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ABSTRACT

The primary activity of teachers is teaching; specifically, instructional time in the classroom--a generally individual practice. Other than instructional time, the activities that most consume teachers' time are those related to the courses they teach but that are not instructional time--lesson planning (short-term planning including short-range assessment construction), course planning (long-term planning including defining the course and comprehensive assessment construction), record keeping, grading, and other sorts of work outside the classroom that enables their work inside the classroom. It is in these activities that the greatest potential for collaboration exists. This paper seeks to explore collaboration and individuality in secondary school mathematics departments largely through the lens of course and lesson planning. Seven public schools were studied. Mathematics teachers' desire to collaborate varied greatly, apparently depending on many factors. Less experienced teachers appeared to want to collaborate more on instructional techniques. Teachers with more students seemed to want to spend more time discussing students. Some teachers regularly talked to a subset of the teachers in their department more than the rest of the department, possibly because of common free time or convenient location of work areas. Some teachers collaborated with their colleagues much less frequently. Some teachers were open to discussion when they felt there was something to discuss but would rather not have had regular formal collaboration. (Contains 16 references.) (ASK)

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TEACHER COLLABORATION AND INDIVIDUALISM
IN SECONDARY SCHOOL MATHEMATICS DEPARTMENTS

A PAPER SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS IN TEACHING

BY
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1. INTRODUCTION

The primary activity of teachers is teaching, specifically instructional time in the classroom—a generally individual practice. Other than instructional time, the activities which most consume teachers' time are those which relate to the courses they teach, but are not instructional time—lesson planning (short-term planning, including short-range assessment construction), course planning (long-term planning, including defining the course and comprehensive assessment construction), record keeping, grading, and other sorts of work outside the classroom that enables their work inside the classroom. It is in these activities that the greatest potential for collaboration exists. This paper seeks to explore collaboration and individuality in secondary school mathematics departments, largely through the lens of course and lesson planning.

It seems that there are four dimensions of teaching which teachers might discuss: content—the actual material being taught, assessment—measuring the extent to which the content is learned, instruction—strategies and methods for conveying the content, and students—those being taught. For each of these dimensions, there are several basic questions to ask of teachers. How often do they collaborate on the dimension? Would they like more, less, or about as much time for collaboration on the dimension? Would they like to collaborate more, less, or about as frequently on the dimension? If they were given more time to spend doing work for the course,

how much of it would they spend collaborating on the dimension? How teachers answer these four questions should be related, although the answers may well be different for each of the dimensions.

One might also wonder how much collaboration varies from school to school, department to department. There are bounds on the extent to which a department can be labeled collaborative or individualist. At one extreme, a department might have common planning time for teachers, formalized planning teams, common course and lesson plans, common activities, and common assessments. Such a department clearly attempts to be as collaborative as possible and exists in a school which enables them to that end. At the other extreme, a department might have no common time and no formal unity within a course on lesson planning, course planning, activities, or assessments. It is nearly impossible for a department to prevent teachers who are interested from sharing ideas and talking to one another. "While teachers might meet informally to collaborate, the underpinning of those types of interactions are often weak . . . Usually, they rest on the good intentions of those involved. Not surprisingly, such a foundation for collaboration can only support sporadic or short term efforts" (Dillon 1999, 4).

Teachers might be characterized as being as collaborative as the highly collaborative department above, whether because of such a department or because of their own interest and initiative. Teachers, however, might also avoid discussing their teaching with colleagues, avoid sharing their lessons and assessments, and wish to spend less time in department meetings working with other teachers. The latter type of teacher would be an individualist and a department composed of many such teachers would tend to have an individualist character, regardless of the department's structure. There is nothing inherent to this dichotomy, however, that

prevents individualist teachers from existing in an extremely collaborative department nor that prevents groups of extremely collaborative teachers from existing in a less collaborative department.

In *Principles and Standards for School Mathematics*, the National Council of Teachers of Mathematics has said that “much of teachers’ best learning occurs when they examine their teaching practices with colleagues. Research indicates that teachers are better able to help their students learn mathematics when they have opportunities to work together to improve their practice . . . and strong support from colleagues . . .” (2000, 370). Much of the research cited by the National Council of Teachers of Mathematics focuses on the elementary setting and little has been written on the subject of teacher collaboration within secondary school mathematics departments. Reinken wrote, “At present, most literature on teacher professional collegiality focuses on elementary schools” (1998, 5).

Much of the literature on collaboration is only tangentially related to collaboration within the secondary school mathematics department, if it is related at all. There is a large body of writing on team teaching with respect to inclusion programs in special education, including many articles in *The Journal of Special Education* and *Educational Leadership*. There are also many articles and reports on cross-curricular collaboration, including many reports and analyses of recent reform efforts centered on small cross-curricular “pods” as well as papers presented at the Annual Meeting of the American Educational Research Association in the late 1990s. There are also some writings on collaboration within subject departments other than mathematics, as well as writings on subject departments as defining boundaries in the secondary school setting, such as the works of Siskin or Stodolsky.

The wealth of information surrounding the topic of collaboration and individualism in secondary school mathematics departments and the limited information actually about teacher collaboration in that setting makes it an interesting topic to consider. As Riordan and da Costa wrote, “the extensive literature on the sociology of teaching . . . professional development . . . and the insights gleaned from micropolitical analyses of schools . . . led to the view that collaboration among teachers is a rich and complex phenomenon worthy of further study” (1996, 2). Collaboration within secondary school mathematics departments seems to be an interesting and understudied phenomenon.

2. PROCEDURES

School and Course Selection

Seven public schools were studied, four in the western suburbs of Chicago, two in the northwestern suburbs of Chicago, and one in Chicago. The schools were selected to avoid multiple schools in any given district and to facilitate travel to the schools for interviews. The schools presented are those that responded from an original sample of eight.

At each school, the two courses with the most sections were chosen for study. This was done in an attempt to maximize the number of possible teachers surveyed while allowing tighter focus within a given school. Where there were several courses to choose from with the same number of sections, courses primarily for sophomores or juniors were selected in order to have a course both preceded and followed by courses at the school. Courses are designated by the year in which they are most commonly taken followed by a number indicating the tracking level, where tracks are numbered from highest to lowest.

