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HIGH SCHOOL MATHEMATICS COURSE-TAKING PATTERNS OF MIDDLE SCHOOL ALGEBRA I STUDENTS

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ABSTRACT

This study is a follow-up study to one of effective instructional practices of two Wake County Public Schools (WCPSS) middle school Algebra I teachers (Haynie, 2009). In order to study the potential impact of middle school Algebra I teachers on math course taking in high school, the 2003-04 8th grade Algebra I students of the most effective (T1) and least effective(B1) teachers from the aforementioned study were examined further. In high school, 97% of T1's students took Honors Geometry in 9th grade compared to 77% of B1's students. In 12th grade, 62% of T1's students took AP Calculus or higher course compared to 38% of B1's students.

INTRODUCTION

Successful completion of Algebra I is a North Carolina graduation requirement and a prerequisite for advanced mathematics courses in high school. The newly adopted WCPSS Board of Education (BOE) Goal includes preparing students to compete globally:

> *WCPSS students will demonstrate high academic growth; by 2014, all students will graduate on-time prepared to compete globally.*

An indicator of the goal at the high school level is increased enrollment in advanced mathematics courses. Students who take Algebra I in middle school have more opportunity to take advanced mathematics' courses in high school than students who first take Algebra I in high school. It is no surprise that another indicator of the Board's goal is increased enrollment in middle school Algebra I. This indicator implies that increased enrollment in middle school Algebra I will lead to increased enrollment in advanced mathematics courses in high school which will lead to preparation of students to compete globally. This paper reports the findings of a study of the

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high school mathematics course-taking patterns of selected students who took Algebra I in middle school.

The study, reported here, follows from a study of effective instructional practices of middle school Algebra I teachers. In that study, eight middle school Algebra I teachers were identified as most effective (T1-T8) and eight teachers were identified as least effective (B1-B8). These teachers were a subset of the 36 WCPSS teachers who had taught middle school Algebra I for four consecutive years from 2003-2007. Surveys, observations, and focus groups were used to collect data about their instructional practices, and effectiveness was measured by examining residuals from Algebra I results for their past students (Haynie, 2009).

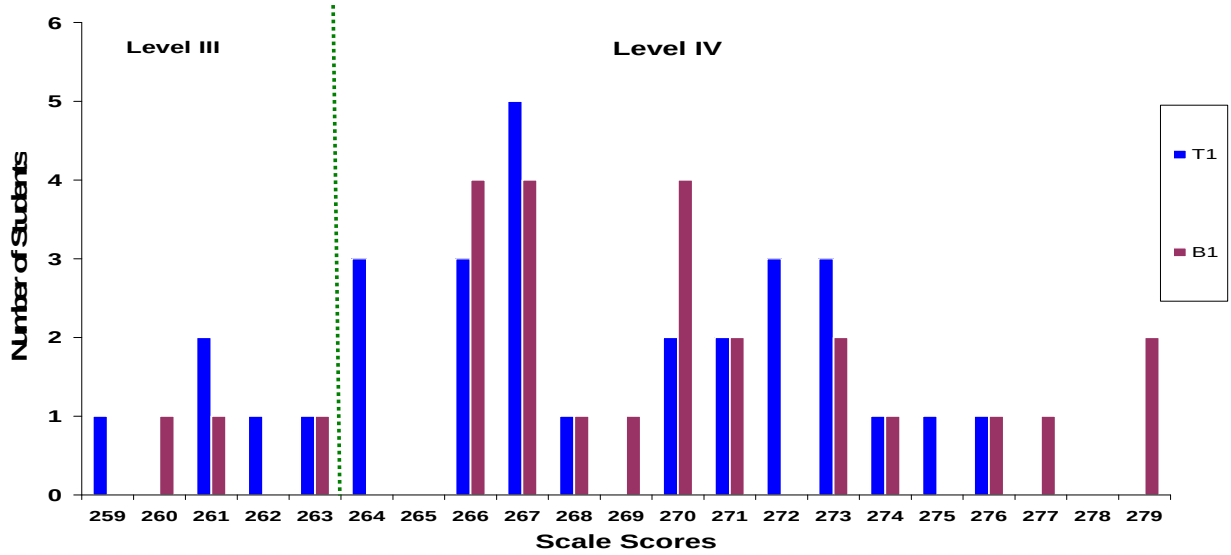
The previous study found that the most effective middle school algebra teachers held a significantly more positive attitude toward their students than did less effective teachers. They had high expectations for **all** students, used mathematics vocabulary appropriately, had a structured classroom management style, taught bell to bell using an invigorated pace, and had a classroom culture in which students were free to ask questions, contribute, and offer explanations (Haynie, 2009).

The teachers in the first study stated, during focus-group interviews, that student success in high school mathematics was another indicator of teacher success in middle school Algebra I. Yet they only heard back from a small percentage of their students after they left middle school. The current study documents the high school mathematics journey for two groups of middle school Algebra I students – one for the most and one for the least effective teacher.

