

The Beliefs, Practices, and Computer Use of Teacher Leaders

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Abstract

Models of school reform, professional development programs, state and federal policies increasingly support teachers in expanded roles, including as Teacher Leaders. Teacher Leadership involves providing peer guidance through formal and informal professional discussions, mentoring, university teaching, conference presentations and academic publishing.

This research analyzes the responses of 4,000 U. S. teachers concerning their educational background, teaching philosophy and instructional practices both with and without computers. We formed 4 groups of teachers based on their reported levels of professional engagement. At the high end of the continuum of levels of Professional Engagement are Teacher Leaders— teachers who place a high value on sharing their knowledge with their teaching colleagues. At the opposite end of the continuum are Private Practice Teachers who report little or no engagement in professional dialog or activities beyond those mandated. Teacher Professionals, similar to Teacher Leaders, were engaged beyond the classroom but reported less leadership activities. Interactive Teachers were not quite as disengaged as Private Practice Teachers.

Teacher Leaders and Teacher Professionals were more likely than Private Practice or Interactive Teachers to:

- 1) have made and continue to make higher investments in their own education.
- 2) promote knowledge construction rather than engage in direct instruction.
- 3) develop instructional practices, both with and without technology, that are theoretically tied to their constructivist philosophy.
- 4) use computer technology for teaching and learning.
- 5) integrate computer technology into their classrooms in ways that support meaningful thinking and involve collaborative project work and sharing of ideas with their peers.

This research adds the voices of Teacher Leaders and Teacher Professionals to the ongoing debate over the best instructional practices. The findings are consistent and strong—Teacher Leaders are better educated teachers, continuous learners, computer users, and promote constructive problem-based learning over direct instruction. Their position in the educational community mirrors students' positions in their classrooms. They use computers to help their students achieve the same level of respect and voice that these teachers have achieved within their professional educational community.

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Introduction

Teacher professional development increasingly recognizes the importance of the expertise of practicing teachers and of teachers learning from and with one another (e.g. Acker 1995; Darling-Hammond, 1994; Renyi, 1996). These new roles and support structures for teachers can work together to establish a professional culture in schools—a culture of collaboration rather than a culture of individualism (Talbert & McLaughlin, 1994; Schlager, Fusco, & Schank, 1998). This collaborative approach to professional leadership is viewed as central to school change (Darling-Hammond & McLaughlin, 1995; Little, 1993).

The isolation and silence of teachers in the discourses on teaching and learning can be seen as a “protective response to subordination” (Smyth, 1989). Teachers, without a sense of agency or authority beyond the classroom, engage in a form of “private practice” behind closed doors. Closed classroom doors open concerns about maintaining high standards for both teaching and learning. This research focuses on how these teachers are similar and different from the group of teacher leaders.

In contrast to this form of private practice, teacher leaders and professionals engage in collaborative dialog about teaching and learning with a belief that “part of being a teacher involves grappling with and collectively confronting the contradictory demands of the educational system,” (Smyth 1989:223). The shift from privacy and self-reliance to collaboration and experimentation or continuous improvement represents a significant shift in values (Little, 1982). Institutional factors like school culture and organizational practices help shape the way teachers view their role in the school (Darling-Hammond and McLaughlin 1995; Fullan, 1991; Guskey and Sparks 1996; Smyley 1995, Becker & Riel, 1999). Teacher leaders view their relationship to other educators within and beyond the school as an important determinant of the quality of student learning in the classroom (Glazer, 1999).

We begin this paper with a review of the literature in two areas: (1) the rationale for our choice of teacher leadership dimensions; and (2) a brief discussion of our choice of dimensions for discussing school philosophy, practice and computer use.

Teacher Leadership Dimensions

Collaborative forms of professional development exist at the school site and beyond the school and include participation in peer review groups, teacher networks, and partnerships with universities and organizations, and programs. They involve teachers in national, state, and local school and curriculum reform activities.

Teacher Leadership in School

Teacher leaders improve classroom practice by engaging other teachers in critical reflection on their experiences and sharing classroom experiences with other teachers in formal and informal ways (Little, 1994; Lieberman, 1995; Darling-Hammond & Ball, 1997; Loucks-Horsley et al., 1998).

INFORMAL DISCUSSIONS

Teachers working together to explore dimensions of teaching and learning, creating school improvement plans, and developing school curriculum are directly linked to effective schools (Johnson 1986; Glatthorn and Fox 1996). Lieberman & McLaughlin (1995) found that successful teacher school networks unite members who share interests and concerns around a common goal that the participants themselves believe to be important. Little (1982) underscores the importance of a school culture "teachers valued and participated in norms of collegiality and continuous improvement." Strong networks also provide participants with an opportunity to interact in a non-threatening environment where both teaching and learning occur simultaneously.

TEACHER MENTORING AND CLASSROOM VISITS

Teacher mentoring is a school reform strategy that recognizes and rewards the talent and expertise of master teachers. Teacher leaders work with in one-to-one relationships with colleagues as peer mentors, providing information and feedback on the implementation of a new program or on a promising instructional strategy (Elmore & Bierney, 1996). In this role, teachers are able to use their extensive knowledge of teaching in specific school contexts to help colleagues who may be new to teaching or new to the school. This peer teaching and collaboration approach encourages the development of local expertise. Opportunities to observe others, to model desired behaviors, to benefit from coaching by colleagues, and to receive meaningful feedback on their progress help create a culture of collaboration (Lieberman & Miller, 1992).

While recognizing that some mentoring programs can be conservative in nature with experts transmitting a skill-based culture to a new generation of teachers (Cochran-Smith & Paris 1995), for many these programs are viewed as catalysts for transformational change in school culture (Caldwell & Carter 1992; Monahan (1996)). Because mentoring programs are based on teachers working together, and supporting one another, they can create a school culture of collaboration. However, the development of these programs may be an important dimension with mandated mentoring programs leading to "contrived collegiality" rather than to a culture of collaboration (Hargreaves, 1994).

Professional Teachers and Leadership beyond the School

INFORMAL COMMUNICATIONS

Professionally engaged teachers see teaching as a process of continual, reflective inquiry and the exchange of ideas with their peers leading to the development of a shared technical language and a shared knowledge base (Little, 1994). They value opportunities to share their expertise with colleagues beyond their schools. Out-of-school experiences--collaborations with formal and informal networks, partnerships with community groups, and involvement in district, state, national and international education activities--expand teachers' understanding of policy and practice in ways that are sometimes unavailable in school. The recent availability of email and Internet access encourages informal professional and leadership opportunities.

PROFESSIONAL DEVELOPMENT OPPORTUNITIES

Teachers are often required to attend workshops given by "outside experts" in teaching and learning while their knowledge--gained from years of practice--is undervalued (Lieberman, 1995, Cochran-Smith and Lytle, 1990). This encourages a view of "teaching as technical, learning as packaged, and teachers as passive recipients of "objective research." (Lieberman, 1995:591).