School locations as well as courses chosen at each school and the number of surveys received from each school are listed in Table 1. At most schools, not all teachers teaching the selected courses responded to the survey. Teachers teaching both selected courses at a given school were asked to complete one survey for each course, so the total number of surveys received at a given school may be more than the number of teachers responding from that school.

For every course selected, there were multiple teachers teaching the course, providing an opportunity for collaboration.

Table 1. Schools Investigated

School	Location	Focus Courses			
		Name	Surveys	Name	Surveys
HS1	NW Suburbs	Freshman 4	2	Sophomore 4	1
HS2	Chicago	Freshman 2	3	Sophomore 3	2
HS3	W Suburbs	Sophomore 2	7	Junior 2	8
HS4	NW Suburbs	Freshman 3	5	Sophomore 4	5
HS5	W Suburbs	Freshman 4	3	Sophomore 4	5
HS6	W Suburbs	Freshman 2	5	Sophomore 2	5
HS7	W Suburbs	Freshman 3	4	Sophomore 3	4

Chairperson Interview

Department chairpersons were interviewed in person whenever possible (four of the seven) and interviews conducted in person were taped. The interviews were largely directed at finding out how the two target courses were planned. Specifically, the chairpersons were asked how the content for the course was selected, how the topics were arranged, whether or not teachers were expected to teach the same topics in the same order, whether or not exams, tests, and quizzes were common to all or most sections of the course, whether or not the teachers worked together in their daily planning, and if there was a lead teacher and if so, does the position rotate? The chairpersons were also asked similar questions to those on the teacher survey to

provide a comparison between the chairperson and the teachers' perspectives. The complete interview protocol can be found in Appendix B.

Most chairpersons were able to answer most of the questions comprehensively. Question 10, "How many hours per week do you think they [the teachers of the studied courses] spend, on average, on this course?" was difficult for some chairpersons to answer, reportedly due to vastly different amounts of time spent by different teachers. Some other questions, particularly those about how long structures had been in place (Questions 3 and 9) and how things were constructed (Questions 4, 6, and 15), were difficult for some chairpersons who had not held the position long or had not been at the school very long. The interviews took approximately twenty minutes each.

Teacher Survey

The teacher survey was designed to get several types of information from teachers. Questions 1 through 5 and 17 are about the teachers themselves or their own classes. Teachers were asked about their experience: how many years they have been teaching in total, how many years teaching mathematics, how many years teaching mathematics at their present school, and how many years teaching the focus course (Questions 1 and 2). They were also asked about the focus course: how many hours they spend doing work for the course (excluding teaching), how many sections of the course they have, and how many students they have in those sections (Questions 3 through 5). Question 17 asked the teachers how they would allocate an hypothetical additional twenty hours among several tasks: helping students, contacting parents, planning,

grading, record keeping, discussing content, discussing assessment, discussing instructional techniques, and an “other” option which asked the teachers to specify the other task.

Questions 6 through 9, 15, 16, and 18 are about the teacher’s collaborative behavior. Teachers were asked about the frequency with which they discuss content, assessment, instruction, and students with their colleagues (Questions 6 through 9), as well as whether they would like more, less, or as much time to discuss each of these four dimensions and whether they would like to discuss each dimensions more, less, or as frequently (Questions 15 and 16). Question 18 asked the teachers to list the teachers with whom they most frequently discuss the focus course and provided four spaces for teacher names. Parts of Question 17, discussed above, also address collaboration.

Questions 10 through 14 are about the course content and structure across the department. Question 10 asked teachers to compare the experience of a student in their sections of the course with the experience of a student in other teachers’ sections of the course, asking the teacher to indicate which of the following applied: they would work on the same units in the same order, they would be working on the same topics most days, they would do similar activities for most of the topics, they would do the same activities for some topics, they would often take similar tests and quizzes, they would always take the same tests, or an option for none of the above. Questions 11 and 12 asked the teacher what percentage of the year is spent covering required material and what percentage of the year is spent on optional material and Question 13 asked if other teachers cover the same optional topics. Question 14 asked who determines the content of the course, allowing teachers to select all applicable from options indicating that the teacher themselves determines the content, the teachers teaching the course as a group determine

the content, the department as a whole determines the content, and that people or groups outside the department determine the content of the course.

Surveys were collected from teachers teaching the focus courses at all seven schools. Teachers teaching both courses were asked to complete one survey for each course. Not all teachers who were asked to complete the survey responded. There were 59 surveys collected, 55 of which were filled out completely or missing only minimal information (4 surveys were blank on the second page). Responses on the survey were tabulated, with numeric coding applied to Questions 6 through 9 and 15 and 16 to allow for correlation coefficients to be computed.

As might be expected, responses to the three aspects of the first question and to the second question, all of which should measure experience, were correlated ($r > 0.68$, $p < 0.01$). For Questions 6 through 9, the answer choices were coded by approximations of the monthly frequency as follows: “rarely, if ever” was coded as 0, “once or twice a month” as 2, “once or twice a week” as 6, and “three or more times per week” as 12. The coded responses to these four questions were correlated ($r > 0.42$, $p < 0.01$). For Questions 15 and 16, “more” was coded as 1, “less” as -1, and “same” as 0. For each of the four aspects (content, assessment, instruction, students), the responses in 15 (time) and 16 (frequency) were correlated ($r > 0.66$, $p < 0.01$).

The complete teacher survey can be found in Appendix C. Correlation coefficients for numeric or coded responses on the teacher survey can be found in Appendix D. A comparison of department chairperson responses and teacher responses for select questions by school can be found in Appendix E.

3. FINDINGS

Formal Collaboration

Several schools (HS4, HS5, HS6, and HS7—“course team schools”) reported having formalized the groups of teachers teaching given courses into teams (“course team”) or at least having a teacher formally in charge of each course (“lead teacher”). In HS4, HS5, and HS7, the lead teacher changed yearly or every few years. In HS6, the lead teacher tended to be the most experienced teacher with strong communication abilities, so there was less rotation of the position. HS1, HS2, and HS3 all reported that although there was no formal lead teacher, there was informally a teacher who was responsible for some aspects of leading the course.

