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ABSTRACT

An interdisciplinary curriculum program was introduced at a suburban high school almost 1,700 students when the school became eligible for a Chapter 1 program grant for academically at risk students. The interdisciplinary program, which integrated English, Algebra, Biology, and World History, developed and was expanded to all students, including an honors group. This study focuses on students in the Class of 2000, tracking the initial members of the class and subsequent enrollees. So far, the study has followed these students through 3 years; fourth-year additions will be grades for these students' senior year, in which there are no interdisciplinary classes, and college attendance rates. The first 3 years of the study have shown that behaviors by students in the interdisciplinary program are more positive than those for discipline-based students, as indicated by lower absence and suspension rates. Academic performance of interdisciplinary students is higher, and scores on the Iowa Test of Educational Development are equal or higher for the interdisciplinary group. Teachers of the interdisciplinary program expressed a strong preference for the instructional approach. An appendix contains a chart of Iowa Test of Educational Development scores. (SLD)

An Examination of the Effects of an Interdisciplinary Curriculum Program on Behavior and Academic Performance in a Suburban High School

Steve Cordogon and Lois Stanciak

An Examination of the Effects of an Interdisciplinary Curriculum Program on Behavior and Academic Performance in a Suburban High School

(A Compilation from the First Three Years of a Four-Year Study)

Introduction

This report on the Shepard High School interdisciplinary research study is the product of a collaboration between two authors with distinctly different perspectives. Dr. Lois Stanciak, the Assistant Principal for Curriculum and Instruction at Shepard High School in Palos Heights, Illinois, led the interdisciplinary effort, including the planning, implementation, assessment, and subsequent documentation and reporting. Dr. Steve Cordogan, the Coordinator of Research and Evaluation at Illinois Mathematics and Science Academy (IMSA), provided leadership with the research methodology, analysis, and reporting of the quantitative data.

Background

Shepard High School is comprised of almost 1700 students, with a racioethnic profile of 73.6% White, 19.5% Black, 5.0% Hispanic, 1.5% Asian, and .5% Native American. It is one of three comprehensive high schools in District 218.

The integrated journey began in 1993 when Shepard became eligible for a small Chapter One Program grant for academically at-risk students. A team of Shepard faculty and administrators decided that a new approach should be taken to meet the needs of this segment of the student population. At the same time the team applied to participate in the Association for Supervision and Curriculum Development (ASCD) Interdisciplinary Teaching and Learning Consortium, jointly sponsored by ASCD and IMSA. Acceptance to this consortium marked the beginning of Interdisciplinary Teaching and Learning (ITL) program.

The implementation began with considerable research and time devoted to staff development, focusing on the following areas: learning styles, interdisciplinary curriculum design, assessment and curriculum planning, multiple intelligence research, team building, conflict resolution, change process, meeting strategies, cooperative learning, brain research, block scheduling, and motivation.

The program began with a facilitator/coordinator and four teachers who shared the same 48 Chapter One students for two of their five-period teaching load. The program integrated English 1, Algebra, World History, and Biology through themes, concepts, skills, and strategies. Subsequently, the facilitator/coordinator was utilized as a tutor for the students, facilitating the replacement of the remedial approach with a more accelerated and challenging curriculum.

As the program developed and the staff perceived positive benefits, ideas developed for furthering such integration and expanding the program to other students, thus erasing the perception that it was an "at risk" program. Hence, the interdisciplinary program was expanded to mainstream students, including an honors group, in the following year.

Participation in a Challenge Grant that focused on Reality-Based Learning furthered the level of sophistication along the interdisciplinary continuum towards Problem-Based Learning. This growing constructivist philosophy transformed the role of teacher to that of facilitator, while motivating students to take an active role in their own learning. In 1997-1998, business partnerships were formed, including those with three Fortune 500 companies. The 1998-1999 school year saw continued expansion to incorporate three-period junior blocks, as well as mini-blocks of two periods.

Each year's expansion was predicated by the increased volunteering of teachers for the program. As of the 1998-1999 school year, program participants included almost 600 freshman, sophomore, and junior-level students, as well as 39 teachers from various disciplines and academic levels serving on 14 interdisciplinary teams.