School district and organizational meetings provide an avenue for teachers to share their ideas beyond the school. Teachers can voice their need for professional development that extends far beyond the one-shot workshop toward fulfilling their expressed need for opportunities to learn how to question, analyze, and change instruction to teach challenging content development (Darling-Hammond, Lieberman, & McLaughlin, 1995). Darling-Hammond and McLaughlin (1995) argue for new forms of staff development which provide "occasions for teachers to reflect critically on their practice and to fashion new knowledge and beliefs about content, pedagogy, and learners." (1995:597). The goal is to engage teachers in studying specific aspects of practice, comparing ideas on implementation, and seeking new ideas or programs. Increasingly teachers are serving as instructors and participants in new forms of professional development that go beyond those that impart research results to engaging teachers in active programs that involve continual partnerships (Wells & Chang-Wells 1992). These district meetings also provide teachers with the opportunity to review curriculum plans, instructional programs and student assessment practices. As teachers identify more and more professional development capacity within their school, they become less dependent on traditional forms of professional development (Darling-Hammond, et al, 1995).

WORKSHOP AND CONFERENCE PRESENTATIONS, UNIVERSITY TEACHING

Teacher leaders often attend conferences and workshops as presenters rather than participants. Some teachers become involved in trainer of trainers programs where their presentation is more likely to be constrained within a model or program that supports teachers teaching teachers (Gray & Sterling, 2000). But often teacher leaders create presentations about their own innovations. To do this well, teachers need to place

themselves at a distance and view their work from the perspectives of their peers. The process of extracting elements of their practice and conceptualizing it for others creates the distributive expertise that is basic to a learning community (Shulman, 1997).

Other leadership opportunities are available by formal relationships with universities where teacher leaders spend some of their time teaching either pre-service or in-service teachers. Increasingly, there is a call for professional development schools where expert teachers serve as instructional leaders for new teachers (Holmes Group, 1990, Levine, 1992, Darling-Hammond, 1994, Sandholtz & Daddles 2000). Teaching in professional development schools revitalizes and veteran teachers for their contribution to the education beyond their classroom teaching (Sandholtz & Merseth, 1992).

EDUCATIONAL PUBLISHING

In communities around the country, teachers--either alone or in groups--are gathering information, analyzing experiences and events, and writing about the issues and problems they confront in schools and classrooms. By publishing their work, teacher leaders share their ideas and strategies with the larger profession. There are at least four reasons for why publishing for teachers is so important. The first is that the process of knowledge construction involves critical thinking and reflection that leads to deeper knowledge (Woodruff, Macdonald & Nason, 1998). The second is the experience can lead to a deeper understanding of how to guide novice writers (Gray & Sterling, 2000). Third, teachers who are authors are more likely to be participants in a academic discourse closing the gap between teaching and research (Berietter, 2000). Fourth, teacher knowledge on how programmatic and organizational changes might be effective in their school or districts can be a valuable resource for school reform.

Dimensions of Teaching Philosophy, Practice, and Computer Use

To understand how teacher leaders differ from other teachers, we examine their philosophy, practice and use of computer technology in terms of current theories of teaching and learning. Teachers today are expected to prepare all students to reach significantly higher academic standards than have previously been attempted in this country (Murnane & Levy, 1996). The student populations that teachers are asked to work with are diverse and have complex learning needs (Mehan, et, al. 1996). The range of methods and approaches and the theories of teaching and learning demand extensive intellectual preparation and continual learning on the part of teachers (Wiske, 1998). The rapid speed of technological development brings new computer mediated tools to the classroom door each year. Teachers have to make continual decisions about how to best utilize these tools in teaching, learning and assessment.

School reform programs are efforts to solve a range of educational problems, however, our examination of the discourse of reform suggests that many of them either explicitly or implicitly derive from theories of learning that can be grouped under the rubric of constructivism (Brooks & Brooks, 1993). These include cognitive constructivism (Piaget, 1952, Papert, 1980), inquiry learning theories (Dewey, 1916,Sizer, 1984), socio-historical activity theories (Vygotsky, 1978; Newman et, al, 1989; Wertsch, 1997), social constructivism (Garfinkel, 1967; Cicourel, 1973; Mehan, 1983, Lave, 1988; Pea, 1996),

meta-cognitive theories (Brown & Campaine, 1994, Bereiter, 2000), and recent brain-based learning (Sylwester, 1995; Renate & Caine, 1997).

These constructivist-compatible instructional activities are quite distinct from a cultural or knowledge transmission view of learning (Hirsch, 1996; Adams, & Engelmann, 1996) that emphasizes teacher-centered whole-class explanation and closely scripted student seatwork.

Dimension of Educational Philosophy	Knowledge Transmission	Co-Construction of Knowledge
Role of Teacher	Delivers information in a structured coherent order	Coach, guide, Learning Community facilitator
Role of learner	Passive reception of information	Group responsible to share interests, learning and knowledge with others
Conception of Knowledge	Accumulation of information in discipline structures.	Cognitive, social and socio-cultural structures that organize information in the mind and in the world
Teaching/learning Process	Association, memorization, conditioning-rewards & punishments	Problem solving, inquiry argumentation, dialog and debate
Assessment Process	Tests of retention of information, psychometric tests	Portfolios, exhibitions, Performance assessment projects

This same distinction is used to understand teacher responses about their classroom practices. Classroom teachers who define instruction as the transmission of knowledge have students learn concepts and skills through listening, copying text, and practicing sets of similar problems. Classroom teachers who define instruction as the co-construction of knowledge focus on project activities that expect students to display understanding, interpretation, and original thought. The questions about practices asked teachers to describe classroom activities in a current on-going classroom unit. The questions were posed so that teachers frequently had to make a choice among options that were closer to one of these two contrasting approaches to classroom instruction.

Computers can be defined in similar ways to convey information, for practicing responses or for tutorials. These are all knowledge transmission uses. Computers can also be used for student inquiry and presentation of students' work. These are co-construction uses.

Research Questions

Our study examines how pedagogical beliefs, practices and computer use of teacher leaders compare to other teachers. In particular, we explore the following questions:

- 1) How do teacher leaders and other professionally engaged teachers compare to other teachers with respect to personal and professional characteristics?
- 2) How does the philosophy of professionally engaged teachers compare to that of other teachers?
- 3) How does the pedagogy of professionally engaged teachers differ from that of other teachers?
- 4) Is the use of computers by professionally engaged teachers different from other teachers' use of computers?
- 5) How do the most active computer-users among professionally engaged teachers differ from other equally engaged teachers but for whom computers are a less central part of their teaching practice?