In the four course team schools, the content of the courses was either determined largely by the course teams or outside standard(s) were refined into a specification of course content by the course teams. In HS1 and HS3, the same task was performed by groups of teachers, although the teachers were not necessarily those teaching the course. In HS2, the task of determining course content was performed by the department as a whole.

All four course team schools reported having common finals constructed or revised by the course teams. At HS5, tests are also common to all sections of the course and constructed by the course teams. HS4 has begun to have some common tests, starting with one per quarter this year. HS3 has common final exams constructed or revised by the teachers teaching the course,

although the teachers are not formally organized into a course team. HS1 has a common final and some common tests for Freshman 4 (constructed again by informal team work), but not a common final for Sophomore 4. HS2 reported that district-wide standardized tests (the CASE¹) are used in place of school-level finals.

The chairperson at HS4 reported that when the course teams were formed, they focused largely on the content of the course, but that after several years the team has shifted toward comparing outcomes and seeking to improve them by exchanging successful instructional techniques.

Collaboration and Teacher Time

Teachers don't have enough time. This is a very common sentiment among teachers today. What if teachers had more time? How would they spend it? Teachers surveyed were asked how they would allocate an additional twenty hours per month among several tasks, if they had such time to spend. There were fifty-five responses, two of which allocated less than twenty hours total.

Two teachers allocated all twenty hours to "helping students." Both of these teachers listed no one when asked to list the teachers with whom they most frequently discuss the course. Neither teacher selected "more" for any part of Question 15 or 16, indicating they wanted either

¹The Chicago Academic Standards Exams (CASE) is "grounded in the Chicago Academic Standards, which were adopted in May of 1997 to set specific goals for core subjects like English/language arts, mathematics, natural and physical science, and social science for all grades" and "more than 70 teachers came together and developed the CASE." (Chicago Public Schools web site, <http://www.cps.k12.il.us/Instruction/feature_archive/Meeting_Standards/meeting_standards.html>).

the same or less time and the same or less frequent collaboration on each of the four dimensions (content, assessment, instruction, and students). The teachers who allocated time for “other” generally were allocating time for learning to use technology, integrating technology into lessons, or working to create better lessons. Table 2 gives the average allocation among the offered tasks.

Table 2. Average Response to Question 17

Task	Hours
helping students	6.5
contacting parents	1.6
planning	3.8
grading/marking papers	1.5
other record keeping	0.5
discussing content with other teachers	1.8
discussing tests, quizzes, and other assessments with other teachers	1.2
discussing instructional techniques with other teachers	2.5
other	0.7

Turning to the collaborative options on the allocation question—discussing content, assessment, or instruction—and looking at the sum of the allocations to those three, the median collaborative allocation was five hours, with more than a fourth of the responses allocating nine or more hours to collaboration. Only fifteen percent (8 of 55) of the teachers surveyed allocated no time to collaboration.

The allocations of time somewhat parallels the responses to Questions 15 and 16—questions asking whether teachers would want to spend more, less, or the same amount of time collaborating and whether they would want to collaborate more or less frequently or with about the same frequency for each of the four dimensions: content, assessment, instruction, and students. The percentages of the 55 responses selecting “more,” “same,” and “less” for each dimension for both time and frequency are given in Table 3. It is clear that the majority of teachers were comfortable with both the quantity and frequency of their discussions about students, although more teachers wanted to decrease the quantity and frequency of their discussions about students than any other dimension. Instruction was the only dimension for which more than sixty percent of teachers wanted increased quantity and frequency of discussion. Instruction also had the highest average allocation of time of the three collaborative options presented in the allocation question. For no dimension did more than ten percent of the teachers surveyed want to spend less time collaborating or collaborate less frequently.

Table 3. Distribution of Responses to Questions 15 and 16

	time			frequency		
	more	same	less	more	same	less
content (%)	51	45	4	47	51	2
assessment (%)	44	55	2	47	51	2
instruction (%)	64	33	4	60	38	2
students (%)	13	80	7	13	82	5

Under the coding method applied to the responses to Questions 15 and 16, there were correlations between both quantity and frequency aspects of the content, assessment, and instruction dimensions and their allocation counterparts ($0.39 < r < 0.52$, $p < 0.01$ for each pair), suggesting that teachers who allocated more time to discussing content, assessment, or instruction were more likely to have indicated that they wanted to spend more time discussing those aspects or discuss them more frequently. Moreover, the allocations of time for discussing content and assessment were correlated ($r = 0.536$, $p < 0.01$).

Further, the number of years teaching the specific course (Question 2) correlated negatively with the coded responses for desired change in quantity and frequency of discussion of assessment ($r = -0.252$, $p < 0.1$ for Question 15b; $r = -0.376$, $p < 0.01$ for Question 16b), possibly suggesting that more experienced teachers are less likely to want to spend more time discussing assessments and less likely to want to discuss assessments more frequently. Also, the number of students that a teacher reported having correlated with the coded responses for desired change in quantity and frequency of discussion of students ($r = 0.398$, $p < 0.01$ for Question 15d; $r = 0.424$, $p < 0.01$ for Question 16d), possibly suggesting that the more students a teacher has, the more likely they are to want to spend more time discussing students or and to want to discuss students more frequently.

Looking at whether teachers want to collaborate more or less is not very meaningful without knowing how much they currently collaborate. Questions 6 through 9 asked for the current frequency of collaboration. The distributions of the 59 responses to these questions are in Table 4. Looking at the percent of responses indicating collaboration weekly or more frequently, content was the dimension with the greatest percentage, followed by assessment and then

instruction, with students having the least percentage. The greater desire to increase discussion of instruction over the other dimensions may be related to the fact that only 56% of teachers discuss instruction at least weekly while 83% discuss content at least weekly and 64% discuss assessment at least weekly.

