Secondary Teachers of Mixed Academic Subjects: "Out-of-Field" Problem or Constructivist Innovators

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During the past decade, Ingersoll and others have drawn attention to the seemingly large percentage of middle and high school teachers who teach one or more classes in subjects for which they are not certified or for which they lack college majors or minors (Ingersoll, 1999).[1] This phenomenon of "out-of-field teaching" has been postulated to be indicative of a teacher's inadequate subject-matter knowledge, and inadequate subject-matter knowledge has been found by some to be a critical element in below-standard teaching quality (Darling-Hammond and Ball, 1997).

However, teaching quality is itself a slippery concept. "Quality" is presumably evidenced by those characteristics of teachers that are associated, in a non-spurious way, with superior student outcomes. Sometimes, though, the outcomes themselves are a matter of judgment and debate. It is true that most current teachers may not have in their retrievable memory all of the subject-matter knowledge that recent subject-matter standards documents call for--either those heavily laden with multitudinous factual content (e.g., National Center for History in the Schools, n.d.) or those aiming at imparting advanced levels of discipline-specific understandings (e.g., National Council of Teachers of Mathematics, 1998) or those, like the national science standards, attempting to do both at once (e.g., National Research Council, 1996). However, if other student outcomes have high priority—for example, intellectual initiative; creative and flexible, interdisciplinary thinking; solving practical problems by applying diverse forms of knowledge not exclusively arising from the academic disciplines—and if student engagement and effort are both extremely problematic conditions for learning, then other teacher characteristics besides having subject-matter knowledge may be more consequential (that is, may be a more useful indicator of teaching quality).

[1] Other sources, notably NCES' study of teacher quality, have found substantially lower levels of out-of-field teaching (U.S. Department of Education, 1999). The main difference between these studies appears to be in the definition of whether the out-of-field subject constitutes the "primary" subject responsibility of the teacher or whether any of the classes which the teacher instructs being out-of-field creates such a designation. Obviously, if any assignment out of the credentialed subject (or college major or minor) creates an out-of-field designation, then much higher percentages will prevail. This is particularly the case if the attribution of having out-of-field assignments is not weighted by the number or percentage of classes that are out-of-field, but is merely a designation that one or more such classes are part of the teacher's workload.

Scholars such as Noddings (1992) and articulate practitioners such as Meier (1995) have both questioned the dominance of university disciplines as the principal organizing structure for secondary education. Noddings suggested an organizing structure around the idea of "caring." Caring, not only as a subject about which students can learn, but as a primary attribute of good teaching, is one which may have little to do with a teacher's own subject-matter expertise but which may result in students making greater investments in learning and thus have more positive long-term academic consequences than subject-matter expertise. In a similar vein, Meier (1995) argued that personalization is an important characteristic of effective secondary schools, particularly for adolescents from lower socio-economic backgrounds. She argues that personalization is best achieved by creating small educational communities in which teachers play a much more "generalist" role than usually given to them. The organization of small educational communities almost mandates that teachers be responsible for a wider array of content over a longer portion of a school day or week than typically occurs in secondary schools, thus enabling each adolescent to be known more deeply by one or two adults who have fewer individual students to teach. In schools organized so that teachers have a broader the array of content responsibilities, one is less likely to find teachers with a high level of subject-matter expertise for each course or subject that they teach. But it is not clear that such schools would lack the good teaching through which important student outcomes could be produced.

Moreover, an important strand of current reform efforts derives from pedagogical theories that place teachers less in the role of providers of knowledge and more in the role of facilitators of independent student and group investigations. To the extent that learning is perceived as primarily something that even adolescents must do for themselves, the primary attribute of good teaching is to enable effective investigative work to proceed—that is, to help students to define good questions, find relevant evidence, develop arguments about the evidence, articulate their understandings, communicate those understandings to others, and apply their understandings as part of an effort to solve a concrete problem in the outside world. Although expertise in a subject-matter certainly contributes to a teacher's ability to provide those helping hands, effective teaching for inquiry-oriented student work may be much more dependent on the teacher's having an inquisitive frame of mind, having broad interests over a range of content of interest to adolescents, and knowing how to help people to make fruitful inquiries.

A constructivist pedagogy that gives principal attention to the meaningfulness to students of the tasks and accomplishments they are asked to master, one which emphasizes processes such as selecting content based partly on student interest and assigning group work and complex, interdisciplinary projects to create that sense of meaningfulness, may mean that a teacher's philosophy of teaching, pedagogical approach, and conception of themselves as lifelong-learners who are part of a professional community may all be more important for high quality teaching than a match between their assigned course titles and the subject of their teaching credential or teaching major. These formal criteria may be only a rough indicator of their ability to carry out high-quality instruction in a given subject.

Not surprisingly, Ingersoll has found that out-of-field teaching occurs more often in small schools than in large schools (Ingersoll, 1999). In such schools, it becomes difficult to assign every teacher to exactly five classes within one disciplinary subject. Indeed, the difficulty of doing so makes it likely that some out-of-field teaching will occur in almost every school. Whether most of the out-of-field teaching that occurs is attributable to the difficulty of dividing class enrollments into sections divisible by five (given other intangible scheduling considerations such as ability-grouping, curriculum- tracking and specialization within subject-fields), or whether only some of it is due to that factor, has not been shown. But certainly, some portion of teachers must complete their schedules by teaching subjects other than the one in which they have a college degree or certification.

Principals, or, more usually, department chairs, thus have some discretion in determining which teachers split their teaching schedule across different subject fields. Some teachers may, in fact, choose to broaden their teaching responsibilities by exploring new subject fields. Such teachers may, in fact, be the ones who are intellectually flexible and alive—characteristics that may be quite valuable for many adolescent students' education and perhaps in many circumstances more productive of important student outcomes than academic preparation or a credential in the field that might have occurred 15 to 20 years earlier. So, it is an open question as to whether teachers whose class assignments involve a mixture of subjects do in fact perform a disservice to

secondary students. At the very least, it would be worthwhile to see just who these mixed-subject teachers are and what backgrounds they might bring to subjects taught out-of-field.

Data and Methods

The empirical investigation of this question employs a national survey dataset called Teaching, Learning, and Computing—1998, constructed as part of a research study on the relationship between teachers' use of computers and instructional reform, a study for which this author was principal investigator. The survey involves two national samples of schools and a sample of teachers within each school. The national probability sample of schools involved roughly equal numbers of elementary, middle, and high schools (N=898). The "purposive schools sample" was a set of 718 selected schools categorized as either “High-end Technology schools” with substantial amounts of computer technology per capita or “Reform Program schools.” The latter group was compiled by identifying schools or individual teachers who had been long-term (3 year+) participants in one of 54 different national or regional externally-defined “programs” of major school or instructional reform or which had established well-publicized programs of their own, and sampling from eligible schools.