HIGH SCHOOL ACADEMIC ACHIEVEMENT

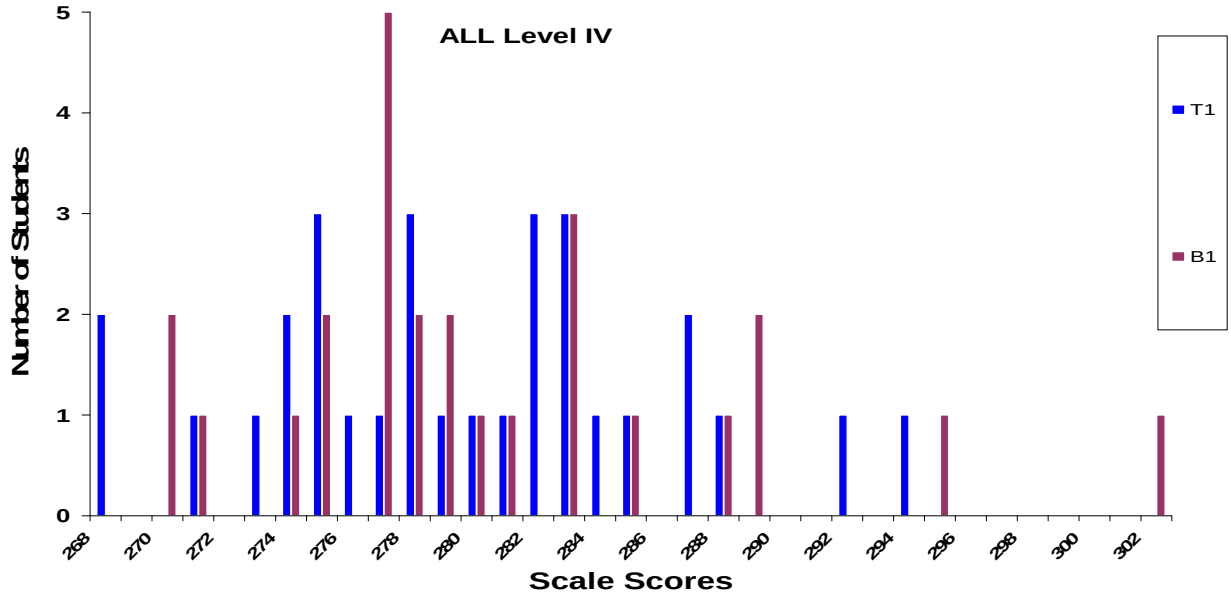
In order to study the potential impact of middle school Algebra I teachers on math course taking in high school, the 2003-04 8^{th} grade Algebra I students of teachers T1 and B1 were studied further. T1 was the most effective teacher of the previous study, and B1 was the least effective teacher. Teacher T1 taught 30 students in 2003-04, and Teacher B1 taught 26 students. There was no significant difference between the two groups of students in terms of their 7^{th} grade reading or mathematics scores (Figures 1 and 2).

Figure 1
7th Grade Reading Scale Scores
2002-03



Notes: T1: Mean 268.0 Standard Deviation 3.0
B1: Mean 269.5 Standard Deviation 3.2

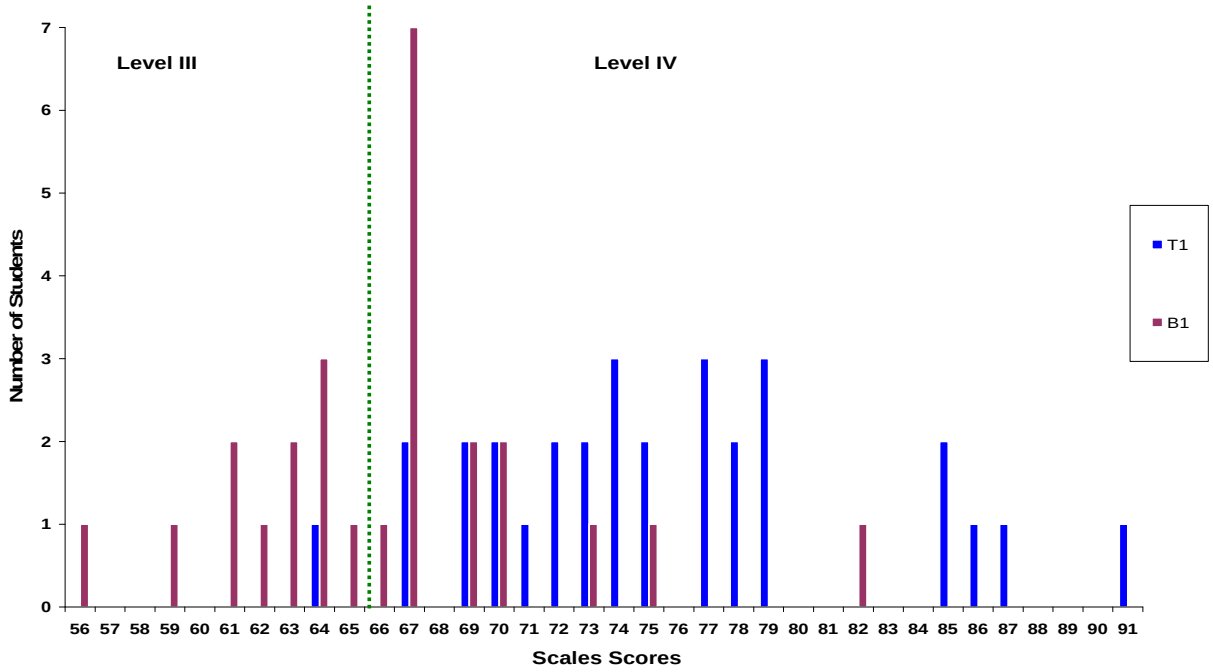
Figure 2
7th Grade Mathematics Scale Scores
2002-03