The perceived benefits were divided into those for students and those for teachers. The positive benefits for the students, similar to those for a school within a school, were higher levels of the following:

- parental involvement;
- interaction;
- empowerment;
- responsibility and accountability;
- challenges;
- rigor, richness, and recursion in learning;
- opportunities to take risks safely;
- utilization of time on-task;
- overall student learning;
- alternative assessments; and
- safeguards against failing and "falling through the cracks" of the system.

Positive benefits to teachers included higher levels of the following:

- empowerment,
- opportunities to take risks safely,
- involvement in program planning,
- opportunities to assume leadership roles,
- teaming,
- collaboration, and
- communication.

The major barriers to implementation included the increased time commitment and negative responses from some faculty and administrative staff members.

Literature Review

Proponents of an interdisciplinary curriculum generally maintain that it has greater real-life relevance, and therefore is more meaningful to the student, than discipline-based curricula.

According to Everett (1992), an interdisciplinary curriculum allows students to learn as they would in the real world. She also believes that such an approach enables a teacher to be student-centered as well as subject-centered, thus promoting greater student participation and shared decision-making. Hackmann and Waters (1998) cite various studies that found that schools with the innovative scheduling inherent in interdisciplinary programs often report improvement in attendance, disciplinary problems, students completing advanced placement courses, mastery of content, and grades.

In contrast, others have questioned such interdisciplinary learning for its focus on connections at the expense of content. Gardner (1999) argues, "To use the word 'interdisciplinary,' one must show that particular disciplines have been mastered and appropriately joined." He believes that pre-collegiate students initially must be immersed in a discipline-based approach to learning in order master the knowledge necessary to pursue genuine interdisciplinary work.

Research Methodology

The study focused on students who were members of the Class of 2000, tracking both the initial members of the class as well as subsequent enrollees over the course of their high school careers. It compared the interdisciplinary students to the traditional-curriculum students using the following quantitative measures:

- academic performance measures: GPA, scores on the Iowa Test of Educational Development and its subsections (freshman year only), percentages of students taking ACT college admissions tests during their junior year, and ACT scores;
- behavioral measures: attendance, tardiness, and suspensions.

The focal additions from the study's fourth year will be grades for the students' senior year, at which time there are no more interdisciplinary classes, and college attendance rates.

In order to compensate for any compromises in the otherwise random assignment of students due to scheduling constraints, the intervening effects of race (grouping Blacks, Hispanics and Native Americans in one group and Whites and Asians in the other) and gender also were examined. Socioeconomic status data, which often are highly related to racioethnicity, were not available. Hence, racioethnic findings may be attributable in part to underlying socioeconomic status.

The above quantitative data were augmented with focused interviews of teacher and student participants in the interdisciplinary program. Students were randomly selected to respond to structured interviews that focused on the following:

- positive and negative experiences,
- block scheduling and the contrast between block periods and regular periods,
- connections made in their coursework,
- skill attainment,
- relevant classroom experiences,
- most valuable activities, and
- desired changes.

Limitations

School-based research designs are restricted in terms of ability to measure all possible dimensions of change and control potential compromises to validity. Such concerns are compounded when the study is well under way before the researcher has begun to work with the school, as was the case in this setting. The major issues were the following.

- Teacher participation in the interdisciplinary program occurred through self-selection. Some differences found between programs could be explained by preexisting differences in the teachers rather than the curriculum. Such differences also may affect grading standards.
- Student assignment to each program largely was randomized, limited only by scheduling restrictions. Nevertheless, differences between the two groups in terms of racioethnicity and gender were found in the student records database. Such differences were expected to favor the interdisciplinary program, since that program's higher levels of females and White/Asian students traditionally have higher GPA's and fewer recorded suspensions than males and Blacks/Hispanics. Statistical techniques to adjust for the inequalities only accommodated differences for which data were kept (for example, there was no income data).