At each school (75% of which participated in the study, 1215 schools), teachers were sampled from grades 4-12 and from all subjects except physical education and special education. Three to five teachers per school (three in elementary; five in middle and high school) were selected with probabilities related to the teacher’s reputed emphasis on higher order thinking, use of group projects, and use of technology. A small number of teachers (a maximum of 2 per school) were selected with certainty (probability equal to 1) based on the principal’s attribution of that teacher having an exemplary instructional practice or based on their known participation in the selected program of instructional reform.

Overall, 67% of sampled teachers completed 20+ page questionnaires, a total of 4,083 teachers. This includes 69% of the teachers in the probability sample of schools and 64% in the purposive schools sample. Four versions of the questionnaire were used, with largely overlapping questions, but permitting somewhat greater coverage of topics than a single version of equal

length would have permitted. The questionnaires dealt with five principal topics: teaching philosophy and related beliefs about instruction and assessment; teaching practices and strategies followed in the instruction of one class—the class in which the teacher felt most satisfied with achieving teaching objectives--; the ways in which the teacher used computers in teaching and professionally and changes over time in the role of computers in her teaching practice; changes in her general pedagogical approaches made over the previous three years; and a wide range of questions about the teaching environment at the teacher's school, including formal professional development, support for technology, informal interactions with other teachers, and pressures experienced in their teaching. In addition, a variety of questions about educational and teaching background and current teaching responsibilities were asked at various points in the questionnaire. Nearly all questions were of the fixed-response type. Open-ended questions about college attended, college major, and current set of courses taught were coded into numerical categories. College attended was coded in terms of selectivity, based on SAT and ACT scores of admitted freshmen in the year 1983.

Because unequal probabilities were used, at both school and teacher level, all analysis employs weighted data, with weights inverse to the probability of selection, as modified by stratum-specific non-response rates and within-school partial completions of teacher rosters. Where purposive and national probability samples are combined, weights are adjusted so that the average weight for teachers in the purposive schools sample is equal to the average weight for teachers from schools in the probability sample.

Operationalization of Mixed Subject and Out-of-Field Teaching

The focus of this paper is on what we call "mixed-academic secondary teachers." These are teachers from middle and high schools in grades 6 and up who teach different classes (rather than a single self-contained class), at least 40% of which are in academic subjects (math, science, English, mathematics, and foreign languages), but who teach no more than 60% of their classes in any one academic subject. Specific classes of secondary teachers were coded into 11 subject categories. Besides the five major academic subjects, codes included computer education, business education, vocational education, fine arts, and two residual categories: "other academic"

(which included classes with academic content but not disciplinary identification, such as "seminar" or "critical thinking"; as well as full-day self-contained classes), and "other applied" such as "family living" and "leadership." Altogether, 305 teachers out of 2991 secondary teachers met our definition of teaching a mixed-academic subject teaching load (10.2%; using weighted N's, 9.5% overall, 10.2% in the probability sample, and 8.8% in the purposive sample). Of these (using weighted N's), 16% were primarily English teachers (i.e., taught exactly three-fifths English courses in their courseload), 14% science, 11% math, and 11% social studies. Nearly all of the rest (43% of the total) were very mixed academic, teaching substantially academic rather than applied courses, but teaching at most half of their load in any one subject-area. Teaching a mixed-subject load of principally academic courses is more prevalent at the middle grades than in the high school grades. More than two-thirds of the mixed-academic secondary teachers in our sample (69%) taught in secondary schools at grades 6-8.

To give the reader a sense of the teaching responsibilities of the Mixed-Academic Secondary teachers in our survey sample (referred to as MAS teachers, in the remaining text), Table 1 lists the course responsibilities of four groups of these teachers formed by two dichotomies: middle vs. high school grade teachers and teachers whose primary teaching responsibilities were in a single academic field vs. those classed as mixed academic as their primary assignment. As can be seen from Table 1, most of these teachers teach courses in two or three of the major academic fields such as English and social studies, mathematics and science, or a foreign language along with another academic area. However, the table evidences a much broader variety of subject combinations than suggested by those pairings. Many of the teachers teach courses in computers, media, and other "applied" secondary subjects

Table 1: Examples of Course Assignments of Mixed Academic Secondary Teachers (MAST)

MAST: Middle Grades Teachers with a Single Primary Academic Assignment				
Math-Science-Technology	Math-Science-Technology	Travel	Math	Math-Science-Technology Gateway
English Literature	Writing	History	Language Arts	History
Reading	Social Studies	Science	Science	Science
Math	Science	Math	Math	Science
US History	Pre-Algebra	Pre-Algebra	Math	Economic
Current Events	Language Arts	Social Studies	Social Studies	Language Arts
Computer Applications	Computer Applications	Writing	Writing	Writing
American Studies	American Studies	American Studies	Pre-Algebra	Pre-Algebra
Science	Avid	Avid	Science	Science
Literature, US History, Writing	Literature, US History, Writing	Drama	School Newspaper	
Marine Biology	Science	Science	Math	Algebra
Study Hall	Language Arts	US History	Eastern Hemisphere	Eastern Hemisphere
MAST: Middle Grades Teachers with a Mixed-Academic Primary Assignment				
Higher Order Thinking Skills	Language Arts	Higher Order Thinking Skills		
Computer Technology	Reading	Math	Social Studies	Mentoring
Algebra I	Pre Algebra	Earth Science	Earth Science	
Spanish	Exploratory Seminar	Religion		
Language Arts	Language Arts	Strive (At-Risk)	Strive (At-Risk)	Social Studies
Computers	Earth Science	Physical Education		
Advanced Spanish	Social Studies	Science	Social Studies	Science
Social Studies	Social Studies	Keyboarding	Keyboarding	Writing
English	Gifted	Enrichment	Enrichment	
Math	Spanish	Spanish	Geometry	Computer
Language Arts	Social Studies	Problem Solving		
Biology	Pre-Algebra	Life Management		
Journalism	Science	Math		
MAST: High School Teachers with a Single Primary Academic Assignment				
Math	Science	Spanish	Math	Science
Technology	English	History	English	Technology
American Studies	American Studies	American Studies	Writing	AP English
Physics	Physics	Physics	Computer Programming	Computer Programming
Physics	Pre-Calculus	Algebra II	Algebra I	General Science
TV Production	English	English		
World History	World History	Honors World History	Engineering, Science & Technology	Engineering, Science & Technology
Computer Applications	Computer Applications	English	Journalism	English
Physical Science	Geometry	Biology	Health Occupations	
Journalism	Journalism	Journalism	Vocational Education	Vocational Education
Government, Economics	Government, Economics	Government, Economics	Alternative Education	Alternative Education
Psychology	Reading	Reading	History	Reading
MAST: High School Teachers with a Mixed-Academic PrimaryAssignment				
Law	Computers	Computers	History	History
Biology	Academic Decathlon	Spanish I	Marine Biology	Biology
Philosophy	Art	Literature		
Nature Seminar	Leadership Alternative Seminar	AP English		
Psychology	College English	College English	Psychology	
Algebra I	Algebra II	E.S.L.	E.S.L.	
Math	Math	Arabic I	Arabic I	Language Arts
Science, World History, American	Math, World History	American History, Health	Science	English
German	AP Chemistry	Latin	Independent Study	
English	English	Biology	French	Vocational Education
Spanish	Spanish	English	Print Media	
US History	Speech	Sociology	Drama	
Math	English	Cooperative Education	Cooperative Education	Government
English	Special Skills	Multimedia Authoring	Speech	