Notes: T1: Mean 279.4 Standard Deviation 4.7
B1: Mean 280.5 Standard Deviation 5.2

The 8th grade Algebra I performance of the two groups, by the end of 2003-04, however, was significantly different with a p-value less than .0005. The mean scale score for T1 students was 75.6 with a standard deviation of 6.8, while the mean scale score for B1 students was 66.3 with a standard deviation of 5.4. T1 scores ranged from 64 to 91, while B1 scores ranged from 56 to 82. The incoming 7th grade mathematics scores for all students were at Level IV for both teachers. The outgoing Algebra I scores included 11 students at Level III for teacher B1 and only one at Level III for teacher T1. Therefore, although T1 and B1 had students with similar incoming skills, T1's students performed significantly better (Figure 3).

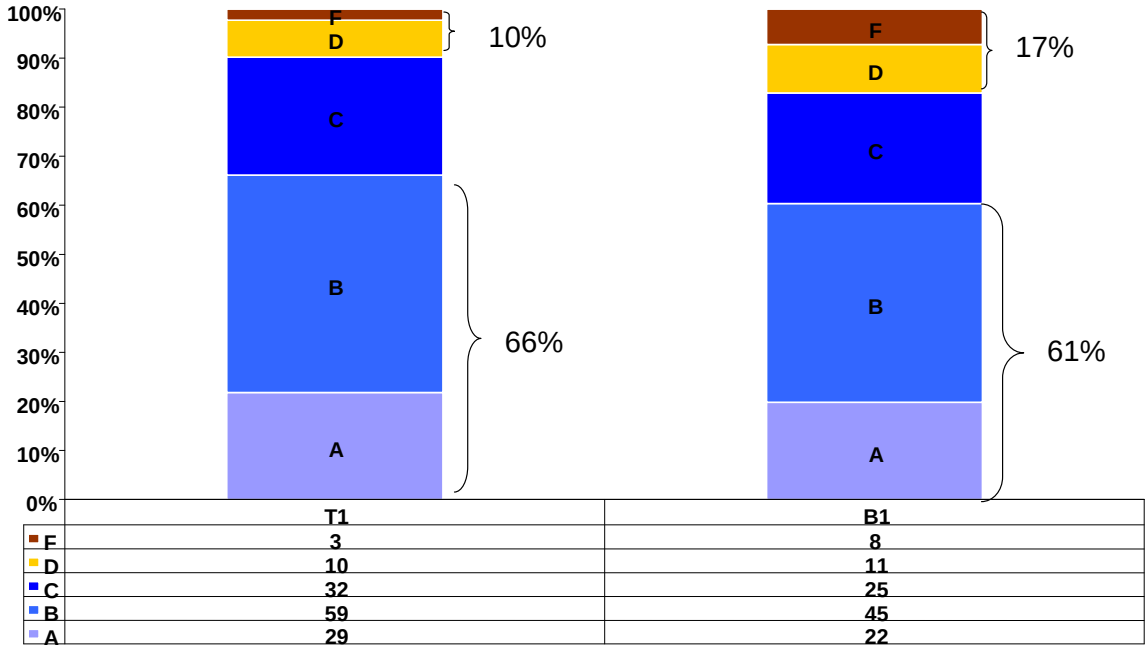
Figure 3
8th Grade Algebra I Scale Scores
2004-05



Notes: T1: Mean 75.6 Standard Deviation 6.8
B1: Mean 66.3 Standard Deviation 5.4

In high school, the students of teachers T1 and B1 took on average 4.3 mathematics courses per student. Looking at course grades, the performance for these courses was slightly higher for T1 than B1 students. Despite these apparent differences, a chi-squared test found no statistical difference between grades obtained by the two groups of students (Figure 4).