Data and Methods

Source of Data, Sampling, and Weighting

This study of teacher professionalism, pedagogy, and computer use is drawn from data collected in 1998 as part of a national survey. "Teaching, Learning, and Computing–1998" surveyed teachers from a national probability sample of schools–898 schools stratified by school level (elementary, middle, high school). It also includes a sample of 718 schools selected either because of the presence of substantial computer technology in the school or because of the involvement of at least one teacher, if not the whole school, in instructional reform activities.² In both the probability sample of schools and the specially selected schools (we refer to the latter as the "purposive" sample), most of the teachers were selected using probability sampling methods from among all teachers of grades 4-12. About one-sixth of the teachers were selected because of their participation in reform programs or their principal's designation of them as exemplary users of constructivist/cognitive approaches.³

Seventy-five percent of schools (N=1215) participated to the point of rostering their teachers for sampling. Among the teachers sampled or selected with certainty, 4,083 provided completed useable surveys, 67% of those rostered and sampled. This includes 2,251 teachers from the probability sample, 1,236 from reform-involved schools, and 596 from the high technology-presence schools. The analysis for this paper combines the probability and the purposive sample in such a way as to take account of the sampling weights of different schools and different teachers in the same school. We also maintain the balance in total numbers between the probability sample (55% of the total sample) and the purposive sample.⁴

The teacher respondents were asked to complete a survey booklet about their teaching practice, teaching beliefs, and their work environment that was 21 pages in length and required approximately 60-75 minutes. Four different versions of the teacher survey booklet were used, with overlapping sets of questions.

Many of the survey questions about instructional practice and teaching philosophy were validated by a prior study (Becker & Anderson, 1998). That research compared teacher questionnaire responses to field-researcher-team judgments based on three in-depth interviews and three hour-long classroom observations. Those items for which teacher responses most closely matched those made by the interviewer-observers were included in (or adapted for) the final versions of the questionnaires.

² The probability sample was a weighted sample with selection probabilities related to school size and the amount of computer technology present. Selection of the additional "purposive" sample schools was based upon extensive data gathering, including tabulation of schools participating in more than 50 reform programs and development of a "technology presence index" for all public schools in the United States, using data from Quality Education Data, Inc.

³ Again, weights were used that were inversely proportional to selection probabilities of different teachers. [Further information about the sampling design can be found at <http://www.crito.uci.edu/TLC>. Principals and school technology coordinators also supplied information for the study.

⁴ Teachers are weighted inversely to their probability of selection within their school, and for the probability sample, schools themselves are weighted inversely to their probability of selection.

Operationalization of Constructs

DEFINING TEACHER LEADERS

We define Teacher Leaders as teachers in our sample who were actively engaged with their peers both at their own school and beyond their school and who indicated that they were engaged in mentoring other teachers, presenting at workshops, university teaching, or publishing (Becker & Riel, 1999). At the other end of our continuum were those teachers who we call Private Practice Teachers. Those were teachers who, by indicating relatively little professional interaction with peers, could be inferred were either implementing mandated policies or found themselves to be both self-sufficient in their teaching practice and uninterested in assisting others in their field. We also labeled teachers in two intermediate categories: Teacher Professionals were closer to Teacher Leaders, while Interactive Teachers were closer to Private Practice Teachers. The placement of teachers into these categories was determined by three multi-part survey questions, each of which was used to form an index which in turn contributed to the overall measure of professional engagement from which the four categories were formed.

Within-School Teacher Interaction. From the first question set, we formed an index of "Within-School Teacher Interaction." This was the average frequency that the teacher reported having six types of interactions with other teachers at their own school. Those interactions included discussions about teaching methods, project ideas, subject-matter issues, and technology (Table 1a) as well as reports of informal observations of another or ones own teaching (Table 1b). Informal interactions averaging halfway between "several per month" and "one to three times per week" was one of the three criteria used to define Teacher Leaders. To be a Teacher Professional, an average answer of "several per month" was needed.

TABLE 1A: FREQUENCY OF TEACHER INFORMAL DISCUSSIONS
WITH OTHER TEACHERS AT THEIR OWN SCHOOL

<i>How often do you have the following types of interactions with other teachers at your school?</i>	Seldom/ Never	Several/ month	1-3/ week	Almost Daily
Discussions about how to teacher a particular concept to the a class	21%	44%	22%	13%
Discussions about ideas for student or group projects	20%	45%	23%	12%
Discussions of different views about an issue within our common subject area (e.g. science)	23%	44%	21%	12%
Discussions about computer software or the Internet	26%	41%	23%	10%
Discussions on <i>any</i> of the above topics	6%	37%	32%	23%

Sample: TLC Probability Sample

TABLE 1B: FREQUENCY OF CLASSROOM VISITATIONS AT THEIR OWN SCHOOL

<i>How often do you have the following types of interactions with other teachers at your school?</i>	Seldom/ Never	Several /month	1-3/ week	Almost Daily
Visits to another teacher's classroom to observe teaching	78%	16%	4%	1%
Informal observations of MY classroom by another teacher	79%	17%	2%	2%

Sample: TLC Probability Sample

Beyond-School Teacher Contact. A second survey question dealt with similar interactions—but with teachers at other schools (Table 2). "Beyond-School Teacher Contact" was defined as how many of the following three criteria the teachers met:

attending workshops with teachers from other schools at least 3 times since September; going to 3 or more committee meetings with teachers from other schools; and using electronic mail with teachers at other schools at least a half-dozen times. To be considered a Teacher Leader, two of these criteria needed to be met; Teacher Professionals had to meet only one of these criteria of Beyond-School Teacher Contact.

TABLE 2: FREQUENCY OF PROFESSIONAL CONTACT
WITH TEACHERS AT OTHER SCHOOLS

	Not so far this year ^a	1-2 times	3-5 times	More Often
A workshop or conference with teacher from other schools	14%	44%	29%	13%
A committee meeting with teachers from other schools	45%	27%	20%	8%
Electronic mail with teachers from other places	61%	14%	9%	16%

Sample: TLC Probability Sample

^a The time period represented is most of a school year. Teachers completed surveys between March and June of 1998.

Leadership. The third survey question asked about the teacher's involvement over the past three years in six types of leadership activities within the profession, including mentoring other teachers (2 measures), giving workshop presentations (2 measures), teaching college-level courses, and publishing (Table 3). The number among these six activities reported by the teacher formed the teacher's "Leadership Activity" score. Teacher Leaders engaged in at least three of these six activities; Teacher Professionals did at least two.

TABLE 3: PERCENT OF TEACHERS INVOLVED
IN PROFESSIONAL LEADERSHIP ACTIVITIES

In the past three years, which of these experiences have you had?	Yes
I have informally mentored another teacher	38%
I have been formally assigned to mentor another teacher	23%
I have given a workshop or talk for at least 25 teachers	35%
I have given workshops for teachers on at least 5 occasions	15%
I have taught a college-level course for credit	10%
I have published an article for professional educators	5%
Four or more of the above	7%
Three or more of the above	20%
None of the above	40%

Sample: TLC Probability Sample

As indicated above, Teacher Leaders and Teacher Professionals had to meet standards deriving from each of the three survey questions. The standards for Teacher Leaders were simply more rigorous. Among those who did not meet standards on within-school interactions, between-school contacts, and leadership activities, we distinguished between teachers who were generally interactive with other teachers, having at least a mean score on an index combining answers to all three survey questions, from those who had a score below the mean, overall. The former we titled Interactive Teachers; the latter, Private Practice Teachers. The numbers and percents of teachers so classified are shown in Table 4. Although this paper focuses on the Teacher Leaders, we present data on all four

groups to provide a context for understanding the survey responses of the Teacher Leaders.