such as vocational education. In addition, many of them teach courses for special secondary populations including English as a Second Language, programs for at-risk students, gifted and enrichment programs, competitive programs (e.g., Academic Decathalon) and seminars on specialized topics.

Teaching a mixed-subject teaching load is not the same as teaching out-of-field although there is clearly a relationship, depending on how "out-of-field" is defined. Because most secondary teachers are credentialed in only a single subject and most have had only a single academic major (even when minors are considered),[2] if a teacher teaches across subject areas, they are "out-of-field" for at least some of their courses. In this study, we did not have data on teaching credentials, but we did code up to three different college major and minor subjects reported by the teacher. Altogether, in our study, 16% of secondary teachers taught a single academic subject for a majority of the their class assignments and did not have a college major or minor in that field. This percentage comes closer to out-of-field percentages reported by NCES (U.S. Department of Education, 1999) than the figures shown by Ingersoll (1999) which appear to have been based on the criterion of a course-credential mismatch for any of the courses a teacher taught. However, our 16% percentage excludes teachers who had primary teaching assignments in applied areas such as fine arts, computers, or business and vocational education or who taught self-contained classes, and some of these may have been teaching out-of-field as well. Overall, of the 309 teachers whose teaching practice we analyze below, 26% were also considered out-of-field by our definition. I examine that group separately to see if there are, in fact, complementary forces going on: teaching out-of-field suggesting a characteristic of weak teacher performance at the same time that the teaching practice of most mixed academic secondary teachers suggests the likelihood of positive outcomes for students.

[2] 14% of our sample of secondary teachers mentioned more than one academic area in response to the question about their college major and minor. That includes education-specializations (e.g., English education) as well as straight academic majors.

Characteristics of Mixed Academic Secondary Teachers

The analysis of the teaching practices of Mixed-Academic Secondary (MAS) teachers includes attention to five aspects of teachers and teaching: the teachers' own educational and teaching experience; their philosophy of teaching; teaching strategies followed in the one class which they selected in which they feel most accomplished as a teacher; their use of computers in their teaching practice; and their orientation towards their teaching role—between a focus on their own classroom, on the one hand, versus having a professional orientation that looks outwards towards their in-school and beyond-school teaching peers. Each of these elements of teaching practice has been examined in other papers and reports issued as part of the Teaching, Learning, and Computing study (Becker, 1999; Becker and Riel, 1999; Becker, Ravitz, and Wong, 2000; Ravitz, Becker, and Wong, 2000; and Riel and Becker, 2000). However, in the context of presenting specific results, we provide a brief summary of the characteristics studied.

In the tables and text below, the primary comparison I wish to make is between Mixed-Academic Secondary (MAS) teachers and teachers who are principally teachers of a Single Academic Subject (SAS). In addition to these groups, however, the tables contain data concerning the Other Secondary Teachers (25% of the total weighted secondary teacher sample). These are principally teachers of four main applied subjects: computer education, fine arts, business education, and vocational education. In addition, teachers who teach a single self-contained class in middle and high schools (most often, a 6^{th} grade class in a middle school) are included here as are a small group of media center teachers and librarians and those who teach primarily courses that could not be clearly identified with one or another of the main subject fields (e.g., "research course" or "basic skills").

Educational and Teaching Background

In many respects, MAS teachers have similar backgrounds to secondary teachers of Single Academic Subjects (SAS). A slightly higher percent are women (66% vs. 61%), although that is entirely explained by the fact that they disproportionately teach in middle schools where women are proportionally more numerous. Although only slightly younger (averaging 41 vs. 43 years

old for SAS), a much higher percentage of MAS teachers are in their first 8 years of teaching (48% vs. 35%), suggesting a somewhat more mature yet fresher involvement in teaching.

In terms of educational background, they are slightly less likely to have academic majors (as opposed to an education major in the subject field) than SAS teachers (60% vs. 65%), but again this is accounted for totally by the fact that middle school teachers are also less likely to have had an academic major than high school teachers (67% vs. 49% in our sample). There are two other indicators, however, that mixed academic teachers make a greater personal investment in their own education. First, they are somewhat more likely to have a masters degree (52% vs. 46%). More importantly, perhaps, given other studies of teaching practice and education (Weiss, 1993), they are much more apt to have been continuing their education recently, with a full two-thirds (67%) having taken a college course for credit in the two years previous to the survey, compared to only 50% of the single academic subject teachers.

These background factors—being somewhat more mature than other teachers with similar years of teaching experience, and making greater personal academic investments themselves—give a small hint that perhaps mixed-academic subject secondary teachers are more sophisticated in their approach to teaching than are teachers of single academic secondary subjects. Our TLC survey investigated teacher sophistication in terms of two aspects of pedagogy: teaching philosophy and the frequency with which teachers used different strategies in actual practice.

Teaching Philosophy

Teachers' beliefs about good practice—their educational philosophy—is an important determinant of how teachers actually teach. Our survey's analysis of teaching philosophy and practice is based on a model of the perspectives and teaching strategies that distinguish between a traditional knowledge-transmission view of teaching and a constructivist one. A constructivist-oriented philosophy is reveal by statements recognizing the importance of student interests and student perspectives in guiding teaching, and the consequent importance of motivation rather than teaching being the implementation of a fixed externally-mandated curriculum. Our measure

of teaching philosophy comes from three survey questions, incorporating 13 individual prompts.[3] In one question, teachers were asked to compare two teachers' approaches to classroom discussion, one approach representing traditional teacher-directed questioning based on prior reading, the other representing teacher-led discussion that provoked questions from the students themselves which the teacher then reflected back to them for further research. A second set of questions presented paired comparisons of contrasting teaching philosophies, each item presented as a hypothetical personal statement of beliefs.[4] The third question involved a set of six agree vs. disagree statements (6-point scales) including statements about the importance of background knowledge as a rationale for direct instruction, the value of building instruction around problems with "clear, correct answers" and ideas "that most students can grasp quickly," and the need to postpone "meaningful learning" until basic skills have been acquired.

