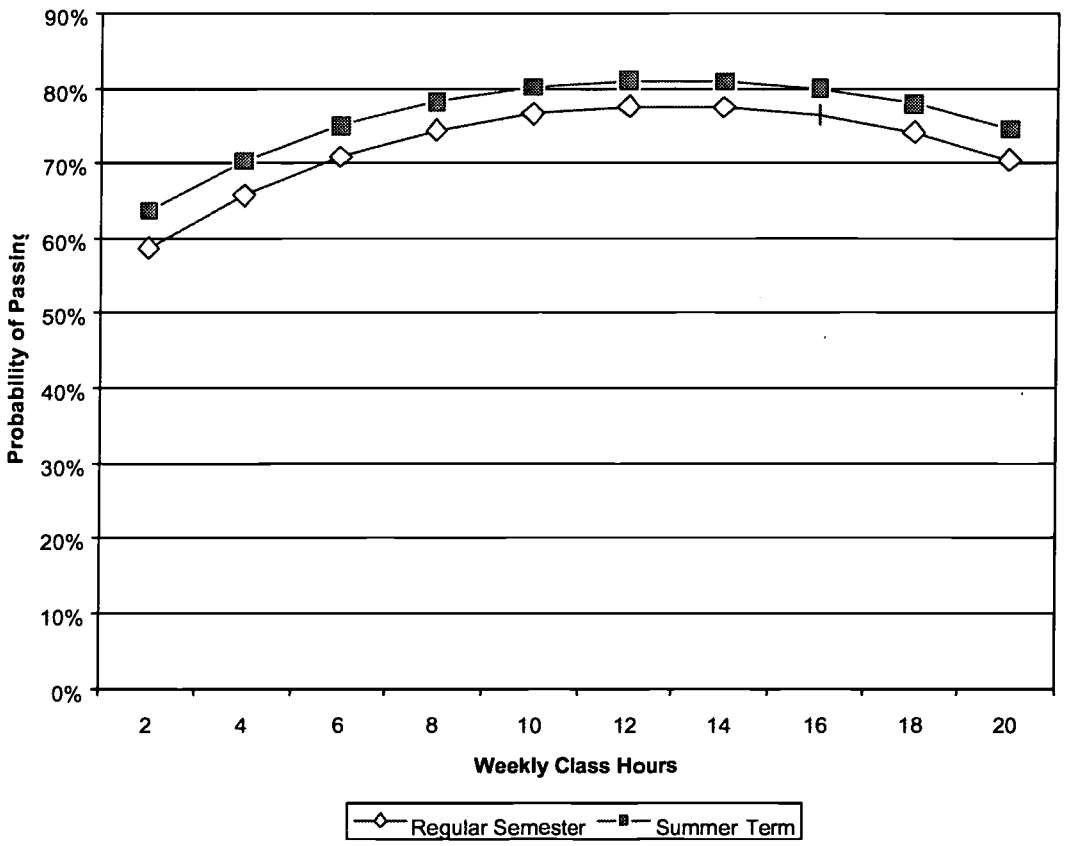
Analysis of Maximum Likelihood Estimates

Effect	Parameter	Estimate	Standard Error	Chi-Square	Pr > ChiSq
Intercept	1	0.0968	0.0801	1.46	0.2266
Semester	2	-0.1053	0.0270	15.26	<.0001
Weekly hours	3	0.1949	0.0169	132.40	<.0001
Weekly hours * weekly hours	4	-0.00756	0.000780	93.87	<.0001

What is of interest here is first the likelihood ratio with a significance level of .1564. Since the level is not below .05 we conclude that the model fits the data. Secondly, weekly class hours are nonlinearly related to the probability of students passing their ESL class. This is the weekly hours times weekly hours factor. Last and most importantly, both weekly class hours AND term of attendance is significant in predicting student success. The parameter estimates in the second half of the output can be used to graph the predicted relationship between semester, weekly hours and the probability of passing. Graph 8 below presents that relationship.

Table 8

Predicted Relationship Between Term of Attendance, Weekly Class Hours and the Probability of Passing ESL Classes



Graph 8 presents the logistic regression output from Table 7. It is clear from the graph that success increases with hours of ESL classes per week. However, in addition to this increase is a summer increase in success at every weekly class hour level. The bend in the line is the nonlinear relationship. Differentiation of the logistic function leads to the determination of the maximum success point. That occurs at 13 hours. The non-linearity of the relationship is important since it implies that intensity of study has its limits (13 hours) beyond which more hours lead to less, not more success.

Conclusions

Unfortunately, it has not been possible to determine which hypothesis is the operative one in English or mathematics. There are just too many holes in the data to answer that question. However, both factors seem to have a positive influence on success. Only in ESL where students take a wide range of hours of class in both summer and regular terms was it possible to reach a tentative answer. That answer is an unexpected 'both'. Both increased hours per week and the compressed summer term increase student success.

Now what is necessary is to flush out the relationship in both English and mathematics. However, to do that one needs a college where students in these disciplines take many different hour combinations in many different term lengths. If random assignment of students to test conditions were possible it would be even better in answering the fundamental question of this paper. That question is, can scheduling of classes improve students' chances of success? Certainly in an era where education is held accountable for the success of its students, the little things that are under the control of colleges and which impact success need to be handled well. Scheduling fits this mold.

I am not arguing here that colleges should change their semester structure. I am only arguing that various length and intensity class combinations need to be investigated more fully. One reason why class combinations need to be piloted is because there may be a maximum number of hours per week beyond which further intensity of study decreases success rather than increases it. The data in both ESL and mathematics suggest that this may be the case. In ESL a success maximum occurred at 13 hours per week. In mathematics, though the model was ill fitting, a maximum occurred at 11 hours. If a maximum intensity exists, high unit classes given in short time frames would overload the student. Certainly a complaint of students in Daniel's (2000) review of the literature on time-shortened classes is of a high level of stress and an inability to complete all of the work required in the shorter time frame. In spite of this qualification, the impact on student success of, for example, three six-week courses in ESL versus one 18-week class needs to be examined. In the similar vein, students might have more success taking 3 five unit classes across disciplines in a semester than 5 three unit ones. These alternatives need to be investigated. This can only be done with the kind of variable scheduling that encourages the piloting of classes of different lengths and intensity.

Because of the observational nature of the data, a causal relationship between intensity and compression on the one hand, and student success on the other cannot be posited. There is a lot going on in the background. Other hypotheses can be suggested that fit elements of the data presented here. However, it is only the aforementioned two hypotheses that have been examined at some length. The practical implications of this work are obvious. Now only the political will to examine them more fully needs to be forthcoming.

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