  There was no racioethnic or gender data in the Iowa test database, but the availability of pretest data demonstrating minimal differences largely eliminated inequality concerns for this comparison.
- The setting is likely to generate a Hawthorne effect. The extra attention and interaction experienced by the interdisciplinary teachers in the implementation of a new program may enhance their performance regardless of the merits of an interdisciplinary curriculum. Such enhancement may in turn affect the performance of their students.
- Novelty effect also may enhance initial teacher and student performance. The passing of time inherent in a longitudinal approach should minimize such an effect.
- The Iowa Test score comparison used the student as the unit of analysis. While such protocol is common in classroom-based studies, contrasts using the class as the unit of analysis (reducing the *n* for each group to one) may be more valid.
- The quantitative data were augmented with interviews of interdisciplinary teachers and students. However, no attitude-specific comparisons were conducted between the interdisciplinary and non-interdisciplinary students.
- Neither the Iowa nor the ACT is designed to focus on the integrative thought fostered by an interdisciplinary curriculum. Such tests tend to focus on content accumulation rather than on understanding and problem-solving. Hence, possibly the integrative benefits of the interdisciplinary curriculum will be minimally measured, while its primary potential weakness will be scrutinized. Consequently, expectations for these more traditional measures should be to find no difference between the two groups; that there is "no harm done" in terms of content learning for the interdisciplinary students.

Findings

Analyses of Iowa Test Comparisons

The thirteen scores from the Iowa Test of Educational Development (ten subscores, two area composites, and an overall composite score) comprised the other set of data for quantitative

analysis. Four sections of the Class of 2000 (interdisciplinary regular, discipline-based regular, interdisciplinary honors, and discipline-based honors) were tested at the beginning and end of the 1996-1997 academic year. The large difference in academic performance levels between the honors and regular students resulted in the use of two sets of analyses. The first was a contrast between students from the interdisciplinary regular class and the discipline-based regular class, and the second was between interdisciplinary honors and discipline-based honors.

The differences for initial scores between the interdisciplinary regular and discipline-based regular students were minimal, with composite score means of 249.0 and 247.7, respectively. The initial differences between the interdisciplinary honors and discipline-based honors were slightly larger, with composite score means of 291.8 and 285.6, respectively. Although none of the differences for the thirteen sets of means were statistically significant, analyses of covariance (ANCOVA's) were used for the comparisons to adjust for the generally slightly higher initial interdisciplinary student scores.

Test scores for both groups showed significant increases for most test scores (see the graph, Freshman Pre- and Post-Test Scores on the Iowa Test of Educational Development: 09/96 - 05/97, in page 1 of the Appendix,).

The ANCOVA's demonstrated that one of the ten individual adjusted final score means, interpreting literary material, was significantly higher for the interdisciplinary regular class contrasted with the traditional regular class ($p = .004$; eta squared (ω^2) = .084). Although unequal variances and sample sizes would reduce the significance of this contrast, the level would remain significant (unequal variance post hoc tests are not available for dichotomous contrasts). Similarly, two of the adjusted final scores, quantitative-advanced skills and quantitative thinking, were significantly higher for the interdisciplinary honors class than the traditional honors class ($p = .009$; $\omega^2 = .079$ and $p = .023$; $\omega^2 = .062$, respectively). None of the composite scores showed significant differences for either the regular or honors student contrasts. Hence, these end-of-freshman-year measures, even when adjusted for between-group differences, showed that the interdisciplinary classes demonstrated generally equal but occasionally superior performance.

Analyses of Interviews of Interdisciplinary students and Teachers

The interviews conducted through the years demonstrated a variety of positive attitudes toward the interdisciplinary program from both interdisciplinary teachers and students. Interdisciplinary students reported increased levels of the following positive trends, many of which matched the intended goals of the program:

- feelings of empowerment;
- acceptance of responsibility for own behavior and performance;
- risk-taking in class;
- team building skills;
- increased difficulty, variety and complexity of assignments;
- opportunity for use of different ways of thinking;
- strategies that appeal to a variety of learning styles;
- project focus;

- authentic tasks and assessments;
- creative lesson plans;
- social interaction and comfort level with peers;
- time on task, focus, and productivity;
- skill proficiency in notetaking, semantic mapping, communication [speaking, listening, and writing], content area reading strategies, study skills, and working independently;
- teacher concern for and interaction with students;
- teachers working with each other;
- parental involvement;
- classes being perceived as more student-centered and interactive; and
- utilization of technology.

The increased blocks of class time were mentioned as fostering many of the above positive trends. The interdisciplinary students had no general negative comments specific to the program.