Table 4. Distribution of Responses to Questions 6 through 9

	rarely, if ever	once or twice a month	once or twice a week	three or more times per week
content (%)	3	14	54	29
assessment (%)	8	27	44	20
instruction (%)	3	41	41	15
students (%)	22	32	27	19

Defining the Course Content

One activity undertaken by high school mathematics departments where one might expect collaboration is in defining the content of courses. Question 14 asked the teachers who they felt determined the content of the course. The percent of responses for each possible actor is given in Table 5. From notations in the margins of the surveys, it is clear that many of the teachers who selected “people or groups outside the department” among their responses did so thinking of state standards or district requirements—an expected interpretation. Most of the 59 responses did not indicate that actors external to the department played a role in determining the course content. The majority of responses indicated that those teaching the course and the department as a whole

determined the course content, although about a third indicated that the individual teacher played a part in determining the course content.

Table 5. Percent of Responses for Each Option in Question 14

Actor	%
individual teacher	32
teachers teaching the course	66
department as a whole	76
people or groups outside the department	15

Chairpersons at HS4, HS5, HS6, and HS7—the course team schools—indicated that the course teams played at least some part in determining the content. At HS2, HS3, and HS5 the chairpersons indicated that there was at least some department-level involvement in determining the content. The chairperson at HS3 also indicated that the district set broad guidelines that at least set bounds on how the department defined the course.

Course Alignment

The question of the degree of parity between different teachers' sections of a given course may not be a question specifically about collaboration, but one might expect some relationship between collaboration and alignment of classroom events. The percent of responses indicating agreement with each option on Question 10, "Other than differences in the personalities of teachers, how do you think the experience of a student in one of your sections of the course

compares to the experiences of most students in most of the other teachers' sections of the course?," is given in Table 6.

Table 6. Percent of Responses Selecting Each Option in Question 10

option	%
a. they would work on the same units in the same order	73
b. they would be working on the same topics most days	56
c. they would do similar activities for most of the topics	61
d. they would do the same activities for some topics	47
e. they would often take similar tests and quizzes	56
f. they would always take the same tests	14

As discussed above, HS5 was the only school with common tests for the entire course, contributing to the low percentage for option (f). The higher percentage for option (a) may be at least partly related to all of the schools having common finals, which would force at least some degree of parity in which topics are taught each term. The chairpersons at HS1, HS2, and HS5 said that all or nearly all teachers teach the same topics in the same order while the chairpersons at HS3, HS4, HS6, and HS7 said they thought that most teachers taught the same units in the same order.

At HS3, the chairperson expected the degree to which teachers would be on the same topics most days would be less than the degree to which they would work on the same units in the same order, but at the rest of the schools, the chairpersons expected that teachers would by and large be within a day or two of each other.

Chairpersons at HS3 and HS5 expected that teachers would do similar activities for most of the topics, while the chairpersons at the rest of the schools expected a wide variety owing to differing styles, differing levels of comfort with and utilization of technology, and teachers sharing activities among their separate groups of teachers to whom they talk. Most of the chairpersons expected that different teachers would do the same activities for some topics, if only common assessments or projects. Other than common tests as discussed already, the chairpersons generally indicated that if groups of teachers used similar or the same assessments, it was largely a factor of that group having shared those assessments.

Teacher Clustering

Based on responses to Question 18, asking the respondent to list the teachers with whom they most frequently discuss the course, it is possible to examine whether clusters of teachers (subsets of the department which communicate heavily internal to the subset) exist within the departments. To explore this, Tables 7 through 13 were created, marking who each responding teacher listed in Question 18. Because the question specified that those listed should be those with whom the focus course is discussed, it is reasonable to expect that clusters found through this question would not cross between the two courses studied at each school.

It would appear that there is a cluster formed by 1 and 2 at HS1, although the small number of responses makes this analysis highly unreliable.

It appears that most teachers at HS2 talk to most other teachers and there are no clear clusters. This may be related to the planning period common to all department members.

Table 7. Teacher Communication Cross-table for HS1

Respondent	Responses		
	1	2	3
1	[X]	X	
2	X	[X]	
3			[X]

Table 8. Teacher Communication Cross-table for HS2

Respondent	Responses				
	1	2	3	4	5
1	[X]	X	X	X	
2	X	[X]	X	X	
3	X	X	[X]	X	X
4		X		[X]	X
5	X	X	X	X	[X]

At HS3, things are less clear from the table. Teachers 1 through 5 appear to form a cluster, as do teachers 8 through 12. For the remaining teachers, there are no clear relationships that would involve them in either cluster, nor do they appear to form a distinct third cluster. Note that this does not mean that they are excluded from communicating with teachers in clusters, but rather that they are not involved in communication with the majority of the members of either cluster. Within each cluster, the teachers all teach the same course, but neither cluster involves all teachers teaching that course.

Table 9. Teacher Communication Cross-table for HS3

Respondent	Responses												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1	[X]	X		X	X		X						
2	X	[X]	X		X							X	
3		X	[X]		X				X	X		X	
4	X	X		[X]									
5		X	X		[X]								
6	X					[X]	X						
7							[X]						
8								[X]	X		X	X	
9									[X]		X		
10			X						X	[X]	X		
11								X	X	X	[X]		
12								X	X	X	X	[X]	
13						X		X					[X]

In HS4, it appears that teachers 1 through 5 form the only cluster. While the responses of teachers 3 and 6 suggest that a cluster may be formed by 3 and 6 through 9, the lack of data from teachers 7 and 8 make it difficult to determine. Teachers 1 through 5 all teach a common course and are the only teachers teaching that course. This suggests that those teachers may be collaborating because they share that course. This is reinforced by the fact that the potential cluster of 3 and 6 through 9 would involve all teachers teaching a common class and only those teachers.

Table 10. Teacher Communication Cross-table for HS4

Respondent	Responses								
	1	2	3	4	5	6	7	8	9
1	[X]	X	X		X				
2	X	[X]	X	X	X				
3		X	[X]	X	X		X		X
4		X		[X]					
5	X	X	X	X	[X]				
6			X			[X]	X	X	X
7							[X]		
8								[X]	
9			X			X			[X]

In the table for HS5, teachers 1 through 4 seem to form a cluster, although all the connections come from teacher 4 listing another teacher or another teacher listing teacher 4. Teachers 5 through 9 more clearly form a cluster, although these teachers predominantly listed teachers 7, 8, or 9. The division of the two clusters again appears to be along course boundaries. The asymmetry of the clusters might be a manifestation of varying experience with the course or varying involvement in the design of the course.