An index was created by taking the mean of these 13 prompts, after equalizing item standard deviations (effectively creating standard scores for items). The alpha reliability for this index was .84. Scores were transformed to z-scores so that group differences are expressed in standard deviation units, making the calculation of "effect size" statistics very straightforward. (Effect size equals the difference between group means divided by the within-group standard deviation.)

Comparing MAS and SAS teachers on this index of Constructivist Teaching Philosophy finds MAS teachers to be more than one-fourth a standard deviation more constructivist than SAS teachers, and this is after controlling for school level (middle school vs. high school), where the difference in mean scores by level is itself .15 of a standard deviation. (See Table 2.)

[3] For more detailed information on teachers' responses with respect to teacher philosophy and practice see Ravitz & Becker, (1999).

[4] The first item contrasted the role of the teacher as learning facilitator in inquiry-based learning versus transmitter of information and procedural directions. A second item contrasted the primacy of "sense-making" with importance of transmitting the required curriculum. A third item presented the choice between believing that motivation and student interest were more important than specific subject-matter versus believing that the textbook content in history, science, math, and language skills should "drive what students study." A fourth item contrasted a teaching style with multiple activities incorporating the integration of diverse skills occurring simultaneously in the classroom with a whole-class model with short time-span tasks that "match students' attention spans and the daily class schedule."

Table 2: Constructivism of Teaching Philosophy by Secondary Teacher 's Teaching Assignments

Teaching Assignments	Middle School (mean z-score)	High School (mean z-score)
MAS: Mixed Academic Subject	.25	.19
SAS: Single Academic Subject	.02	-.09
Other Secondary Teachers (applied, self-contained, etc.)	.09	-.10
All Middle and High School Teachers in TLC Samples	.07	-.08

The differences between MAS and SAS teachers can be seen more clearly in answers to individual survey questions. The teachers were asked whether they saw their role more as a facilitator "who tries to provide opportunities and resources for my students to discover or construct concepts for themselves" or whether it was, instead, more important for teachers to go over material in a structured way, "to explain, to show students how to do the work, and to assign specific practice." While teachers of Single Academic Subjects split evenly on this choice (35% of them favoring each point of view, with the remainder choosing the middle position on a 5-point scale), MAS teachers favored the facilitator role by two-to-one (46% vs. 23%).

An even larger distinction between MAS and SAS teachers appears in another survey question about the kinds of classroom questioning environment that results in students gaining more knowledge. Teachers were presented with two short vignettes that described characteristic teaching practices of two teachers. Ms. Hill was described as using questions, in a rapid-fire way, to prompt students to recall information from the previous night's reading. Mr. Jones was described as having a classroom discussion in which many of the questions came from the students themselves, but rather than answering students' questions directly, Jones was described as suggesting "where the students could find relevant information," admitting that "he couldn't really answer most of the questions himself." While the latter response might indeed be indicative of a teacher with less of a knowledge basis in the subject being taught, it also suggests a teacher who views his role as one of encouraging students to investigate their own questions—to take charge of their own learning. Overall, we found that of the Mixed-Academic Subject teachers, 57% believed that the inquiry-oriented approach of Mr. Jones led to students

gaining greater knowledge, while only 39% of the SAS teachers did so. A plurality of the SAS teachers (44%), instead, believed that Ms. Hill's direct instruction approach produces more knowledge for students. (The remaining teachers chose the middle response on a 5-point scale.)

Because direct instruction has been associated with the teaching of low-ability classes while an inquiry approach is largely understood to be something that teachers are more apt to follow when teaching above-average ability classes, we controlled on the teacher's report of the ability level of her classes to see whether that accounted for SAS teachers' reporting a more constructivist point of view.

If anything, controlling on reported student ability increased the difference in teaching philosophy between MAS and SAS teachers. For classes deemed relatively high in student ability, MAS teachers had a Constructivist Philosophy score .36 s.d. (standard deviations) higher than SAS teachers. For average-ability classes, the difference was .28 s.d. Only for low-ability classes was the relationship smaller than in the un-controlled situation (ES = .17 s.d.)[5] The overall pattern is also reflected in the two specific examples discussed above. The differences between MAS and SAS teachers is quite sizable for those who teach high ability classes, and relatively small for those who teach low-ability classes. For example, on the question comparing the direct instruction teacher, Ms. Hill, with the inquiry-oriented Mr. Jones, two-thirds of MAS teachers of high-ability classes (66%) explicitly said Jones' approach produced more learning, while only 40% of SAS teachers of high-ability classes did so. For the teachers of low-ability classes, the comparable percentages were 52% and 42%. Still, regardless of student ability-level, teachers of multiple academic subjects appear to be more constructivist in teaching philosophy than teachers of single academic subjects.

[5] Note: In this version of the paper, effect sizes are not calculated based on actual within-group standard deviations, but on the simple difference in z-scores. Within-group standard deviations are likely to be slightly below 1.0; therefore actual effect sizes are likely to be somewhat larger than in this version.

Teaching Practice: Projects, Group Work, and Cognitive Challenge

Although what teachers believe constitutes "good teaching" affects to some extent the way they carry out their teaching practice, the way teachers actually manage their students' class time can be affected by other factors as well, including in particular their own expertise in carrying out the philosophy that they espouse. Carrying out a teaching practice based strongly on such beliefs is *anything but easy* to accomplish. Even when teachers have constructivist beliefs, having to be responsible for entire classrooms of individual students at the same time, having holes in their own pedagogical or content knowledge, having competing teaching objectives, or having external pressures on what they must do—all of these forces interfere with the implementation of a constructivist philosophy.

As discussed above, in the section on teaching philosophy, the heart of a constructivist teaching practice is teaching that organizes student work around meaningful activities so that students are thoughtfully engaged with content (hopefully, important content). Thoughtful engagement with content would be expected, for example, if students are required to monitor their own learning experience as part of their class work, or to consider multiple ways of considering the same idea, or to help plan classroom activities, design their own problems to solve, or undertake tasks where there is not a clear "correct" answer ahead of time. Frequent assignments involving reflective writing, making conjectures about why things exist, and backing up those conjectures with reasoning and evidence are other examples of teaching practices that suggest that students are thoughtfully engaged in intellectual work. These are among the operational indicators we use to measure constructivist-compatible teaching practice.