TABLE 4: CATEGORIES OF PROFESSIONAL ENGAGEMENT

Level of Professional Engagement	Description of Professional Engagement	Weighted Percent & Raw N*	
		Probability Sample Only	Full TLC Sample
Teacher Leaders	Teachers meeting the highest standards on within-school informal interactions, between-school contact, and leadership activities.	2% (70)	3% (176)
Teacher Professionals	Teachers meeting somewhat more modest standards on all three dimensions of Professional Engagement.	10% (311)	12% (627)
Interactive Teachers	Teachers who spent some time interacting with their peers but did not meet standards on all three dimensions.	29% (724)	30% (1331)
Private Practice	Teachers who do not interact substantially with their colleagues near or far.	58% (1109)	55% (1870)

* The number of teachers shown is the actual number of teachers surveyed who placed into that category. The percent shown is the weighted percentage of all studied teachers, taking into account the sampling probabilities for each teacher and each school. The rightmost column combines teachers from the probability sample of schools and the selected reform-involved and high-technology schools in proportion to their relative sample size.

PEDAGOGY: DIRECT INSTRUCTION VS. KNOWLEDGE CONSTRUCTION

To measure instructional practice, teachers were asked a set of questions that focused on how frequently they employed specific instructional strategies in the one class in which they felt most accomplished as a teacher. An index was constructed based on the mean scores of 27 item prompts from five survey questions:⁵

Methods used to introduce the current unit to the class included introductory drills (coded in the direction of "Direct Instruction"), small group discussions, making conjectures, and raising truly problematic questions ("questions...that I did not know the answers to"). The last three were coded in the direction of "Knowledge Construction."

Reasons given for asking students questions included eliciting student opinion, getting students to justify their reasoning, and relating issues to students' experiences (all coded "Knowledge Construction").

How the most recent five hours of class time had been spent, including teacher-led whole-class discussion (coded "Direct Instruction"), student presentations and student led discussion, and student small group work ("Knowledge Construction").

Frequency of various types of assignments and class activities (2 questions) included individual seatwork ("direct instruction"), hands-on activities, weeklong projects, journal-writing, planning classroom activities, problem-solving in small groups, working on problems with no obvious method for solving, explaining their reasoning by writing, holding formal debates, designing their own problems to solve, small group discussions of procedures for solving problems, doing oral or written reflection on their own work,

⁵ For more information on this scale and responses of the sample see Ravitz, Becker, and Wong (2000), available on www.crito.uci.edu/tlc

tasks involving multiple representations of the same idea, making a product to be used by someone else, demonstrating work to an audience (other than their class or parents), and undertaking tasks without clear correct answers (all “Knowledge Construction” items).

The alpha reliability for this index was .86. For this paper, the index was divided roughly into quartiles, with teachers in the lowest quartile classified as “direct instruction-oriented” and those in the highest quartile as “knowledge construction-oriented” in terms of pedagogy.

EDUCATIONAL PHILOSOPHY: TRADITIONAL BELIEFS VS. CONSTRUCTIVIST BELIEFS

In our model, teacher beliefs about good practice--their educational philosophy--is a control variable in the main analysis. Beliefs about teaching that derive from constructivist learning theory represent a *potential* for implementing a constructivist-compatible teaching practice. Yet, it is well understood that implementing many of these practices is hard work. One question we address in this paper is whether leaders are more able to implement a constructivist pedagogy than are other teachers, even when they hold essentially similar teaching philosophies. Our measure of teaching philosophy comes from three survey questions, incorporating 13 individual prompts.⁶ 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.⁷ 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 , 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.

⁶ For more detailed information on teachers’ responses with respect to teacher philosophy and practice see Ravitz & Becker, (1999).

⁷ 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.”

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.

COMPUTER USE

Teacher involvement in using computers involves having students use a variety of software as part of their classroom instructional practice as well as using computers for their own professional work. In addition, a strong computer-use practice would seem to involve reasonably substantial expertise in using basic computer applications and having adequate resources available for professional and student use. The survey contained several measures of computer access and use that we placed into a broader operational definition of teacher involvement with computers:

- 1) The extent to which teachers had students use each of 10 different types of software (the Web, spreadsheets and databases, multimedia authoring software, word processing, games for practicing skills, simulations, presentation software, e-mail, programs for printing graphics, and CD-ROM reference software)
- 2) The variety of ways they themselves used computers professionally (e.g., corresponding with parents, getting information or pictures for the Web for use in lessons, and exchanging computer files with other teachers)
- 3) The extent of their technical expertise (e.g., knowing how to make and present a slide show, develop a multimedia document, create a new database, etc.)
- 4) Their experience and felt expertise with Windows and Macintosh platforms
- 5) How many computers they had in their classroom
- 6) The variety of other technology resources which their schools gave them access to (e.g., classroom telephone, easy access to a fax machine, Internet access and electronic mail from their classroom, access to the school's computer network from home)
- 7) How long they had had a home computer and Internet access
- 8) Whether their students had ever used computers for complex, integrative projects (several examples shown and asked about)
- 9) The extent that their use of computers had increased in several ways over the past five years (e.g., for class preparation, for student projects)

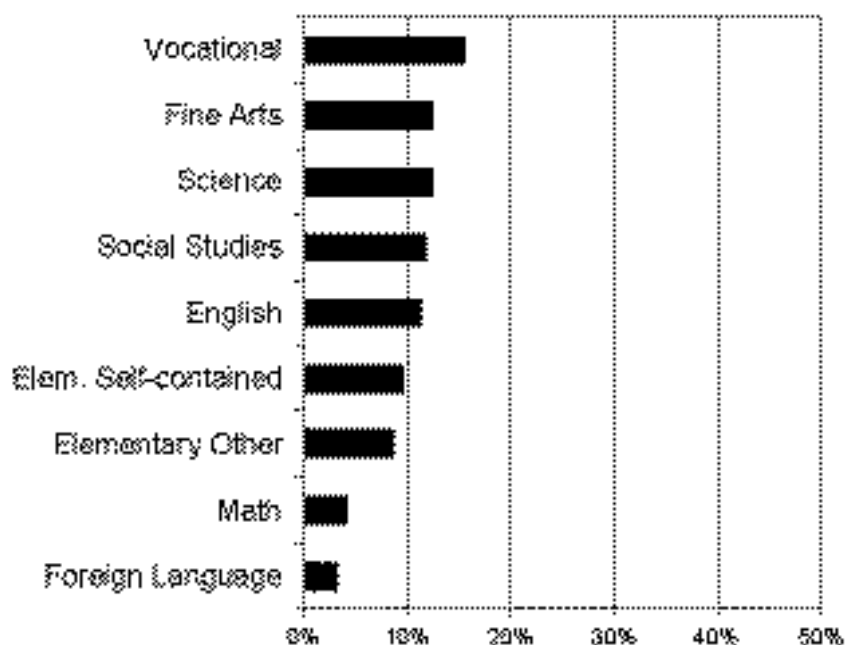
Factor analysis of all of the different indicators of computer use produced three dimensions of teacher computer involvement, which we labeled "Student Tool Use," "Frequent (relatively simple) Uses," and "Teacher Use and Expertise." These three dimensions were combined, and, using a judgmental process, cutoff points were chosen that, in combination, selected 10% of all teachers as Highly Active Computer Users.⁸

⁸ To operationalize the dichotomous construct "Highly Active Computer User," we employed a cutoff score for each of the three dimensions, setting the cutoff point according to a judgment of how important each dimension was for the underlying construct. Specifically, teachers were judged to be Highly Active Computer Users if they were .25 standard deviations above the mean on Student Tool Use, .25 standard deviations above the mean on Teacher Use and Expertise, and no lower than .25 standard deviations below the mean on Frequent Simple Uses. These cutoff points represented the top 24% of teachers on Student Tool Use, the top 41% on Teacher Use and Expertise, and the upper 54% on Frequent Simple Uses. To

(Computer education teachers and business education teachers were excluded from the factor analysis and subsequent categorizations because computer use was essentially defined as essential elements of their courses.)