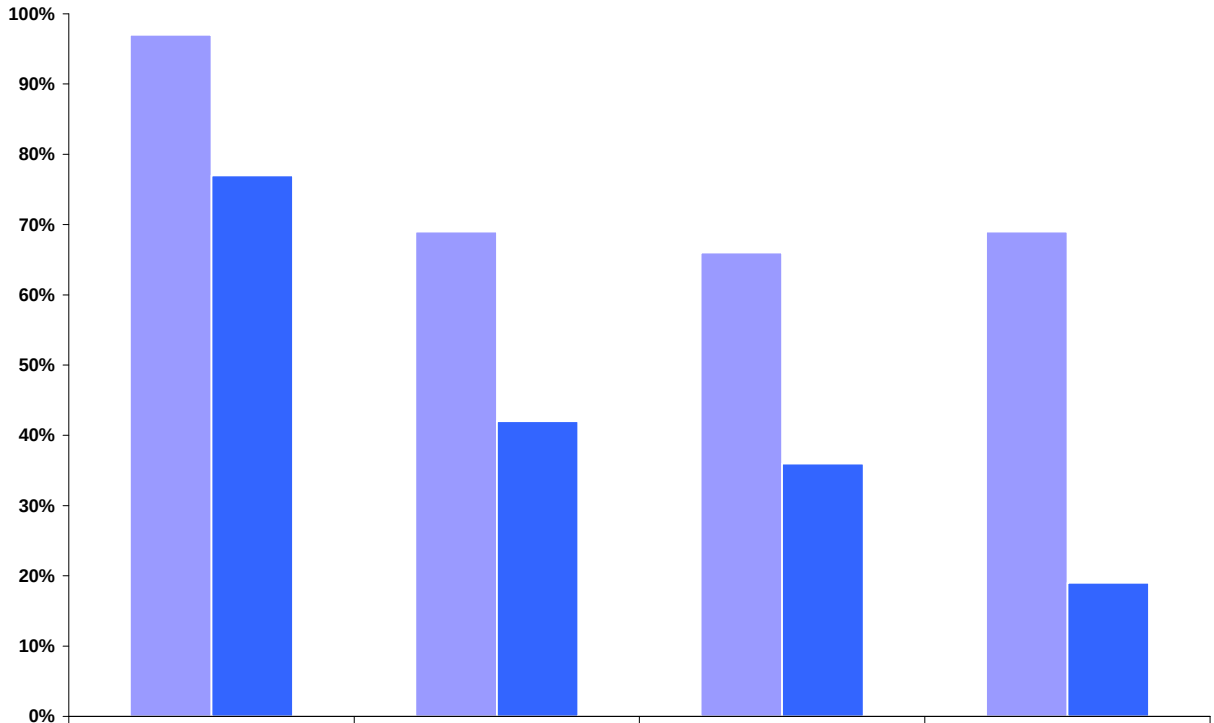
Figure 4
High School Mathematics Grades
2003-04 T1/B1 Cohort



	T1	B1
F	3	8
D	10	11
C	32	25
B	59	45
A	29	22

The types of courses taken, however, were very different for the two groups. In 9th grade, 97% of T1's students took Honors Geometry, compared to 77% of B1's students. In both cohorts, fewer and fewer students were taking the highest level of mathematics courses as they journeyed through high school, yet far more of T1's students took the most advanced courses. In the 12th grade, 69% of T1's students were taking AP Calculus or higher (courses that required successful completion of Honors PreCalculus), compared to only 19% of B1's students. A chi-squared test showed a significant difference in the proportion of students in the most advanced courses by teacher group (Figure 5).

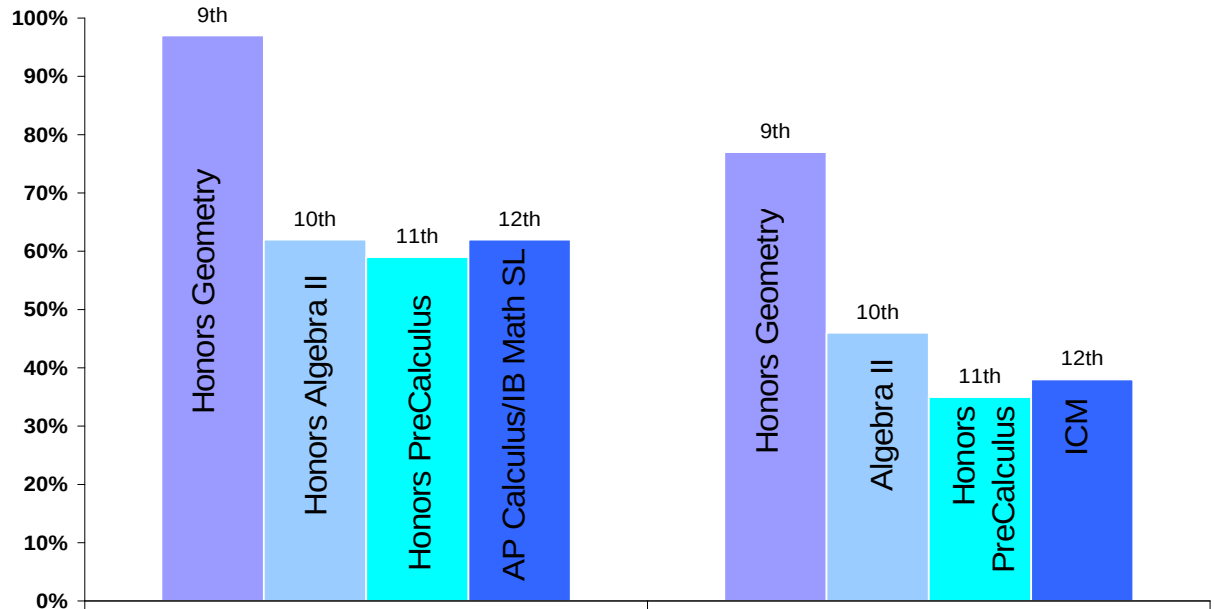
Figure 5
Percentage of Students in the Most Advanced Mathematics Courses
2003-04 T1/B1 Cohort



	Honors Geometry	Honors Algebra II	Honors PreCalculus	AP Calculus/IB Math SL
T1	97%	69%	66%	69%
B1	77%	42%	36%	19%

It is also interesting to observe that at least 59% of T1's students were taking the most advanced mathematics course available each year. Figure 6 shows the course that was most commonly taken by each cohort of students each high school year. In 10th grade, the course taken most often by B1 students was non-honors Algebra II, and in the senior year it was the honors course Introduction to College Mathematics (ICM). Appendix A has a flow chart for each cohort that details their journeys through high school mathematics.