Other teaching practices are also compatible with constructivism but do not appear to be inevitably associated with a constructivist philosophy—practices such as having students work in groups, do laboratory activities, or work on complex projects. Projects and small group work can be assigned without attention to deep intellectual engagement; they are activities that teachers can, to some extent, be expected to report whether or not they are particularly constructivist. However, they are included in our overall measure of constructivist practice, because we found overwhelming evidence of their co-occurrence—that is, the correlations are quite substantial

between engaging in teaching that focuses on meaningful intellectual engagement and using strategies such as student projects and group work (Ravitz, Becker, and Wong, 2000).

Our survey asked teachers to report how frequently they assigned the kinds of activities discussed in the previous paragraphs—activities indicative of providing cognitively challenging tasks for students and activities involving small group work and projects. Teachers responded in terms of the particular class that they taught in which they felt they most successfully accomplished their teaching objectives. Five survey questions were involved. One question asked about the methods the teacher used to introduce the current unit to their class (e.g., asking students to make conjectures about what they will learn; giving them introductory drills). Another asked about the purposes they had for asking students questions (e.g., to see if they have done their homework; to have students relate what they are working on to their own experiences). Another asked about how the last five hours of class time were divided among different activities such as the teacher leading a whole-class discussion or students working together in small groups. Two other questions asked about how often students take part in certain activities (e.g., helping plan classroom activities, working on problems for which there is no obvious solution, making a product that will be used by someone else).

Many researchers who observe teachers in day-to-day practice are quite suspicious of survey methodology for accurately measuring teacher practices. To a large extent, it is true that survey questions can only get at the surface of teacher behavior whereas it seems plausible that important distinctions between effective and ineffective practices lie in the particular ways that teachers implement any particular practice such as "having students take greater responsibility in devising solutions to problems." Many people suspect that "social desirability" (survey respondents' beliefs about how different responses would be evaluated by significant others) bias survey responses to questions about their instructional practices. Prior to this national survey, a validation study was conducted involving 72 teachers from 24 schools in three states. Validation involved approximately three hours of interviews with each teacher and observation of three class lessons, along with examination of recent quizzes and homework assignments. Most of the items used in the national survey were ones that were used in the validation study and which

correlated most strongly with the field team observation and interview data about the 72 teachers studied. See Becker and Anderson, 1998, for additional details.

In any event, repeated exploratory factor analyses with the 30 prompts contained in the five survey questions produced a set of four indices of instructional practice, involving 27 items altogether (see Table 3) which when collapsed together constitute our measure of Constructivist Teaching Practice. The following analysis examines each of the four components separately as well as the combined Teaching Practice index. The four components are Cognitive Challenge (itself a combination of sub-indices called Reflective Writing, Meaningful Thinking, and Problem Solving), Projects, Group Work, and (Absence of) Transmission-Oriented Practices.

Each index value is computed as a z-score, and in particular, each index is itself standardized on the subject-matter of the single class about which the teacher was responding. Thus, all teachers reporting about a mathematics class have an average score on each index of 0, even though, on an absolute scale, mathematics teachers generally score below almost all other teachers on these measures of constructivist practice (Ravitz, Becker, and Wong, 2000). Similarly, all reports about English classes average to a 0 as well even though English teachers as a whole are substantially more constructivist than other secondary teachers. The reason for using "within-subject-matter" z-scores is that one could reasonably claim that many of the items measure activities that are inherently more appropriate for certain subjects than for others. Thus, rather than determine whether that in fact was the case, use of the within-subject scores takes subject-matter out of the measurement. For this analysis, then, of Mixed Academic Subject teachers versus Single Academic Subject teachers, the comparisons are between the two groups of teachers relative to teaching in the very same subject field—the field of the single class about which the teachers responded.

Table 3: Survey Items Measuring Constructivist Practice

COGNITIVE CHALLENGE					
MEANINGFUL THINKING					
Meaningful Tasks	Reflective Writing	Problem - Solving	Projects	Group Work	Transmission-Oriented (Reversed)
	How Often Did Students…				
Students made conjectures when unit was introduced? Teacher raised questions about that she did not know the answer to when unit was introduced? Teacher spent time having students lead a discussion or presentation? Teachers asks <u>questions to…</u> · elicit students' ideas and opinions · get students to justify and explain their reasoning? · have students relate what they are working on to their own experience How often are there tasks <u>where students..</u> · suggest or help plan classroom activities or topics? · debate and argue point of view, perhaps not be their own? · represent the same idea or relationship in more than one way? · tasks w/ no indisputably correct answer	write in journal? write an essay explaining their thoughts at length? write an essay about or seriously assess their own work?	work on problems for which there was no obvious method of solution? have to design their own problems to solve? decide on their own procedures for solving a complex problem and then discuss results?	do hands-on/ laboratory activities? work on projects that take a week or more? make a product to be used by someone else? demonstrate their work to an audience including people other than from the school or their family?	Students discussed topic in groups when introduced Students worked together in small groups to complete assignment as team How often did students work in small groups to come up with a join solution or approach to a problem or task?	Students did introductory drills on skills and facts? Teacher spent time leading a whole-class discussion (students listened and answered questions) Teacher asks questions to see if students know the correct answer? How often did students work individually answering questions in the textbook or worksheets?

As with the examination of teaching philosophy, differences between MAS and SAS teachers are shown (in Table 4) separately for middle grades secondary teachers and high school teachers. As opposed to the results for teaching philosophy, where at both school levels the MAS teachers were roughly one-fourth of a standard deviation more constructivist than SAS teachers, the results for actual teaching practice were quite different by levels.