HS6 and HS7 provide an interesting contrast in their cross-tables. While HS6 shows no clear signs of clustering, HS7 is clearly divided into two clusters, teachers 1 through 4 and teachers 5 through 8. These clusters are precisely the groups of teachers teaching the two courses, again reinforcing the relationship between clustering and courses taught.

Table 11. Teacher Communication Cross-table for HS5

Respondent	Responses								
	1	2	3	4	5	6	7	8	9
1	[X]								
2		[X]		X					
3			[X]	X					
4	X	X	X	[X]					
5					[X]		X	X	X
6						[X]		X	X
7						X	[X]	X	X
8							X	[X]	X
9							X		[X]

Table 12. Teacher Communication Cross-table for HS6

Respondent	Responses							
	1	2	3	4	5	6	7	8
1	[X]		X				X	
2		[X]	X	X		X		X
3			[X]	X				
4		X	X	[X]				
5		X			[X]			X
6						[X]		
7	X					X	[X]	X
8		X					X	[X]

Table 13. Teacher Communication Cross-table for HS7

Respondent	Responses							
	1	2	3	4	5	6	7	8
1	[X]	X		X				
2	X	[X]	X	X				
3		X	[X]	X				
4				[X]				
5					[X]		X	X
6					X	[X]	X	
7							[X]	
8					X		X	[X]

The teacher clustering, where it exists in these schools, seems to suggest that teacher collaboration relationships are related to the courses teachers teach. Moreover, the lack of clustering in some schools or the lack of inclusion of all teachers of a given course in a cluster suggests that there are other factors which contribute to the way clusters form. Two possible factors suggested by chairpersons in interviews and by teachers on their surveys were physical location of the teachers' desks or work areas and timing of free periods or planning periods, though physical layouts of buildings and schedules of teachers were not explored in this study.

4. CONCLUSIONS

A mathematics teacher's desire to collaborate varies greatly, apparently depending on many factors. Less experienced teachers appear to want to collaborate more on instructional techniques. Teachers with more students seem to want to spend more time discussing students. Some teachers regularly talk to a subset of the teachers in their department more than the rest of the department, possibly because of common free time or convenient location of work areas. Some teachers collaborate with their colleagues much less frequently. Some teachers seem open to discussion when they feel there is something to discuss, but would rather not have regular formal collaboration. "Teachers . . . work largely alone . . . Yet we have observed that they turn to one another for assistance and consider such peer help their most important source of assistance" (Lortie 1975, 76). Comfort with collaboration may be as dependent on the individual as teaching style.

Two areas of mathematics courses seem dominated by formal collaboration or at least institutionalized informal collaboration—common assessments and structured expectations. All schools examined have some common assessments. In the majority of cases, these assessments were constructed collaboratively. Further, every school examined has some structured expectations for each course, regardless of who teaches it. This definition of the course tended to have been constructed collaboratively. In both these areas, there is some need for synchronicity

between all sections of a given course. Most schools have at least common final exams and established common definitions for courses. The easiest way for teachers to be connected to the common elements they must use is to have them participate in the creation or revision of these elements—essentially, to have them collaborate on these elements. Thus, collaboration in these areas should not be as dependent on individual personalities.

“Talent imitates, genius steals” (T.S. Eliot). One of the main benefits of collaboration is the sharing of good ideas, allowing others to imitate or steal the best ideas and improve their own based on these. This may also be one reason why some people are hesitant to collaborate. While it may not be a conscious consideration, some people may feel that those ideas which make them unique may be imitated and stolen through collaboration, eroding their own uniqueness. Collaboration should be more than just replicating and distributing good ideas. Through collaboration, good ideas should get better. “Research indicates that teachers are better able to help their students learn mathematics when they have opportunities to work together to improve their practice” (NCTM 2000, 370). Even though many teachers would not want to increase the quantity of collaboration or frequency with which they collaborated, very few teachers actually wanted to decrease the quantity of collaboration or frequency with which they collaborated.

There are several directions in which further study is needed. First, while there have been papers focused on several experimental secondary schools which arranged their teachers into cross-curricular “pods”—creating teams consisting of one teacher from each subject area, giving them common space and time—there appears to be nothing written about secondary schools which give their subject departments or course teams common space and time. Would collaboration increase if each course team had common planning time and a shared office? Further, many

of the papers that explore cross-curricular collaboration in experimental schools do so from an internal point of view—the author(s) having taken some role in the school itself. If an experimental school with course team common space and time could be constructed and then researched by agents within the school, it might be possible to get a deeper understanding of the role of teacher collaboration, how teachers place themselves on the collaborative-individualist continuum, and how this impacts their role in the subject department.

National research involving large numbers of locations, schools, and teachers is also needed. While this study has shown some interesting points, it is limited to one metropolitan area, a small number of schools, and a relatively small number of teachers. The teacher survey used in this study was constructed with limited teacher time and a limited time frame for the study in mind, limiting the depth to which some aspects might have been explored. A larger, national study should be conducted with a greater time frame and broader scope, exploring whole departments and exploring relationships between collaboration and factors such as experience and student load. The relationship between patterns of collaboration (i.e. teacher clustering) and factors such as the physical layout of the department (location of teachers' rooms as well as location of teachers' work areas), common time, and existence of course teams should be explored on a broad scale.

Finally, further study is needed regarding the utility of collaboration. While teachers in this study were asked about their desire to change the amount and frequency of collaboration with respect to the four dimensions (content, assessment, instruction, and students), teachers were not directly asked to rate the usefulness of collaboration. To some extent, the benefits of collabora-

tion seem obvious, but there appears to be a lack of actual exploration of what is gained from collaboration in the secondary school mathematics department.