Between 9% and 10% of teachers of each school level passed these cutoff points to be designated as Highly Active Computer Users. Teachers of most subject-areas were in the range of 9% to 12%, with only foreign language (3%) and mathematics teachers (4%) below that point and vocational education teachers (16%) above (Figure 1).

FIGURE 1: PERCENT OF ALL TEACHERS CLASSED AS
HIGHLY ACTIVE COMPUTER-USING TEACHERS



Results

Our contrast of Teacher Leaders with other categories of teacher Professional Engagement will be reported in three major sections, (1) descriptions of personal and educational backgrounds, teaching responsibilities, and participation in staff development activities (2) teaching philosophies related to pedagogical practices and (3) computer use. Throughout, we contrast the Teacher Leaders with the other categories of teacher professional engagement.

meet the criterion for being labeled a "Highly Active Computer User," a teacher needed to pass all three cutoff points.

Professional and Personal Characteristics

We use personal and professional characteristics including information on teachers' educational background experiences and current participation in learning to provide an image of Teacher Leaders.

PERSONAL CHARACTERISTICS AND TEACHING EXPERIENCE

Teacher Leaders, on the average, are about 5 years older and have had 5 years more teaching experience than the other teachers in the sample. While it makes sense that veteran teachers should be providing leadership, this finding runs contrary to assertions often made about teachers, such as that older teachers, educated at a time when teaching was seen as a more solitary activity, might be less likely to be involved in professional activities. Clearly, that is not the case. (See Table 5.)

In the overall sample, 66% of the respondents were female. Private Practice Teachers were 65% female which is very similar. However the Teacher Leaders were more likely to be female with 74% female.

TABLE 5: PERSONAL BACKGROUND DATA

Professional Engagement	Mean Years of		
	Mean Age	Teaching Experience	% Female
Teacher Leaders	48.0	19.5	74
Teacher Professionals	44.9	15.9	70
Interactive Teachers	43.5	15.2	65
Private Practice	42.6	13.7	65
Total	43.3	14.6	66

Sample: Probability and purposive samples.

EDUCATIONAL BACKGROUND

The Teacher Leaders came from more selective schools, maintained higher grade point averages, and were more likely to have graduate degrees than the rest of the teachers in the sample. When we combine the educational background information into an index, and compare Teacher Leaders' to the total sample, their average "Educational Investment" places them in 69th percentile nationally (See Table 6, Z scores). Teacher Professionals are also more educated than typical teachers in the sample (60th percentile). The Private Practice Teachers are, in contrast, less well educated (45th percentile). Although there are likely to be many very good teachers who are isolated in their classrooms, this data suggests that those who close the door are teachers with less academic preparation than those who are engaged in professional activities.

TABLE 6: PERSONAL BACKGROUND DATA

Professional Engagement	% Arts and Sciences Major in College*	% Graduated from selective college	% Undergrad GPA 3.5+	% MA or higher	% took credit college course in past 2 yrs	Educational Investment Index z-score
Teacher Leaders	48	13	50	64	50	0.49
Teacher Professionals	50	8	39	59	60	0.26
Interactive Teachers	53	7	34	50	54	0.07
Private Practice	52	8	28	42	49	-0.12
Total	52	8	32	47	52	0.00

Sample: Probability and purposive samples.

* Not part of Educational Investment Index.

TEACHING RESPONSIBILITIES

Teacher Leaders and Teacher Professionals were distributed proportionally across subject areas and grade levels in the national probability sample--selected to represent the nation--with one exception: Proportionately more computer education teachers were included in these two categories of the more professionally engaged teachers (see Table 7). Thus, it appears that teachers who teach computer classes, as a whole, are more engaged in a collaborative culture than teachers from other subject areas.

The Teacher Leaders and Professionals who were identified from the purposive sample--the reform programs schools and schools with very high levels of technology--showed more variation by subject area. These schools appear to have proportionally more professional leadership in interdisciplinary subjects, in applied secondary subjects, and in elementary self-contained classrooms.

TABLE 7: PERCENT TEACHER LEADERS AND TEACHER PROFESSIONALS BY SAMPLE TYPE AND SUBJECT TAUGHT

	% Teacher Leaders and Professionals, Probability Sample	% Teacher Leaders and Professionals, Reform/Tech Sample	% Teacher Leaders and Professionals, Both Samples
Secondary			
Computer Education	22	24	23
Business Education	13	34	19
Vocational	11	30	18
Social Studies	13	13	13
Science	11	18	15
English	12	13	12
Other Secondary	13	22	17
Math	12	11	11
Elementary			
Self-contained classrooms	13	25	17
Other Elementary	12	19	13
All Teachers	12	18	15

STAFF DEVELOPMENT PARTICIPATION

Teacher Leaders spend, on the average, 6 more days than other teachers in staff development activities. If we contrast Teacher Leaders with those teachers who are isolated in their classrooms, the Teacher Leaders are spending twice as much time in professional development activities (see Table 8). When looking at the content of these sessions, the Teacher Leaders were more likely to be engaged in professional development activities which focused on technology and instructional strategies than the teachers in the other groups.

TABLE 8: TOTAL # OF STAFF DEVELOPMENT DAYS ATTENDED IN PAST YEAR

Professional Engagement	Mean
Teacher Leaders	15.2
Professional Teachers	11.4
Interactive Teachers	10.4
Private Practice	7.5
Total	9.0

Philosophy and Pedagogy and Professional Engagement

PHILOSOPHY

Using the complex of questions that formed our Philosophy Index, we arranged the teachers by quartiles from those who see the aim of education as knowledge transmission to those who hold that knowledge construction is the basic aim. Table 9 shows the percent of Teacher Leaders and the other three categories who fall into each of those quartiles. Only 3% of the Teacher Leaders fall in the knowledge transmission quartile compared to 32% of the Private Practice Teachers, while 58% define their overall goals in educational as consistent with a constructivist philosophy (compared to only 20% of Private Practice Teachers).