Table 4: Constructivism of Teaching PRACTICE in One Class by Secondary Teacher's Teaching Assignments, Sub-Indices and Overall Index (within-subject-field z-scores)

Teaching Assignment	Component of Teaching Practice				
	Cognitive Challenge	Projects	Group Work	(Absence of) Traditional Practices	Overall Constructivist Practice
Middle Grades					
MAS: Mixed Academic	**.13**	**.17**	**.08**	**.01**	**.13**
SAS: Single Academic	**.08**	**.06**	**.02**	**-.02**	**.07**
Other Middle	-.03	.05	.10	.00	.01
All Middle	.06	.07	.05	-.01	.07
High School					
MAS: Mixed Academic	**.53**	**.26**	**.26**	**.40**	**.54**
SAS: Single Academic	**-.10**	**-.09**	**-.04**	**.01**	**-.10**
Other High Sch.	-.06	-.03	-.11	-.07	-.07
All High School	-.05	-.06	-.04	.01	-.06
Both Secondary Levels					
MAS: Mixed Academic	**.25**	**.20**	**.14**	**.13**	**.26**
SAS: Single Academic	**-.02**	**-.03**	**-.01**	**-.01**	**-.03**
Other Secondary	-.05	.00	-.02	-.04	-.04
All Secondary	.00	.00	.00	.00	.00

Among middle grades teachers, there were only small differences in teaching practice between MAS and SAS teachers. The largest differences were in terms of the use of student projects, but even there the difference was only .10 s.d. Among high school teachers, in contrast, on three of the four sub-indices, and for the overall measure, Mixed Academic Subject teachers were at least .25 s.d. more constructivist than SAS teachers, and on the two most central statistics—the Cognitive Challenge subscale and the overall Constructivist Practice measure, the differences between MAS and SAS teachers were greater than .60 s.d. (e.g., on Cognitive Challenge, the mean MAS score was +.53 s.d.; the mean SAS score was -.10 s.d.).

Although we are dealing here with a relatively small sample (only 83 MAS teachers, 93 weighted, representing 6% of all high school teachers), these are very substantial differences on very central aspects of pedagogy. Moreover, it may be significant that the largest differences are not for the more surface manifestations of constructivist pedagogy such as projects and group work, but concern tasks such as reflective writing and problem-solving and others that attempt to make learning meaningful for students—perhaps the most challenging pedagogy for teachers as well as students.

One other point. These findings hold when we control for teaching philosophy. Controlling for teaching philosophy addresses the question of which teachers are actually able to implement a constructivist practice given similar teaching philosophies. The ability to do so is another mark of teaching expertise. Table 5 shows that high school MAS teachers average more than .50 s.d. above SAS teachers in their overall constructivist practice, even after philosophy is held constant (through use of the residual practice score after predicting practice from philosophy in a regression equation). Middle school MAS teachers show no advantage at all over SAS teachers in this respect. Their slightly higher Contructivist Practice score is totally accounted for by their having a higher Constructivist Philosophy score than SAS middle grades teachers. Thus, middle grades MAS teachers do hold a more constructivist-compatible set of beliefs about good teaching, but given that, they are no more able to implement them than are middle grades SAS teachers who hold the same teaching philosophies.

Table 5: Constructivism of Teaching Practice in One Class by Secondary Teacher's Teaching Assignments, Controlling for Teaching Philosophy (within-subject-field z-scores)

Teaching Assignments	Middle School Grades	High School Grades
MAS: Mixed Academic Subject	.02	.50
SAS: Single Academic Subject	.06	-.07
Other Secondary Teachers (applied, self-contained, etc.)	.00	-.07
All Middle and High School Teachers in TLC Samples	.04	-.04

Teachers' Use of Computers

The use of computers and computer-related technologies such as the Internet and digital photography are one of the foremost innovations occurring in teaching during the last several years. Although computers have been part of school inventories for nearly 20 years, only in the last five years have their capabilities become sufficiently powerful and convenient and has their number in schools become substantial enough for most teachers to begin thinking about making their use a central part of their pedagogy. Teachers differ a great deal in how much access to computers they have (particularly in their own classroom), how much knowledge they have in how to use them, and in the extent that they use them both professionally and instructionally during their students' class time. Previous research with the same dataset has demonstrated the factors that predict differential use of the Internet (Becker, 1999) and in other ways (Becker, 2000). The chief determinants of both Internet use and computer use by students in general appear to be classroom access to sufficient technology, teacher computer expertise, and teacher belief in and use of a constructivist pedagogy. Teacher leaders—those who engage in both formal and informal professional exchanges among their peers—are also much more likely to be highly active computer users, both in terms of their own expertise and in terms of having students use computers for objectives compatible with a constructivist pedagogy (Riel and Becker, 2000).

In this analysis of Mixed Academic Subject secondary teachers, we examine four measures of computer use: a measure of the breadth and frequency of software use by teachers' students during class time; a measure of teacher expertise and professional use of computer resources; a dichotomous measure of whether the teacher would be classified among the top 10% of all teachers in terms of being a Highly Active computer user; and a measure of the extent to which the teacher reports that their students appear to use computers for class work outside of class time, for example, after school or at home (for the class about which the teacher described her teaching practices). These four measures cover most of the aspects of computer use available in our dataset. Details about the measurement of these variables are not provided here, but can be found in Riel and Becker, 2000; and Becker, Ravitz, and Wong, 2000).

In this national sample of secondary teachers, Mixed Academic secondary teachers clearly use computers in their classes more than teachers of single academic subjects. Transforming index mean scores into z-score equivalents, Table 6 shows that at the middle school level, MAS teachers use a variety of software at a level of frequency that is about .40 s.d. greater than SAS teachers do, and at the high school level, the difference is even greater-- two-thirds of a standard deviation (+.46 vs. -.21).

Table 6: Indicators of Computer Use by Secondary Teachers' Teaching Assignments

	Frequency and Variety of Software Use by Students Index zscore	Teacher Professional Uses, Computer Expertise Index zscore	Percent of Teachers Meeting Criteria for Highly Active Computer Use	Extent of Reported Student Computer Use for Class Work Outside of Class Time (Index zscore) (limited to computer-assigning teachers and 50% sample)
Middle Grades				
MAS: Mixed	**.29**	**-.05**	**14%**	**.14**
SAS: Single	**-.12**	**-.15**	**9%**	**-.21**
RST: Remaining	.32	.14	8%	-.18
All Middle Grades	.03	-.08	10%	-.15
High School				
MAS: Mixed	**.46**	**.06**	**18%**	**.78**
SAS: Single	**-.21**	**-.02**	**9%**	**.24**
RST: Remaining	.45	.33	8%	-.25
All High School	-.03	.06	9%	.13
Both Secondary Levels				
MAS: Mixed	**.34**	**-.02**	**15%**	**.37**
SAS: Single	**-.17**	**-.08**	**9%**	**.03**
RST: Remaining	.39	.25	8%	-.22
All Secondary	.00	.00	9%	.00
Excluding Teachers who taught any computer or business course				
MAS: Mixed	**.26**	**-.06**	**14%**	**.38**
SAS: Single	**-.18**	**-.09**	**9%**	**.03**

One reason might be that MAS teachers are more likely to teach a course about computers itself, as part of their mixed subject responsibilities. However, even when we exclude such teachers from consideration (the bottom two rows of Table 6), the difference between MAS and SAS teachers in the frequency and variety of software their students use diminishes only slightly, from .51 s.d. (across middle and high school combined) to .44 s.d.