Teachers were asked to comment on the advantages disadvantages, limitations, problems, and possibilities of working in the integrated block. The advantages reported were:

- larger blocks of time enhanced efficiency, inasmuch as activities (e.g., labs, projects, covering themes and concepts) can be introduced, completed, and reviewed in the same day;
- collaboration provided support, promoting enthusiasm and growth;
- collaboration produced better solutions to problems, particularly relative to individual students; and
- larger blocks of time produced stronger relationships with students.

The disadvantages found were:

- excessive familiarity among students,
- students who did not assume responsibility for make-up work, and
- extra time needed for planning.

In general, the teachers expressed that after being in the integrated block teams, they did not want to return to the relative alienation and isolation of a traditional class setting.

Analyses of Grade, Behavioral, and ACT Data

The initial t-test analyses demonstrated that for the Class of 2000, the interdisciplinary students had higher GPA's and lower rates of days absent, tardies and suspensions, as indicated by the chart below.

Comparisons between Program Means

	1996-1997		1997-1998		1998-1999	
	Discipline-based (n = 303)	**Interdisciplinary** (n = 158)	**Discipline-based** (n = 228)	**Interdisciplinary** (n = 202)	**Discipline-based** (n = 161)	**Interdisciplinary** (n = 247)
GPA	2.91	3.64	3.00	3.79	3.15	3.71
# of Days Absent	13.1	8.2	13.2	7.7	13.5	9.5
# of Tardies	1.1	.6	1.6	1.1	3.7	2.3
# of Suspensions	.7	.2	.7	.2	.5	.3
ACT scores	not analyzed		not analyzed		20.8*	21.1*

* only 38 (23.6%) of the discipline-based students, versus 134 (54.3%) of those in interdisciplinary, took the ACT by the end of their junior year.

Most of the findings were highly statistically significant, as indicated by the chart below. Levels for ω^2 were included to display an estimate of the amount of variance explained by the relationships.

t-tests of Differences between Programs

	1996-1997		1997-1998		1998-1999	
	Significant? (at .05 level)	p (ω^2)	**Significant?** (at .05 level)	p (ω^2)	**Significant?** (at .05 level)	p (ω^2)
GPA	Y	<.001 (.114)	Y	<.001 (.162)	Y	<.001 (.075)
# of Days Absent	Y	<.001 (.036)	Y	<.001 (.071)	Y	<.001 (.045)
# of Tardies	Y	.001 (.018)	Y	.036 (.010)	Y	.003 (.027)
# of Suspensions	Y	<.001 (.045)	Y	<.001 (.060)	N	.122 (.006)
ACT scores	not analyzed		not analyzed		N	.783 (.0004)

Note that while the difference between ACT scores was not significant, the percentage of interdisciplinary students taking the ACT was almost double that for discipline-based students. The chi-square of 37.55 for this difference was highly significant ($p < .001$), and regression analyses demonstrated that program choice explained at least 9.2% of the variance in ACT test-taking levels (8.5% after factoring for the initial effects of racioethnicity). Hence, the finding of no significant difference for the comparison of mean scores is tempered by the much larger proportion of interdisciplinary students taking them.

Differences were found between the program in terms of gender and race. The traditionally underrepresented groups (Blacks, Hispanics, and Native Americans) were underrepresented in the interdisciplinary program, particularly in the 1996-1997 and the 1997-1998 years. Also, males were somewhat underrepresented in the interdisciplinary program all three years. Hence, it was necessary to factor out the effects of racioethnicity to determine whether the differences were programmatic or simply an artifact of racioethnicity and gender.

The three-way ANOVA's, controlling for the effects of race and gender, demonstrated that the interdisciplinary program students demonstrated generally more positive behaviors to a statistically significant degree for most measures, as illustrated in the chart below.

ANOVA's for Differences between Programs, Factoring for Racioethnicity & Gender

	1996-1997		1997-1998		1998-1999	
	Significant? (at .05 level)	***p* (ω^2)**	**Significant? (at .05 level)**	***p* (ω^2)**	**Significant? (at .05 level)**	***p* (ω^2)**
GPA	Y	<.001 (.038)	Y	<.001 (.095)	Y	<.001 (.047)
# of Days Absent	Y	.008 (.016)	Y	<.001 (.046)	Y	<.001 (.038)
# of Tardies	Y	.015 (.013)	N	.195 (.004)	N	.081 (.008)
# of Suspensions	Y	.006 (.017)	Y	<.001 (.046)	N	.201 (.004)
ACT scores	not analyzed		not analyzed		N	.752 (.001)