Teachers have limited time. Collaboration takes time—*common* time. It is difficult to find time common to large groups of teachers in one department and it is difficult to get already-busy teachers to invest time in something they may not see as essential. “Collaborative norms tend to develop when circumstances are tailored to promote their practice. Secondary schools, however, operate in ways that make collegial sharing difficult.” (Don Hill in Siskin and Little 1995, 128). Achieving collaboration in secondary school mathematics departments will always require balancing the need for synchronicity with the need for individualism.

APPENDIX A
SCHOOL AND COURSE ANONYMITY PROTOCOL

Rather than referring to the high schools by name, they are referred to simply as HS1, HS2, etc. They have been arranged in no particular order.

Course names have been replaced by the year in which the course is typically taken (Freshman, Sophomore, Junior, or Senior) followed by a number indicating the tracking level. Tracking level numbers are determined by numbering from the highest track to the lowest. For example, if “Algebra II Regular” is typically taken by juniors and there is an “Honors” track and an “Accelerated” track above the “Regular” track, it would be referred to as Junior 3.

APPENDIX B
INTERVIEW PROTOCOL FOR DEPARTMENT CHAIRPERSONS

Pre-Interview

- Which two courses have the most sections?
- Who teaches these courses?

School/Department Background

1. What courses are offered?
2. How are they tracked?
3. How long has this structure been in place?

Target Courses

4. How was the course content chosen and arranged?
5. Are teachers expected to teach the same topics in the same order?
6. Are there common final exams? Tests? Quizzes? How were they constructed?
7. Do teachers work together in their day-to-day planning?
8. Is there a lead teacher? Rotating lead teachers?
9. For how many years has the course been this way?

Teacher Survey Parallel (regarding teachers teaching the target courses)

10. How many hours per week do you think they spend, on average, on this course?
11. How often do you think they discuss the content of the course? Tests, quizzes, and other assessments? Instructional techniques? Students?

12. Would students in different teachers' sections work on the same units in the same order? On the same topics most days? Do similar activities for most of the topics? Do the same activities for some topics? Take similar or the same tests and/or quizzes?
13. What percentage of the course is required material? Optional material?
14. Do teachers cover the same optional material?
15. Who determines the content of the course?
16. Do you think that teachers would like to spend more/less/the same amount of time collaborating on content of the course? Tests, quizzes, and other assessments? Instructional techniques? Students?
17. Do you think that teachers would like to collaborate with their colleagues more/less/about as frequently on content of the course? Tests, quizzes, and other assessments? Instructional techniques? Students?
18. If the teachers had additional time (i.e. twenty additional hours per month), how do you think they would spend it?

APPENDIX C
TEACHER QUESTIONNAIRE

The following two pages reproduce the survey as it was given to the teachers surveyed, with page numbers added for this paper. In Question 17, items (h) and (i) are identical (and were on the surveys given to the teachers) due to production error. Item (i) should have read “discussing students with other teachers.” In coding the data, responses written for the two identical items were summed and considered as one item.

Appendix D contains the pair-wise correlation coefficient matrix for those questions with numeric or coded responses. Appendix E contains a comparison of teachers’ responses to selected questions to the responses of the department chairperson at their school to parallel questions.

Thank you for your participation in this project. Your responses will be kept confidential. Data presented in the final report will include neither school nor teacher names.

Name _____

1. How many years have you been: Teaching, total: _____ years
 Teaching mathematics: _____ years Teaching mathematics at present school: _____ years

Please respond to the following questions with respect to your sections of _____.

2. How many years have you taught the course and level named above? _____ years
3. About how many hours per week do you spend doing work for this course, excluding teaching? _____ hours
4. How many sections of this course do you have? _____ sections
5. How many students are in these sections, total? _____ students
6. How often do you discuss the content of this course with colleagues: (check one)
 rarely, if ever once or twice a month
 once or twice a week three or more times per week
7. How often do you discuss tests, quizzes, and other assessments for this course with colleagues: (check one)
 rarely, if ever once or twice a month
 once or twice a week three or more times per week
8. How often do you discuss instructional techniques for this course with colleagues: (check one)
 rarely, if ever once or twice a month
 once or twice a week three or more times per week
9. How often do you discuss students in your sections of this course with colleagues: (check one)
 rarely, if ever once or twice a month
 once or twice a week three or more times per week
10. Other than differences in the personalities of teachers, how do you think the experience of a student in one of your sections of the course compares to the experiences of most students in most of the other teachers' sections of the course? (check all that apply)
 a. they would work on the same units in the same order
 b. they would be working on the same topics most days
 c. they would do similar activities for most of the topics
 d. they would do the same activities for some topics
 e. they would often take similar tests and quizzes
 f. they would always take the same tests
 g. [none of the above]
11. What percentage of the year is spent covering required material? _____ percent
12. What percentage of the year is spent covering optional material? _____ percent
13. Do other teachers cover the same optional topics as you? Yes No
14. Who determines the content of the course? (check all that apply)
 I do those teaching the course do, as a group
 the department as a whole people or groups outside the department

APPENDIX D

CORRELATION COEFFICIENTS FOR THE TEACHER QUESTIONNAIRE DATA

Table A1, on the following page, contains the pair-wise correlation coefficient matrix for those questions with numeric or coded responses. Where a pair of responses gave a correlation coefficient not significant at the 90% level ($p > 0.1$), the coefficient is omitted from the table. Where the correlation coefficient was significant at the 99% level ($p < 0.01$), the coefficient appears in boldface.