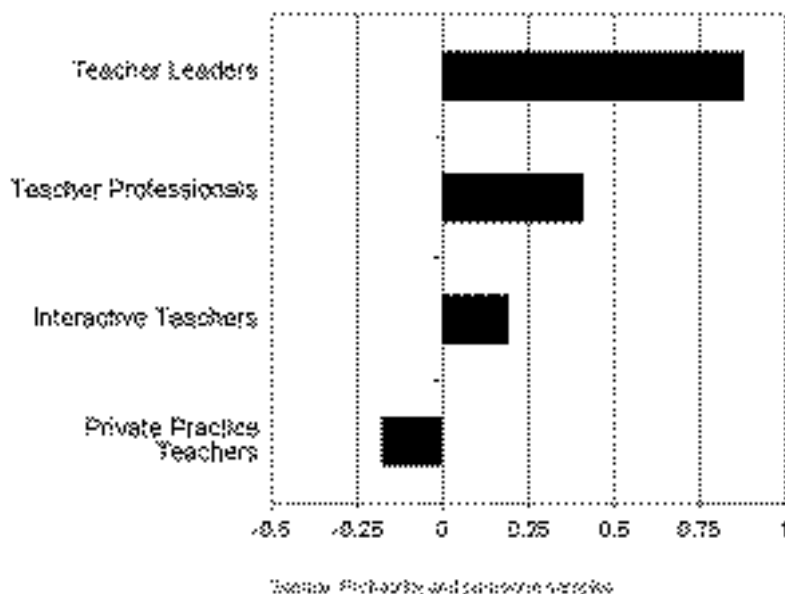
TABLE 9: TEACHING PHILOSOPHY BY PROFESSIONAL ENGAGEMENT

Professional Engagement	% Knowledge Transmission	% 2nd Quartile	% 3rd. Quartile	% Knowledge Construction	% Total
Teacher Leaders	3	9	30	58	100
Teacher Professionals	14	20	26	40	100
Interactive Teachers	19	24	24	32	100
Private Practice	32	25	23	20	100
All teachers	25	24	24	27	100

Sample: Probability and purposive samples.

The Private Practice Teachers are the only group to have a higher percent of teachers who hold the more traditional views of knowledge transmission than hold knowledge construction viewpoints. This difference is clearly visible in Figure 2. However, it is important to remember that Private Practice Teachers are also the largest group in the sample and represent half of the teaching population.

FIGURE 2: CONSTRUCTIVISM OF TEACHING PHILOSOPHY BY LEVEL OF PROFESSIONAL ENGAGEMENT (Z-SCORES)



PEDAGOGY

As discussed earlier, we asked teachers to select one class period in which they were most satisfied with their teaching, the one in which they felt that they were closest to accomplishing their educational goals. All the questions about teacher pedagogy (i.e., their actual teaching practice) were about this particular class.

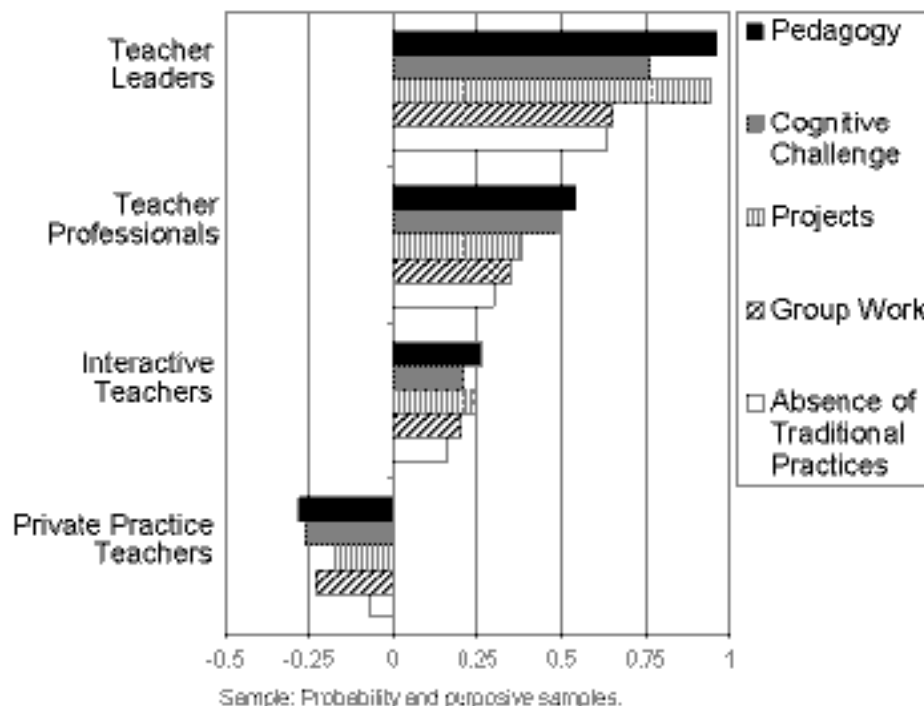
The 27 items from the Pedagogy Index were divided into quartiles, similar to how the Philosophy Index was handled. In Table 10, it is apparent that most of the Teacher Leaders fall in the quartile that most supports a knowledge construction approach to education. Conversely, only 2% of the Leaders are located in the direct instruction quartile.

TABLE 10: CONSTRUCTIVIST PEDAGOGY BY PROFESSIONAL ENGAGEMENT

Professional Engagement	% Direct Instruction	% 2nd Quartile	% 3 rd Quartile	% Knowledge Construction	% Total
Teacher Leaders	2	16	25	57	100
Teacher Professionals	11	20	23	47	100
Interactive Teachers	16	22	29	33	100
Private Practice	33	28	23	16	100
All Teachers	24	25	25	26	100

Sample: Probability and purposive samples.

FIGURE 3: CONSTRUCTIVISM OF TEACHING PEDAGOGY (INCLUDING SUBSCALES)
BY LEVEL OF PROFESIONAL ENGAGEMENT (Z-SCORES)



A series of exploratory factor analyses of the 27 survey prompts that comprised the Pedagogy Index revealed that the items can be reasonably assigned to four different sub-components: (1) the use of student projects; (2) small group work; (3) tasks involving cognitive challenge; and (4) presence or absence of direct instruction. Figure 3 shows that on all four of these sub-indices, as with the full index as a whole, Teacher Leaders demonstrate the most constructivist pedagogies; Teacher Professionals, the next most; and Private Practice Teachers, the least. Teacher Leaders differ most from the other three categories of teachers on items measuring student project work, where they are nearly one full standard deviation above the mean for all teachers in the TLC sample.