Although the above year-to-year contrasts indicate higher-level performance in the interdisciplinary program, there are additional considerations of student transience across years. While there were no specific data available on whether the students had dropped out of school entirely, it was possible to track students in terms of whether or not they left the school or switched from one program to the other. There also were many students who transferred into the school over the course of the three years. The following highlights the most meaningful transfer data:

- For the interdisciplinary students, 108 of the original 158 (68.4%) stayed in the program throughout its three years (again, there is no interdisciplinary program their senior year). Eleven left the school after their freshman year and another 11 after their sophomore year. Although no one transferred from the interdisciplinary program to the discipline-based program after their freshman year, 28 of the original 158 transferred after their sophomore year. This increase was attributed to the limited honors scheduling at that level in the interdisciplinary program.
- In contrast, 72 of the original 303 (23.8%) stayed in the discipline-based track program throughout its three years. Sixty left the school after their freshman year and another 37 after their sophomore year. Also, 48 of the original 303 transferred from the discipline-based program to the interdisciplinary program after their freshman year (12 of them transferred back after their sophomore year, possibly due to the limited honors offerings) and 82 more transferred to interdisciplinary after their sophomore year.

Differences in the effect of programs on student learning and behavior would be most pronounced for students who had stayed with each program throughout the three years. Hence, the most valid analyses of contrasts in terms of differentiating the effects of the programs are represented in the table below.

ANOVA's for Differences between Persisters Across All Years in Each Program, Factoring for Racioethnicity & Gender

	Significant? (at .05 level)	***p* (ω^2)**
GPA	Y	<.001 (.163)
# of Days Absent	Y	<.001 (.068)
# of Tardies	N	.575 (.002)
# of Suspensions	Y	<.001 (.126)
ACT scores	Y	.037 (.052)

Note that this time, the difference between ACT scores was significant. Furthermore, the percentage, the percentage of interdisciplinary students taking the ACT was 72.2% versus only 15.3% for discipline-based students. The chi-square of 56.0 for this difference was highly significant ($p < .001$), and regression analyses demonstrated that program choice explained at least 31.1% of the variance in ACT test-taking levels (27.2%% after factoring for the initial effects of race).

Conclusion

The following conclusions have emerged from the first three years of the research study:

- Behaviors by student in the interdisciplinary program are more positive than those for the discipline-based students, as indicated by the generally lower absence and suspension rates (findings on tardies are less clear). Also, the attrition rate for the interdisciplinary program has been much lower. Additionally the discipline-based students more frequently have chosen to transfer into the interdisciplinary program. Furthermore, the interdisciplinary students expressed a preference for their current classes over past discipline-based ones.
- The academic performance levels of students, as measured by GPA, were much higher for interdisciplinary students. Also, the Iowa Test of Educational Development scores were equal or higher for the interdisciplinary students. Although the standards for GPA are not necessarily uniform across the two programs, and the Iowa test is demonstrated interdisciplinary superiority in only a small percentage of areas, such performance does not support any concerns towards a "dumbing down" of interdisciplinary curricular content. The ACT data preliminarily indicates a definite superiority (to a minor degree in terms of actual scores and to a major degree in terms of percentage taking the test) for interdisciplinary program
- Interdisciplinary teachers expressed a strong preference for their current teaching experience over prior non-integrative ones.

The 1999-2000 data will be incorporated into the findings in July, 2000, adding a fourth year of these data as well as initial long-term data (particularly more college entrance test scores, college attendance rates, and GPA's for a senior year which has no interdisciplinary program). Hence, the comparison of senior-year GPA's between former interdisciplinary students and those from the discipline-based program can be contrasted without concerns for between-program differences in grading standards. The gathering of comparison data on attitudes, as well as additional information on subsidized school lunch eligibility and dropout status, also will be pursued.

The final question that remains is whether the curriculum can be credited with the apparent positive aspects of the interdisciplinary students and teachers. The teacher self-selection into the program, novelty effect of new experiences, and the extra attention paid to an innovation, were factors which initially may have provided an edge to interdisciplinary teacher and student performance measures. However, as the study continued, the novelty diminished and the measures became longer-term. Furthermore, the students and teachers seem to be benefiting from the program, regardless of the reason. So for now, the cumulative three-year positive

findings solidly support the continuation of this interdisciplinary experiment at the high school, and indicate that other schools might want to emulate the program.