Figure 6
The Mathematics Course with the Largest Cohort Enrollment
2003-04 T1/B1 Cohort



	T1	B1
9th	97%	77%
10th	62%	46%
11th	59%	35%
12th	62%	38%

For comparison purposes, Appendix B has high school course-taking flow charts of students in the Algebra I classes of the top and bottom teachers of the previous high school Algebra I effectiveness study (Haynie, 2008). These students took 8th grade mathematics in 2003-04. The difference in performance is again present, with the students of the top teacher continuing to have greater success in mathematics courses as they move through high school. Of interest is that although it was possible to take honors mathematics courses in high school without taking 8th grade Algebra I, very few students did, and none of these students took calculus.

Table 1 gives a summary of the four cohorts. Note that although the top high school teacher had a higher Algebra I mean scale score than the bottom middle school teacher, B1, fewer of these students took honors courses. The honors designation, for these students, appears to have been established in middle school. Some middle school Algebra I students left the honors pathway, but few high school students joined.

Table 1
Summary Statistics
Comparison of Students Taking Algebra I in Middle School to High School
2003-04 Cohort

Mean Reading Pretest *	TOP T1	BOTTOM B1
MIDDLE SCHOOL	268.0	269.5
HIGH SCHOOL	266.7	264.3

Mean Mathematics Pretest*	TOP T1	BOTTOM B1
MIDDLE SCHOOL	279.4	280.5
HIGH SCHOOL	274.3	268.9

Mean Algebra I	TOP T1	BOTTOM B1
MIDDLE SCHOOL	75.6	66.3
HIGH SCHOOL	71.6	56.3

Percentage taking Honors or AP Mathematics in 12th grade	TOP T1	BOTTOM B1
MIDDLE SCHOOL	96%	75%
HIGH SCHOOL	24%	5%

* Middle School Pretest was the 7th grade EOG/ High School Pretest was the 8th grade EOG
Note: High School data taken from Haynie (2008).

CONCLUSIONS AND DISCUSSION

The current study is limited to two middle school teachers and two high school teachers with only one year of Algebra I data for each. It is also limited by the exclusion of any teacher or school data between Algebra I and 12th grade mathematics. There are many possible intervening factors that would add to the explanation of the results. For the students in this study, there were some clear differences in their high school mathematics course taking, depending on whether they had a higher or lower-performing algebra teacher in 8th grade.

The 2003-04 students of the most effective middle school teacher entered Algebra I with 7th grade EOG scores comparable to the students of the least-effective teacher. In fact, the average scale scores were slightly lower among the students of the top teacher. At the end of Algebra I, however, T1's students scored significantly higher on the Algebra I EOC than B1's students. In high school, 97% of T1's students took Honors Geometry in 9th grade compared to 77% of B1's students. In 12th grade, 62% of T1's students took AP Calculus or higher course compared to 38% of B1's students.

For these two groups of students, the disparate course-taking patterns in high school mirrors their performance in 8th grade and correlates with the effectiveness of the 8th grade teachers. Generalizing to all students and teachers of middle school Algebra I is unwise with so little data. It is recommended that additional studies look for supporting evidence of the long-term effects of the middle school Algebra I experience on high school course-taking behavior, and on the possible intervening factors that may help to push high-performing middle school students to continue on a rigorous pathway in mathematics.