Despite their greater use of computers with students, it turns out that MAS teachers are no more expert in their knowledge of computers than SAS teachers nor are they likely to use computers on a professional basis any more. (See the second data column in Table 6.) Instead, their distinction is that they have chosen to use computers as a tool of student learning much more than other academic teachers do. We are not surprised by this finding, in that other analyses have established a clear link between constructivist pedagogy and greater classroom use of computers (e.g., Becker, 2000).

The mixed results of MAS teachers being more active computer-assigning teachers, but being no more involved or expert themselves in using computers produces the intermediate result in column 3. Middle school MAS teachers are half-again as likely to meet the high standards for being designated Highly Active Computer-Using Teachers, but still only 14% do so. High school MAS teachers are twice as likely as SAS teachers to meet those criteria (18% vs. 9%). This is a substantial difference, but not an overwhelming one.

What is an overwhelming difference, however, is the difference between high school MAS and SAS teachers on one other measure of computer use: teachers' estimates of the proportion of their students who "have done work for this class using computers in [settings outside of class] on at least several occasions." Again, converting mean values to standard deviation units, we find that MAS high school teachers are more than .50 s.d. higher on this measure of out-of-class student use of computers than are SAS teachers. At the middle school level, the difference is .35 s.d., and even when we exclude the teachers who have one or more computer or business education classes, the overall difference between MAS and SAS teachers is .35 s.d.[6] Thus, not only do MAS high school teachers employ a greater variety of software in their students' classwork (and have a greater frequency of use of that software), but even out-of-class time (e.g.,

[6] This difference probably cannot be explained by the clientele the two groups of teachers serve. The average teacher-estimated student ability levels for the two groups of teachers is not different. It is true that high school MAS teachers teach in schools with somewhat higher socio-economic-status (SES). (The difference was .18 s.d.). However, when we control on SES and on how much in-class use of software students have, there is nearly as strong an association between Mixed vs. Single subject teaching assignment and out-of-class student computer use as before the controls (beta coefficient of .13 vs. simple correlation of .16). (Multiple regression analysis details available from the author.)

after school and at home), their students put in more time using computers for their class assignments, at least as reported by their respective teachers.

Teacher Role Orientation and Mixed vs. Single Academic Subject Teaching Load

It is frequently mentioned that teachers spend the vast majority of their workday in the company of no other adult. More significant, though, than the absence of contact is the fact that teachers' learning, planning, and decision-making is primarily an individual matter—very little is negotiated with other practitioners except, perhaps, for allocation of time to shared spaces and other shared resources. Moreover, the bureaucratic culture of public educational organizations further limits how much teachers participate in other teachers' work lives.

The traditional view of teachers working as isolated practitioners is reasonably well supported by our national survey. Only one-third of all secondary teachers in our national probability sample report having even one discussion per week with other teachers about how to teach or about group projects or technology. Only conversation about personal matters occurs more often. And when it comes to observing one another teaching a class, fewer than one-quarter of all secondary teachers report doing this at all (more than "seldom"). Although most teachers attend at least one or two workshops during a year, only a minority ever give workshops for other teachers, or mentor new teachers on a regular basis.[7]

Yet recent arguments for how to improve teacher practice generally call for increased involvement by teachers in other teachers' work lives, through informal discussions, observations, and informal mentoring within the same school, and through informal communications, leadership in professional development activities, university teaching, and publishing beyond the school. Our final empirical examination of the difference between Mixed- and Single-Academic Subject secondary teachers concerns the question of whether either group is more involved in the professional lives of other teachers through participation in activities such as those mentioned above.

[7] Data on these items from the TLC national probability sample is contained in Becker and Riel, 1999. These tabulations on secondary teachers alone were done for this paper. Details available from the author.

From 15 prompts in three survey questions about within-school interactions, beyond-school contacts, and leadership activities, we developed a scale of Teacher Professional Engagement (Becker and Riel, 1999; Riel and Becker, 2000). Overall, 12% of the national probability sample of teachers met criteria for breadth and frequency of involvement in professional activities sufficiently to be designated Professionally Engaged Teachers. (Eighteen percent of teachers from the purposively selected schools met these requirements suggesting a much higher level of professional involvement in schools involved in reform programs or having high-density of computer technologies.) Combining both samples, 15% of all surveyed teachers (weighted), and 14% of the secondary teachers, met these criteria.

At the middle school level, Mixed Academic Subject teachers were only slightly more likely to meet the criteria than were Single Academic Subject teachers (16% vs. 13%; see Table 7). However, among high school teachers, the Mixed Academic Subject teachers were more than twice as likely to do so (29% vs. 12%). No one component of the Professional Engagement index made an especially great difference. MAS high school teachers were higher on all three survey questions. Moreover, at the other end of the scale, roughly the same percentage of MAS and SAS high school teachers fell into the category describing the opposite end of the index, "Private Practice" teachers (52% and 55%, respectively). Thus, even at the high school level, about half of MAS teachers attend mainly to their own classroom. However, in the relatively small pool of professionally engaged teachers, a disproportionate number of MAS teachers stand out as leaders among teachers.

Table 7: Percent of Teachers Classified as Professionally Engaged, by Teaching Assignment

Teaching Assignments	Middle School Grades	High School Grades
MAS: Mixed Academic Subject	16%	29%
SAS: Single Academic Subject	13%	12%
Other Secondary Teachers (applied, self-contained, etc.)	19%	17%
All Middle and High School Teachers in TLC Samples	14%	14%

Mixed Academic Subject Teachers and Out-of-Field Teaching: Some Final Data and Discussion

This paper opened with a discussion of the presumed problem of out-of-field secondary teaching, where teachers teach part or all of their workload in one or more subjects for which they lack college degrees or credentials. The characterization of those teachers suggested that they were likely to give inferior performances in those duties, lacking sufficient disciplinary knowledge to engage in effective teaching. In contrast to that characterization of out-of-field teachers, the reader was asked to consider a different designation for a similarly defined population of teachers: teachers whose willingness (or interest) to teach courses in multiple subjects might indicate a more intellectually alive mind, a teacher more apt to instruct students according to reform ideas that emphasize interdisciplinary content, the importance of connecting students' perspectives to content (making it meaningful), and a teacher perhaps more effective in the complex task of bringing along adolescents to being interested in and taking effort in learning in academic subjects.