Table A1. Correlation Coefficients for Numeric or Coded Survey Responses

	q1t	q1m	q1s	q2	q3	q4	q5	q6	q7	q8	q9	q11	q12	q15a	q15b
q1t	1.000														
q1m	0.927	1.000													
q1s	0.718	0.748	1.000												
q2	0.730	0.749	0.686	1.000											
q3	—	—	-0.256	—	1.000										
q4	—	-0.262	—	—	0.279	1.000									
q5	—	—	—	—	0.375	0.898	1.000								
q6	—	—	—	—	—	—	—	1.000							
q7	0.241	—	—	—	0.235	—	—	0.712	1.000						
q8	0.217	—	—	—	—	—	—	0.696	0.696	1.000					
q9	—	—	—	—	—	—	—	0.446	0.524	0.427	1.000				
q11	—	—	—	—	—	—	—	0.312	—	0.267	0.236	1.000			
q12	—	—	—	—	—	—	—	-0.228	—	—	—	-0.959	1.000		
q15a	—	—	—	—	—	—	—	—	0.250	—	—	0.250	-0.263	1.000	
q15b	—	—	—	-0.252	0.260	—	—	0.330	0.265	—	0.230	0.372	-0.382	0.371	1.000
q15c	—	—	—	—	—	—	—	—	—	—	—	0.256	—	0.367	0.258
q15d	—	—	—	—	—	0.328	0.398	—	—	—	—	—	—	0.259	—
q16a	—	—	—	—	—	-0.238	—	0.249	0.319	—	—	0.301	-0.313	0.852	0.422
q16b	—	—	-0.272	-0.376	—	—	—	0.268	—	0.234	0.235	0.451	-0.404	0.371	0.809
q16c	—	—	—	—	—	—	—	—	—	—	—	0.368	-0.334	—	0.300
q16d	—	—	—	—	—	0.343	0.424	—	—	—	—	—	—	—	—
q17a	—	—	—	—	-0.277	—	—	-0.225	—	—	—	—	0.273	-0.234	-0.335
q17b	-0.230	—	—	—	—	—	—	—	—	—	—	—	—	—	—
q17c	-0.235	—	—	—	0.243	—	—	—	—	—	—	—	—	—	—
q17d	—	—	—	—	0.251	—	—	—	—	-0.309	—	—	—	—	0.357
q17e	-0.227	—	—	—	—	—	—	—	—	—	—	—	—	—	0.246
q17f	—	—	—	—	—	—	—	—	—	—	—	—	—	0.433	0.266
q17g	—	—	—	—	—	—	—	0.251	—	—	—	—	—	0.371	0.505
q17h	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
q17j	—	—	—	—	—	—	—	—	—	0.229	—	—	—	-0.394	—

	q15c	q15d	q16a	q16b	q16c	q16d	q17a	q17b	q17c	q17d	q17e	q17f	q17g	q17h	q17j
q15c	1.000														
q15d	0.381	1.000													
q16a	0.244	—	1.000												
q16b	0.305	—	0.297	1.000											
q16c	0.664	—	0.287	0.352	1.000										
q16d	0.279	0.954	—	—	—	1.000									
q17a	-0.341	—	-0.349	—	-0.420	—	1.000								
q17b	0.227	—	—	—	—	—	—	1.000							
q17c	—	—	—	—	—	—	-0.290	—	1.000						
q17d	—	—	—	—	—	—	-0.431	—	0.369	1.000					
q17e	0.228	—	—	0.243	—	—	-0.385	—	—	—	1.000				
q17f	—	—	0.513	—	—	—	-0.334	—	-0.281	—	0.283	1.000			
q17g	—	—	0.400	0.490	—	—	-0.353	—	-0.382	—	0.368	0.536	1.000		
q17h	0.397	0.243	—	—	0.427	0.266	-0.427	—	—	-0.264	—	—	—	1.000	
q17j	-0.305	-0.234	-0.246	—	—	—	—	—	—	-0.241	—	—	—	—	1.000

Note: Marginally significant values ($p > 0.1$) have been omitted. Values in boldface have $p < 0.01$.

APPENDIX E

COMPARISON OF CHAIRPERSON INTERVIEWS AND TEACHER SURVEYS

The following tables compare the responses of the teachers on the surveys to the responses of the department chairpersons on the parallel interview questions.

Table A2. Chairperson-Teacher Comparison on Question 3:
Time Spent on Course Excluding Teaching Time

School	Chairperson	Teachers (hours)
HS1	“a couple of hours per week”	mean: 3.33; 5-pt. summary: (1,1,4,5,5)
HS2	“10, minimum”	mean: 8; 5-pt. summary: (5,7,8,10,10)
HS3	—	mean: 3.89; 5-pt. summary: (1,3,3,25,4,10)
HS4	about 6	mean: 5; 5-pt. summary: (3,5,5,6,6)
HS5	—	mean: 6.57; 5-pt. summary: (2,3,6,10,11)
HS6	“more than 5, less than 10”; about 6-7	mean: 12.22; 5-pt. summary: (5,6,11,15,22.5)
HS7	about 2	mean: 6.21; 5-pt. summary: (2,3,5,10,12.5)

Note: 5-pt. summary refers to the ordered quintuple of the minimum value, first quartile, median, third quartile, and maximum value.

Table A3. Chairperson-Teacher Comparison on Question 6:
Frequency of Discussion of Course Content

School	Chairperson	Teachers (%)			
		rarely, if ever	once or twice a month	once or twice a week	3+ times per week
HS1	daily	33	—	—	67
HS2	at least 3 times per week, maybe more	—	—	—	100
HS3	dependent on teachers	7	7	67	20
HS4	at least biweekly	—	60	40	—
HS5	dependent on teachers	—	—	38	63
HS6	1-2 times per week	—	10	70	20
HS7	daily	—	—	100	—

Table A4. Chairperson-Teacher Comparison on Question 7:
Frequency of Discussion of Assessments

School	Chairperson	Teachers (%)			
		rarely, if ever	once or twice a month	once or twice a week	3+ times per week
HS1	2-3 times per week	33	—	67	—
HS2	weekly or biweekly, when tests are given	—	—	—	100
HS3	dependent on teachers	20	13	53	13
HS4	monthly	10	80	10	—
HS5	dependent on teachers	—	—	63	38
HS6	weekly	—	30	50	20
HS7	daily	—	38	63	—

Table A5. Chairperson-Teacher Comparison on Question 8:
Frequency of Discussion of Instructional Techniques

School	Chairperson	Teachers (%)			
		rarely, if ever	once or twice a month	once or twice a week	3+ times per week
HS1	daily	33	—	—	67
HS2	1-2 times per week	—	—	—	100
HS3	dependent on teachers	7	40	53	—
HS4	biweekly	—	100	—	—
HS5	dependent on teachers	—	—	88	13
HS6	weekly	—	60	30	10
HS7	daily	—	25	75	—