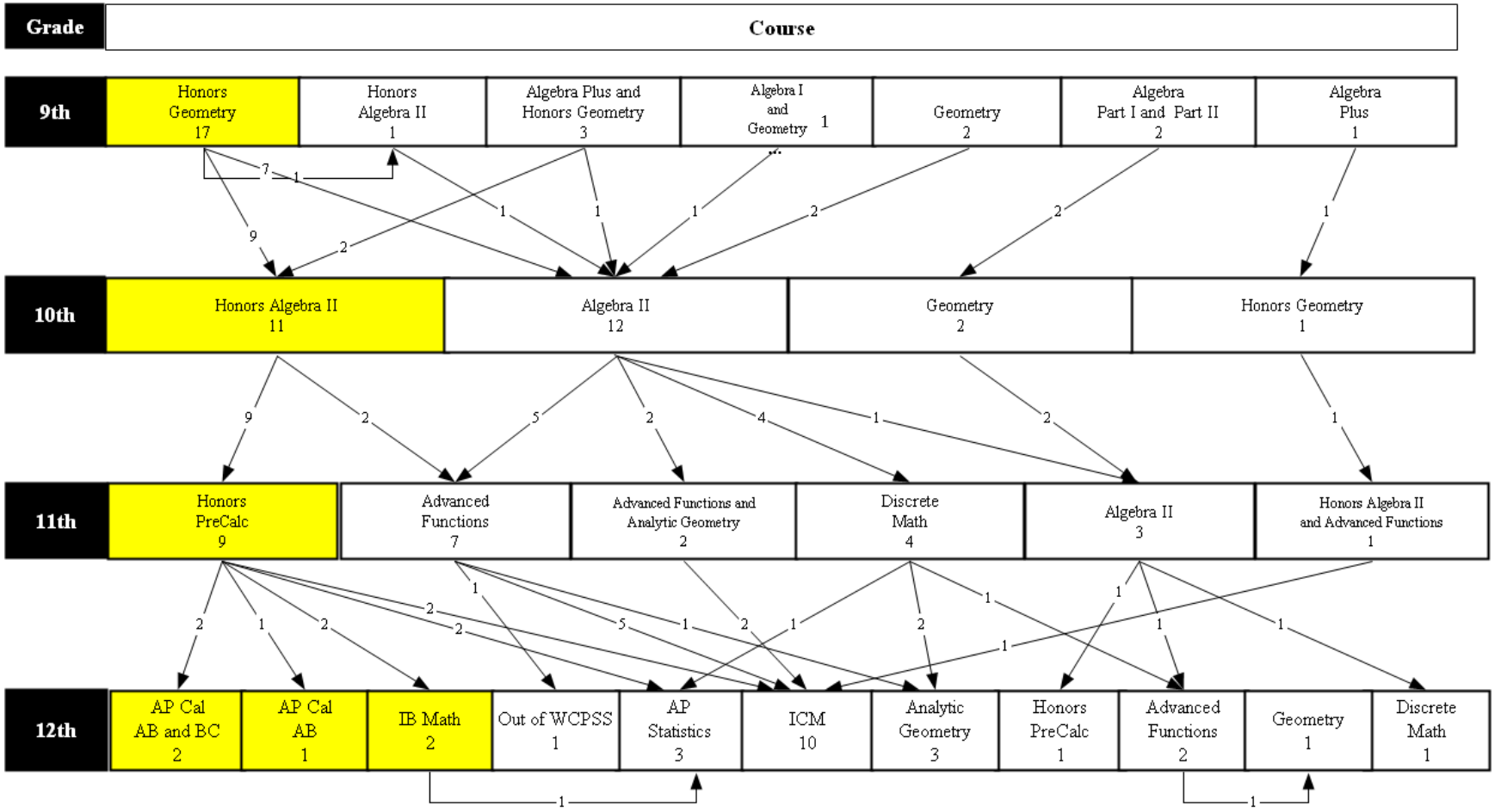
REFERENCES

Haynie, G. (2008). *Improving student success in high school Algebra I by identifying successful teachers and schools.* Raleigh, NC: Wake County Public School System.

Haynie, G. (2009). *Middle school Algebra I: Effective instructional strategies with comparison to high school practices.* Raleigh, NC: Wake County Public School System.