This analysis of data from a national survey of teachers has shown that secondary teachers defined as having Mixed Academic Subject teaching responsibilities, on average, express teaching philosophies more consistent with constructivist-compatible instructional reform models than do teachers of Single Academic Subjects, and that they more actively involve a diverse range of computer software in the activities they provide for their students and obtain greater effort from their students in using computers outside of class time as well. Moreover, at the high school level, the Mixed Academic teachers are substantially more constructivist in practice than the single subject teachers when each is teaching in the same subject. Finally, again at the high school level, MAS teachers are much more likely to be professionally engaged in formal and informal interactions with their teaching peers than are teachers of single academic subjects.

The remaining question is whether these conclusions apply as well to teachers who fall into a category of "out-of-field" teaching as defined by a mismatch between their own college major and minor and the primary (majority) subject which they teach in school. One problem in answering this question is definitional. Should we consider as being out-of-field, those teachers

who teach such a mixture of subjects that no single field (e.g., various mathematics courses) are taught for a majority of their classes? We did not designate a "primary subject taught" for these "Very Mixed Subjects" teachers, and therefore did not calculate whether such a "primary" subject matched their college major or minor. But given that in most cases at least half of their course assignments would likely be in a field other than their academic major or minor, it seems reasonable to provisionally consider this group to be out-of-field as well.

Table 8 provides a summary of characteristics of teachers—their teaching philosophies, pedagogy, computer use, and professional engagement—according to which of 5 categories of

Table 8: Teacher Characteristics of Mixed Subject vs. Out-of-Field Teachers

Teaching Assignment Category	Within-Subject-Fields z-scores: Construct. Philosophy	Cognitive Challenge Part of Construct. Practice	Projects Part of Construct. Practice	Construct. Practice	Construct. Practice Controlling on Philosophy	% Highly Active Computer User	% Profes-sionally Engaged Teacher	Number of cases (unweighted)
Out-of-field and MAS*	.12	.15	.14	.17	.14	17%	21%	(72)
Out-of-field and SAS**	.06	.11	.11	.11	.08	11%	12%	(416)
Not OOF*** and MAS	.14	.25	.04	.23	.18	14%	14%	(96)
Not OOF and SAS	-.06	-.05	-.06	-.06	-.04	8%	13%	(1553)
Very MAS, probably OOF ****	.36	.31	.33	.32	.17	15%	24%	(137)
Total	-.01	.01	.00	.01	.01	10%	13%	(2274)

Note: Table excludes 717 teachers with primary subject in applied secondary fields such as computers, business education, vocational education and fine arts; and also excludes secondary teachers of self-contained classes
* Mixed Academic Subjects
** Single Academic Subjects
*** Not Out-of-field
**** No subject had a majority of class assignments. Out-of-field status is provisional based on further examination of courses taught and college major or minor.

out-of-field teaching (yes or no) and mixed- or single-subject teaching they are engaged in. (The fifth category is the just-discussed group of teachers who teach no one subject for a majority of their teaching load, a group tentatively defined as "very mixed, probably out-of-field.") Because of the low numbers, middle- and high-school teachers are combined for these analyses.

The teachers with the lowest mean score on constructivism measures—whether philosophy, focus on cognitive challenge, use of projects, or overall teaching practice—are those in the most numerous category: conventionally assigned teachers who neither teach out-of-field nor teach a mixed academic subject teaching load. These are also the teachers who are least likely to be designated as highly active computer users, and their likelihood of being designated as professionally engaged is no greater than average.

Conversely, the teachers with consistently the highest average scores on constructivism measures, as well as being most likely to be professionally engaged and among the more likely to be highly active computer users are the teachers who teach a very mixed-subject teaching

load, such that no single field constitutes a majority of their classes—the group provisionally classified as out-of-field.

From among the other three categories whose teaching practice is intermediary between the constructivism of the Very Mixed, provisionally out-of-field group and the traditional practice of the single-subject, "in-field" teachers, the differences are quite small and only the difference in teacher professional engagement even approaches being statistically significant. But there is one consistent pattern, even if none of the individual differences are statistically significant. Among these three "intermediary" categories, the least constructivist, least likely to be computer leaders and least likely to be professionally engaged appear to be the single-subject out-of-field teachers.

Overall, with respect to out-of-field teaching, as distinct from mixed academic subject teaching responsibilities, the pattern of results suggest that out-of-field teachers are at least as oriented as in-field teachers towards constructivist-compatible teaching models, involving a focus on providing tasks that are cognitively challenging, engaging, and embedded in applications such as through student projects. It is also true, though, that an emphasis on constructivist teaching practices is much more clearly associated with those teachers defined in terms of the mixture of their course assignments rather than in terms of a match between those course assignments and their college degrees. It is, in fact, where both of these characteristics prevail—a teacher teaches a very mixed set of courses, many of which, if not most of which, are likely to be in fields outside of the ones in which they majored or minored in college—where not only constructivist practice prevails, but greater investment in using computers in that practice, and a greater likelihood of exhibiting leadership through professional activity within the profession.

There may, in fact, be problems with out-of-field teaching associated with the arguments that Ingersoll and others have made. Constructivist teaching, project and small group work in particular, even if it provides advantages in making school work more meaningful, particularly for underprepared and disadvantaged students, may not produce superior teaching. However, it also does not seem right to assume that a teacher's subject-matter knowledge is the primary criterion for evaluating good teaching. In many circumstances, including in particular those situations where out-of-school disadvantage and prior school failure yields students who are not

only achieving below grade-level but likely to be very unmotivated and academically disengaged, the most important quality that a teacher can bring to students experiencing a pattern of academic failure may be their enthusiasm for learning and teaching new material—conveying to students by example why it is worth making the effort to learn.

Moreover, at the opposite end of the achievement spectrum, it may be that teachers with intellectual initiative to teach in a variety of subject areas are precisely the type of teachers that successful high school students need to go beyond an outdated discipline-bound curriculum in order to give them experience with ideas and issues that are more relevant to their active minds than the existing discipline-bound school curriculum. Many of the new models of curricular reform, including, for example, the Coalition for Essential Schools, foster and even mandate teacher initiative in designing learning and instruction instead of forcing teachers to teach a ready-made curriculum over which they may have little ownership or little excitement after teaching it year after year.

This research into the pattern of teaching and professional engagement by teachers who do teach across subject field boundaries, and very likely cross beyond the fields of their initial college emphasis suggests that these hypotheses have some merit. Additional investigation into the pattern of effects of out-of-field teaching and mixed subject teaching responsibilities can perhaps specify more clearly the conditions under which this idea has particular merit and the conditions where the contrary theory—that teaching beyond one's field of academic preparation—does do harm, if indeed it does.

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