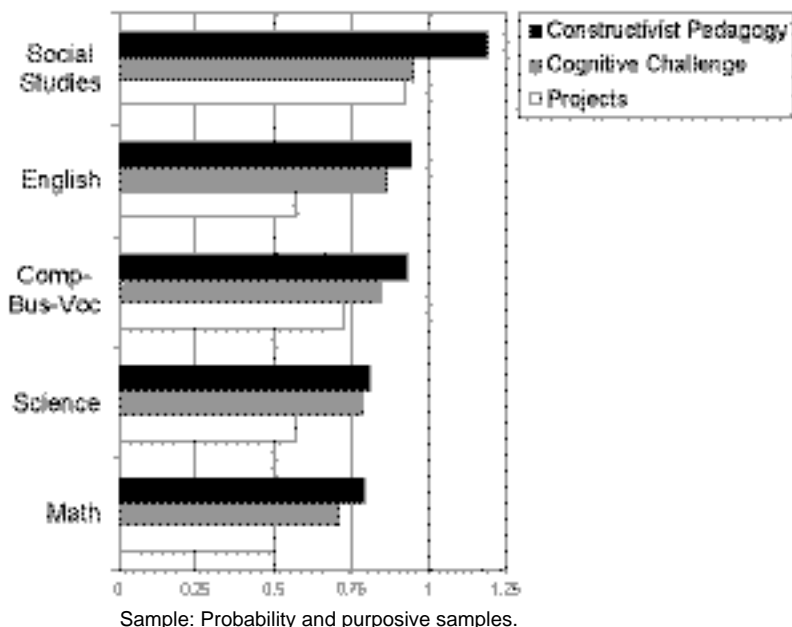
PEDAGOGY, PHILOSOPHY, AND SUBJECT TAUGHT

Subject-matter teaching responsibilities was a principal determinant of how constructivist a teacher appears to be, both in philosophy and pedagogy (Ravitz, Becker, and Wong, 2000).⁹ However, within each group of subject-matter specialists, Teacher Leaders and Teacher Professionals are far more constructivist in practice than Interactive Teachers or Private Practice Teachers. Figure 4 shows this for three measures—the overall Pedagogy Index and sub-indices for two of its primary components—Projects and Cognitive Challenge. The figure shows differences in z-scores (essentially effect sizes) between

⁹ Of course, it is also true that many of the specific prompts used in the Pedagogy Index, in particular, are more relevant to the teaching of some subjects than others. So some of the differences between teachers by subject is artificial. Both "true" and "error" between-subject variance is handled by using within-subject-matter z-scores, as discussed in the text.

Teacher Leaders and Professionals, considered together, versus Private Practice Teachers of the same subject.

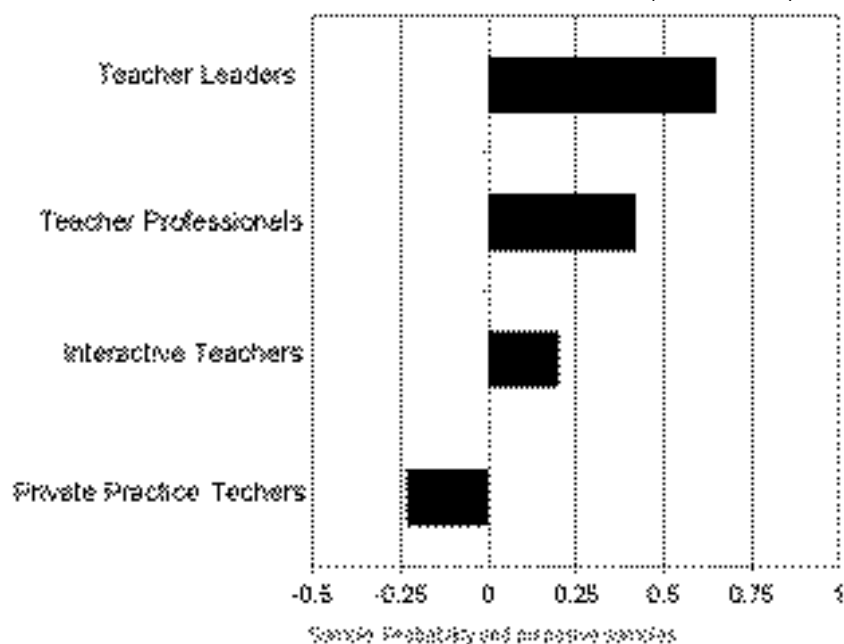
FIGURE 4: PEDAGOGY OF TEACHER LEADERS AND PROFESSIONALS VERSUS PRIVATE PRACTICE TEACHERS, BY SUBJECT (DIFFERENCE IN Z-SCORES)



In addition to subject-matter, teachers' pedagogy is affected by their teaching philosophy. Because we have seen that Teacher Leaders and Professionals have much more constructivist-oriented teaching philosophies than Private Practice Teachers, it is not clear whether the differences in pedagogy shown above in Figure 4 are merely the result of Leaders having more constructivist teaching philosophies. However, implementing a constructivist philosophy is quite difficult (Becker and Riel, 1999). If Teacher Leaders are actually more successful teachers (that is, not only more professionally engaged, but actually more able to implement difficult teaching practices), we would need to control on philosophy in order to see whether the average Teacher Leader's pedagogy is more constructivist than other teachers who happen to hold similarly constructivist teaching philosophies as the Teacher Leader.

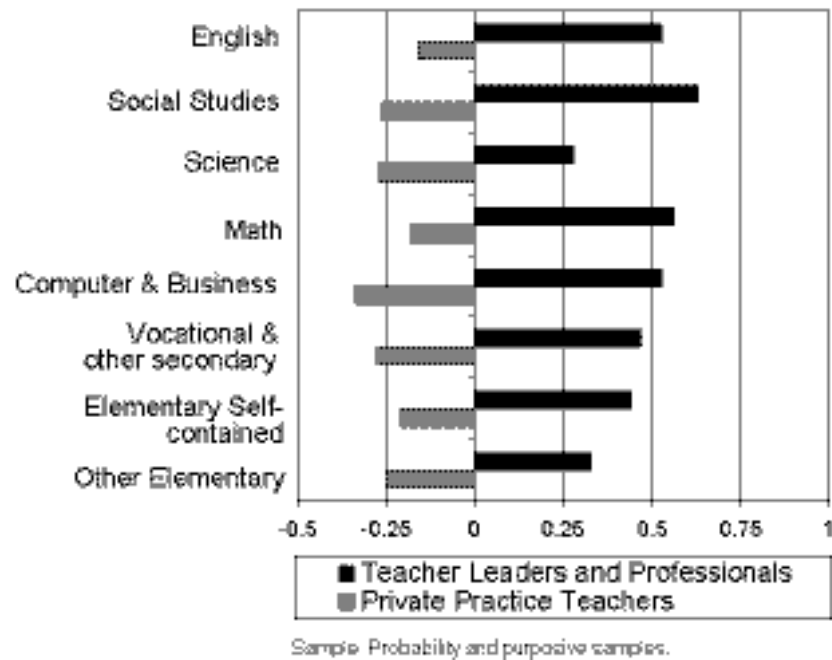
Controlling for philosophy makes it possible for us to match Teacher Leaders with other teachers in the sample who expressed similar philosophical beliefs about the best teaching and learning strategies. We then look at how they describe their classroom practices to see if they employ the strategies they believe are most effective in similar ways.