Table A6. Chairperson-Teacher Comparison on Question 9:
Frequency of Discussion of Students

School	Chairperson	Teachers (%)			
		rarely, if ever	once or twice a month	once or twice a week	3+ times per week
HS1	daily	33	—	67	—
HS2	all the time	—	—	—	100
HS3	dependent on teachers	33	40	27	—
HS4	weekly	10	40	40	10
HS5	dependent on teachers	—	50	—	50
HS6	2-3 times per week	50	10	30	10
HS7	daily	13	50	38	—

Table A7. Chairperson-Teacher Comparison on Questions 11 and 12:
Required and Optional Percentage of Course Content

School	Chairperson		Teachers (%)	
	% required material	% optional material	% required material	% optional material
HS1	100	—	100	—
HS2	100	5-10	99	5
HS3	90	10	92	8
HS4	100	—	91	10
HS5	100	—	98	2
HS6	close to 100	0-10	93	7
HS7	90 at least	0-10	90	10

Table A8. Chairperson-Teacher Comparison on Question 14:
Who Determines Course Content

School	Chairperson	Teachers (%)			
		I do	teachers teaching the course	department as a whole	actors outside department
HS1	group of teachers, not necessarily those teaching course	—	—	100	—
HS2	entire dept.; individual teacher freedom	20	100	100	20
HS3	district; dept.	47	47	80	7
HS4	those teaching course	50	100	50	30
HS5	dept.; those teaching course	13	63	75	25
HS6	those teaching course	20	80	70	20
HS7	those teaching course	38	50	88	—

Table A9. Chairperson-Teacher Comparison on Question 15a and 16a:
Desired Change in Time and Frequency of Discussion of Course Content

School	Chairperson		Teachers (%)					
			time			frequency		
	time	frequency	less	same	more	less	same	more
HS1	same	same	—	100	—	—	100	—
HS2	split	split	—	60	40	—	40	60
HS3	more	more	13	27	60	7	40	53
HS4	same	same	—	70	30	—	70	30
HS5	more	split	—	13	88	—	25	75
HS6	same	same	—	44	56	—	44	56
HS7	same	same	—	67	33	—	83	17

Table A10. Chairperson-Teacher Comparison on Question 15b and 16b:
Desired Change in Time and Frequency of Discussion of Assessments

School	Chairperson		Teachers (%)					
			time			frequency		
	time	frequency	less	same	more	less	same	more
HS1	same	same	—	—	100	—	—	100
HS2	more	more	—	60	40	—	40	60
HS3	more	more	7	73	20	7	73	20
HS4	more	more	—	50	50	—	40	60
HS5	more	split	—	25	75	—	13	88
HS6	same	same	—	44	56	—	56	44
HS7	more	same	—	83	17	—	83	17

Table A11. Chairperson-Teacher Comparison on Question 15c and 16c:
Desired Change in Time and Frequency of Discussion of Instructional Techniques

School	Chairperson		Teachers (%)					
			time			frequency		
	time	frequency	less	same	more	less	same	more
HS1	more	more	—	—	100	—	—	100
HS2	more	same	—	20	80	—	20	80
HS3	more	more	13	27	60	7	40	53
HS4	more	more	—	30	70	—	30	70
HS5	more	split	—	50	50	—	38	63
HS6	more	same	—	44	56	—	56	44
HS7	more	more	—	33	67	—	50	50

Table A12. Chairperson-Teacher Comparison on Question 15d and 16d:
Desired Change in Time and Frequency of Discussion of Students

School	Chairperson		Teachers (%)					
			time			frequency		
	time	frequency	less	same	more	less	same	more
HS1	more	more	—	100	—	—	100	—
HS2	same	same	—	80	20	—	80	20
HS3	more	more	13	87	—	7	93	—
HS4	more	more	20	70	10	20	70	10
HS5	more	split	—	63	38	—	63	38
HS6	same	same	—	78	22	—	78	22
HS7	same	same	—	100	—	—	100	—

Table A13. Chairperson-Teacher Comparison on Question 18:
Allocation of Hypothetical Additional Time

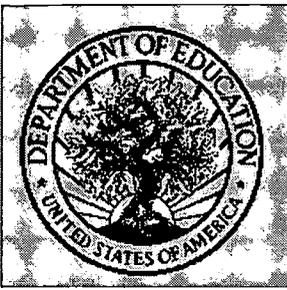
School	Chairperson	Teachers (hours)									
		a.	b.	c.	d.	e.	f.	g.	h.	j.	
HS1	communicating, collaborating on techniques and students	9.0	6.5	1.5	1.0	0.5	0.5	0.5	0.5	—	
HS2	paperwork, developing instructional techniques	7.4	0.6	2.0	0.4	0.2	2.6	2.0	2.8	2.0	
HS3	working together to develop good ideas	7.1	1.2	3.1	1.3	0.5	2.0	1.0	2.8	0.8	
HS4	lesson design, working with students	6.8	1.5	3.1	1.2	0.4	2.0	1.7	2.7	0.6	
HS5	collaboration, meeting with course team leader	6.3	1.1	5.0	1.9	0.8	1.9	1.4	2.4	—	
HS6	learning new techniques, developing technology skills, developing lessons	4.3	1.6	5.8	2.8	0.7	1.7	0.7	2.0	0.6	
HS7	incorporating technology and applications	6.7	2.3	4.2	0.8	0.5	1.0	0.8	2.8	0.8	

Note: The options given to teachers were a. helping students; b. contacting parents; c. planning; d. grading/marking papers; e. other record keeping; f. discussing content with other teachers; g. discussing tests, quizzes, and other assessments with other teachers; h. discussing instructional techniques with other teachers; and j. other.

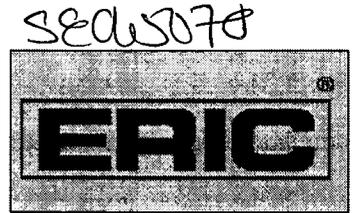
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