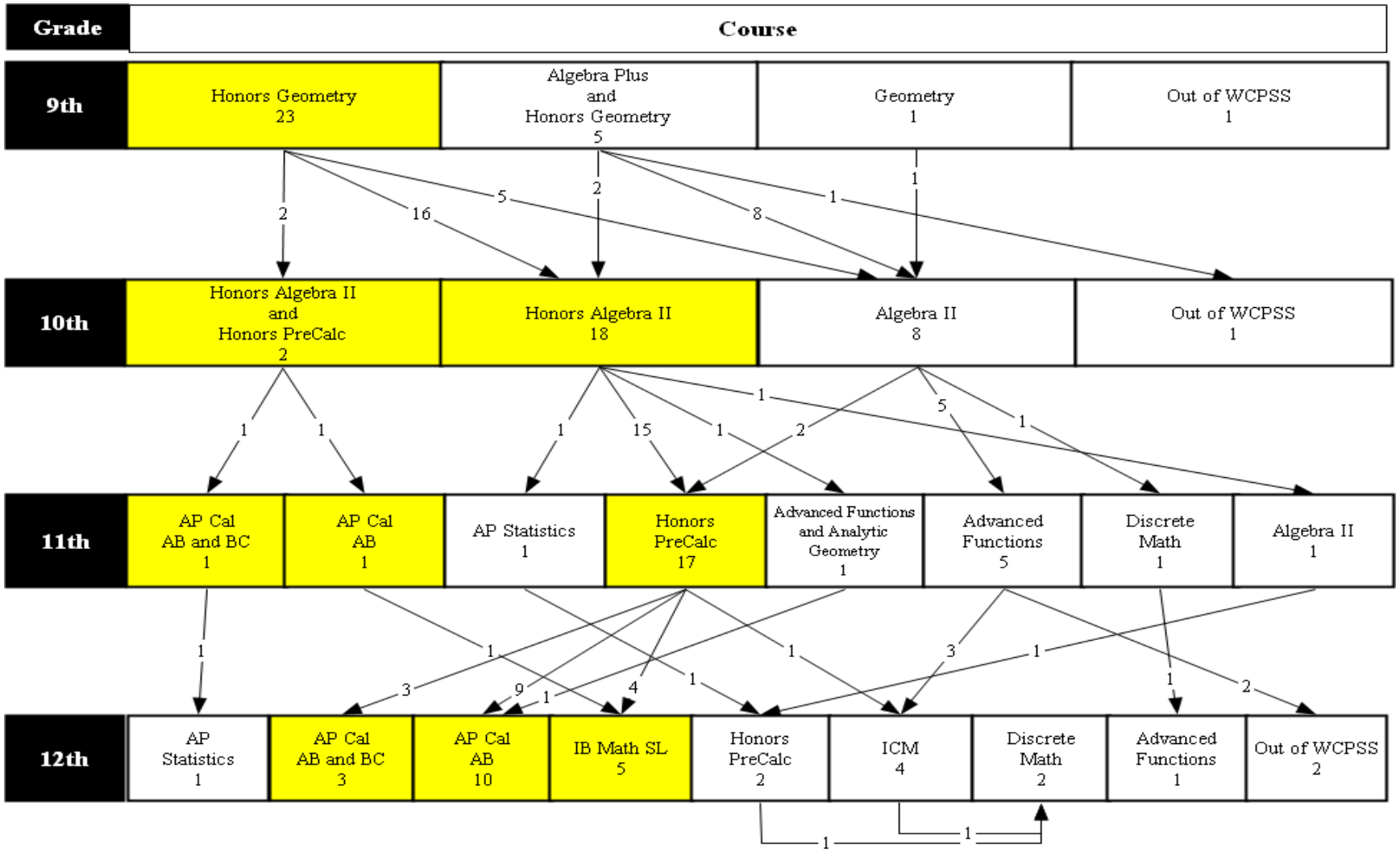
Appendix A
Middle School Cohort 2003-04

Figure A1
The High School Course-Taking Pattern of Middle School Algebra Teacher B1's Students



Note: The most advanced path is colored yellow

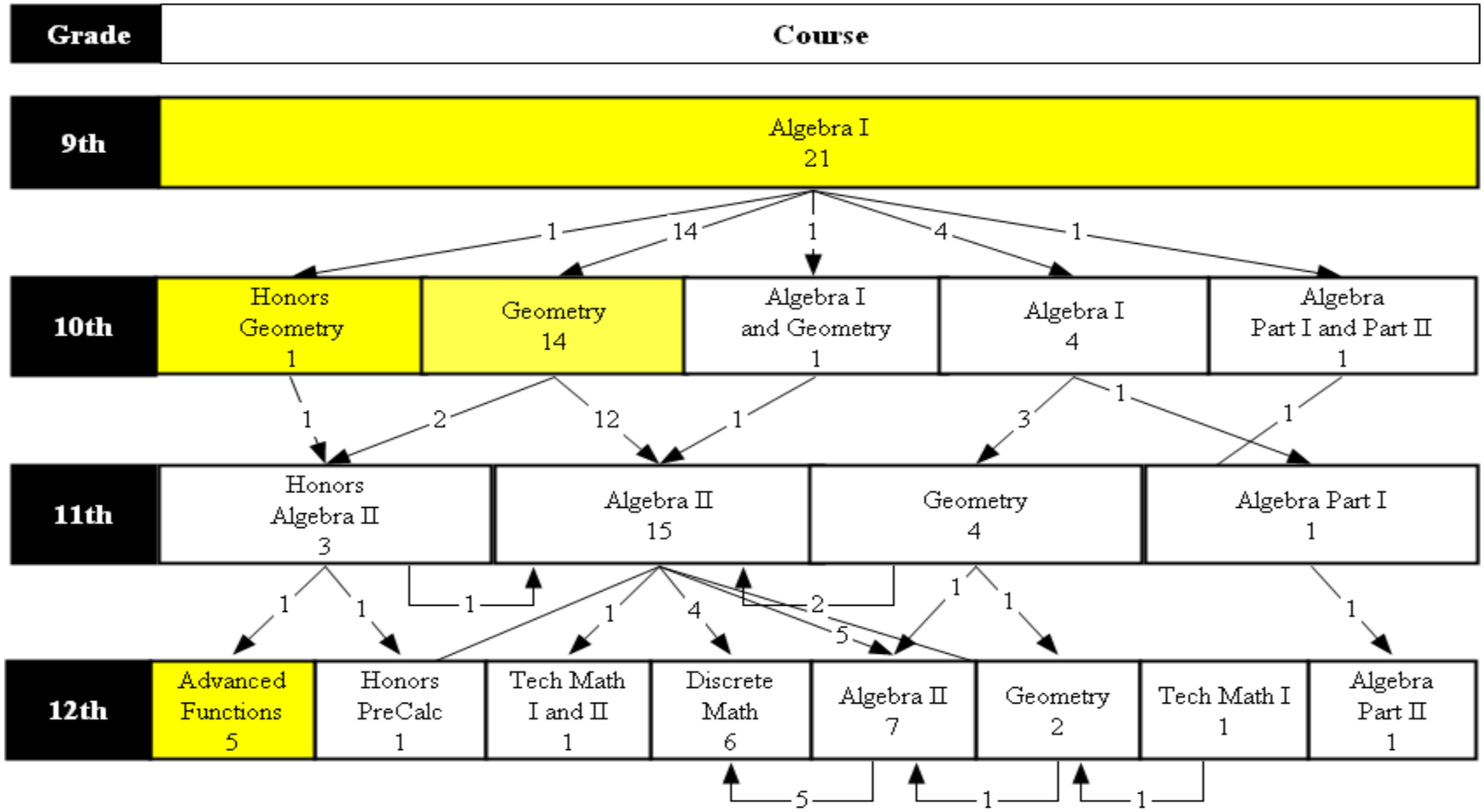
Figure A2
The High School Course-Taking Pattern of Middle School Algebra Teacher T1's Students