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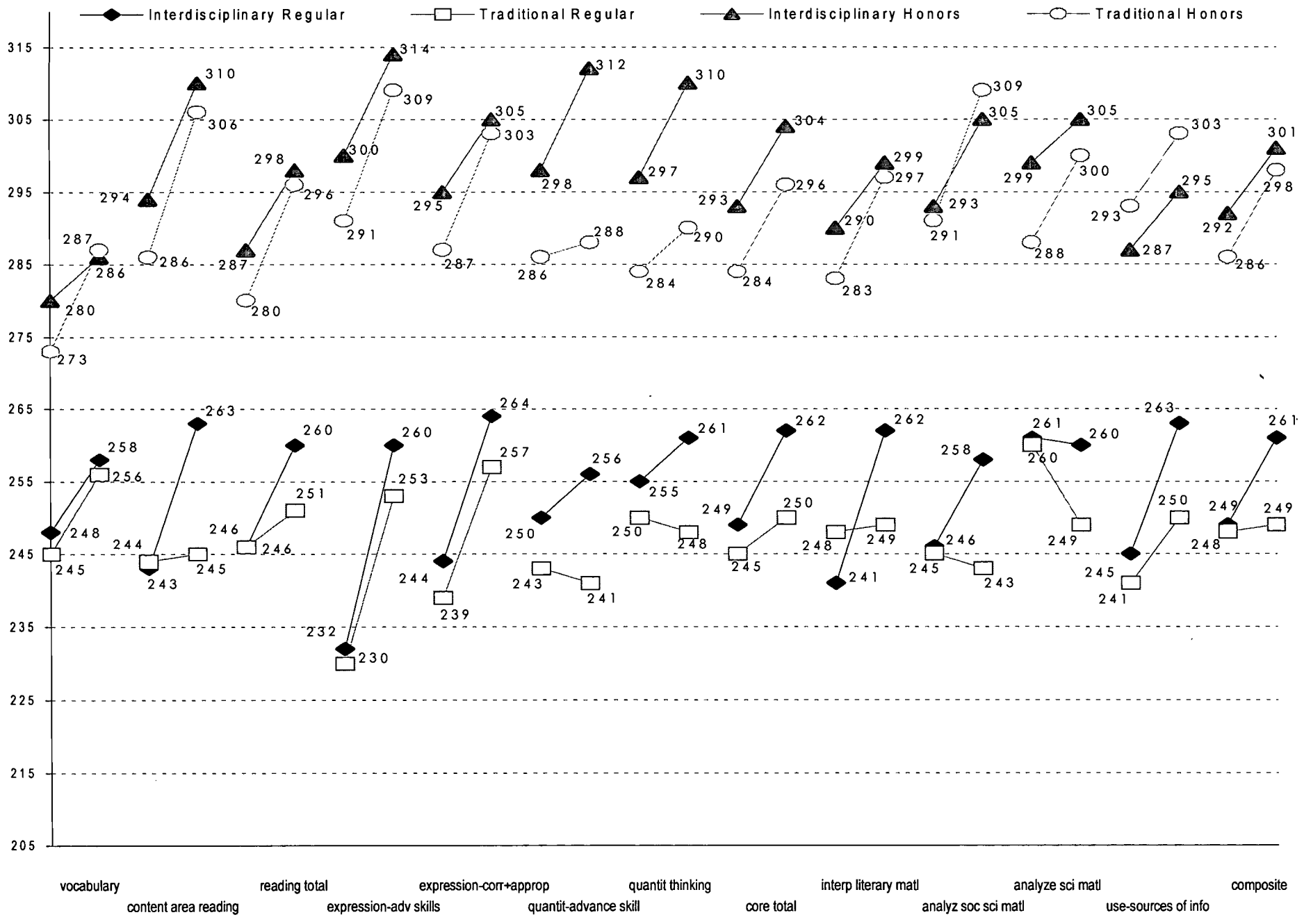
Appendix

Freshman Pre- and Post-Test Scores on the Iowa Test of Educational Development: 09/96 - 05/97



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