Note: The most advanced path is colored yellow

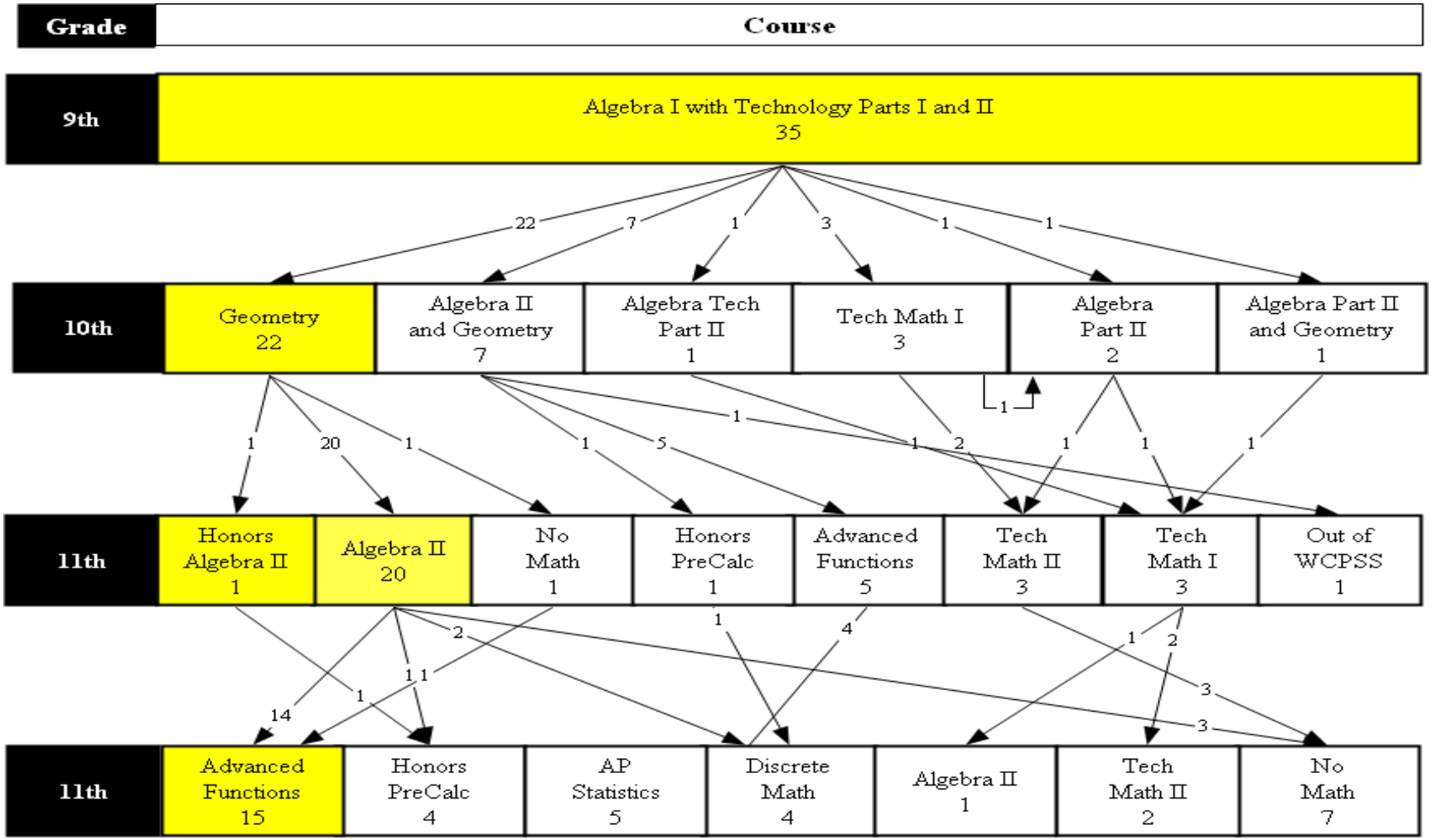
Appendix B
High School Cohort 2003-04

Figure B1
The High School Course-Taking Pattern of High School Algebra Teacher B1's Students



Note: The most advanced path is colored yellow

Figure B2
The High School Course-Taking Pattern of High School Algebra Teacher T1's Students



Note: The most advanced path is colored yellow