FIGURE 5: CONSTRUCTIVISM OF TEACHING PEDAGOGY,
CONTROLLING ON PHILOSOPHY AND SUBJECT TAUGHT,
BY LEVEL OF PROFESSIONAL ENGAGEMENT (Z-SCORES)



We find that Teacher Leaders as well as Teacher Professionals were more likely to have constructivist pedagogy *even when philosophy was controlled* (Figure 5). Moreover, this was true for every subject-area separately, as shown in Figure 6. The difference between Leaders/Professionals and Private Practice Teachers in terms of constructivist practice was greatest in social studies, where it reached nearly a full standard deviation; and it was smallest among science teachers, although even there it was more than one-half a standard deviation.

FIGURE 6: CONSTRUCTIVISM OF TEACHING PEDAGOGY, CONTROLLING ON PHILOSOPHY, BY PROFESSIONAL ENGAGEMENT AND SUBJECT TAUGHT



Thus, it appears from these results that Teacher Leaders and Professionals are more successful in implementing their educational beliefs in the classroom. There are a number of possible explanations for this. One is that with their better educational preparation and their more regular participation in intellectual exchanges with adults, they have learned the skills and strategies that make this translation possible. It is also possible that it is, in some ways, a reflection of their greater institutional power. That is, their identification as mentor teachers, conference presenters, or university instructors has given them more institutional power to enact their views of good education. They are less subject to the will of administrators pressured by parents and school boards to demonstrate student learning in terms of higher test scores.

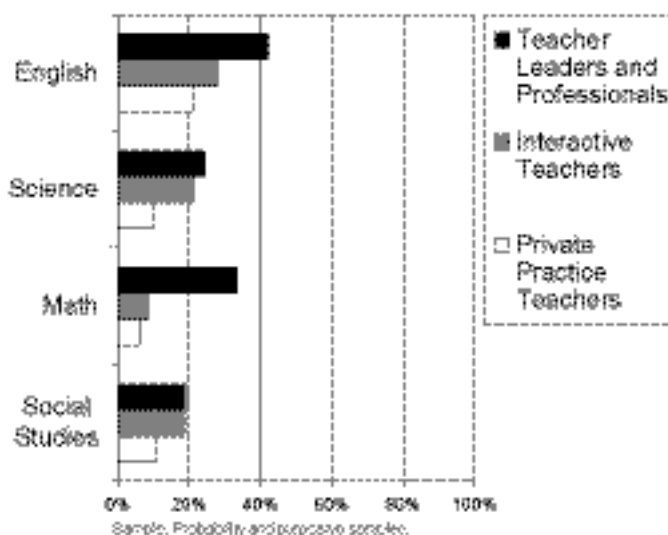
Professional Engagement and Computer Use

In this final section, we compare the frequency of computer use as well as differences in computer use by teachers who are more and less professionally engaged. Our principal focus is on instructional use by students during class time—how frequently teachers give students the opportunity to use computers, what types of software they have students use, and what their objectives for student computer use are. In addition, we employ a more comprehensive measure of teacher involvement with computers, one that incorporates teacher professional uses and their expertise. With this more comprehensive measure, we examine differences among the Teacher Leaders and Teacher Professionals between those who are Highly Active Computer Users and those for whom computers play a less central role in their teaching lives. In all of these comparisons, we are trying to understand the role that computer use plays with respect to the constructivist orientation of Teacher Leaders. Does computer use shape beliefs and practices or is it shaped by teachers' beliefs and practices?

PROFESSIONAL ENGAGEMENT AND COMPUTER USE

In nearly every subject-area of instruction, Teacher Leaders and Teacher Professionals are more likely to have their students use computers on a regular basis during class time than are Private Practice Teachers. For most subjects, they are also more likely than "Interactive Teachers" (the intermediate category of Professional Engagement) to give students regular (i.e., weekly) computer activities. Figure 7 shows that the small number of Teacher Leaders and Professionals who teach Mathematics (11% of all math teachers in the sample) are more than five times as likely to assign computer work weekly as Private Practice math teachers and about four times as likely to do so as Interactive math teachers. The differences for the other academic subjects are smaller, but Professionally Engaged English teachers are half-again as likely as Interactive English Teachers to assign computer work on a frequent basis.

FIGURE 7: PERCENT OF TEACHERS WHO USE COMPUTERS WITH STUDENTS WEEKLY, BY SUBJECT



Professionally Engaged Teachers use every type of software more than Private Practice Teachers. Even when only computer-assigning teachers are considered, the greater the level of professional engagement, the more frequently students of that teacher use a given type of software. Figure 8 shows the pattern for World Wide Web use. Among computer-assigning teachers, students of Teacher Leaders average about 3.5 lessons using the Web while students of Private Practice Teachers average 1.75 lessons, a ratio of two to one.

FIGURE 8: AVERAGE WORLD WIDE WEB USE BY STUDENTS OF COMPUTER-ASSIGNING TEACHERS

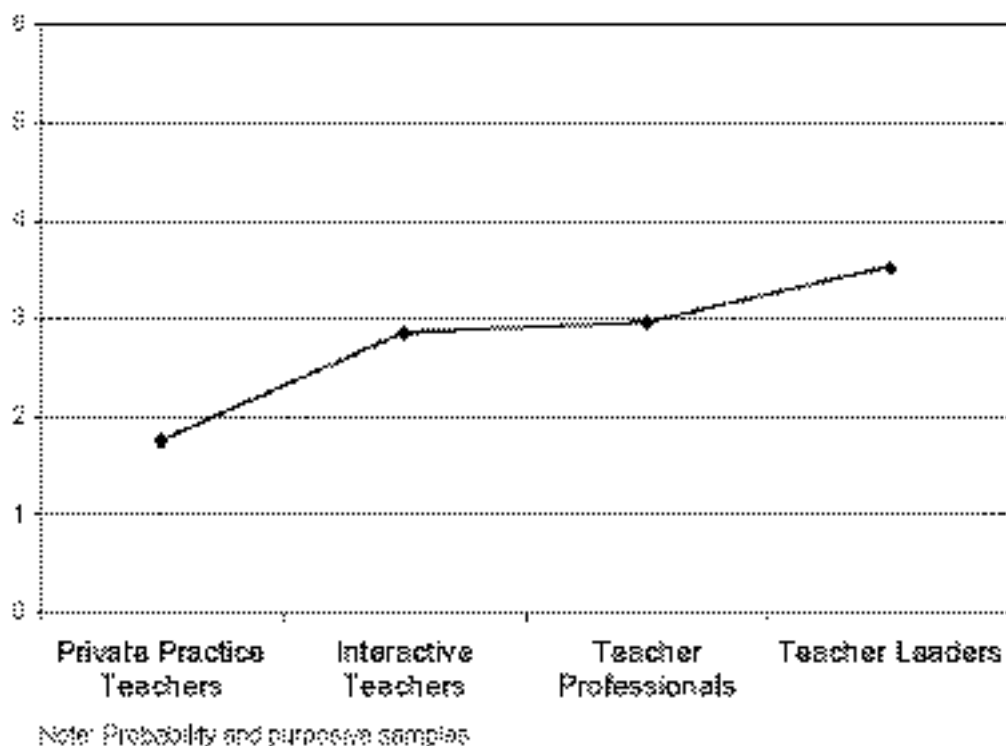
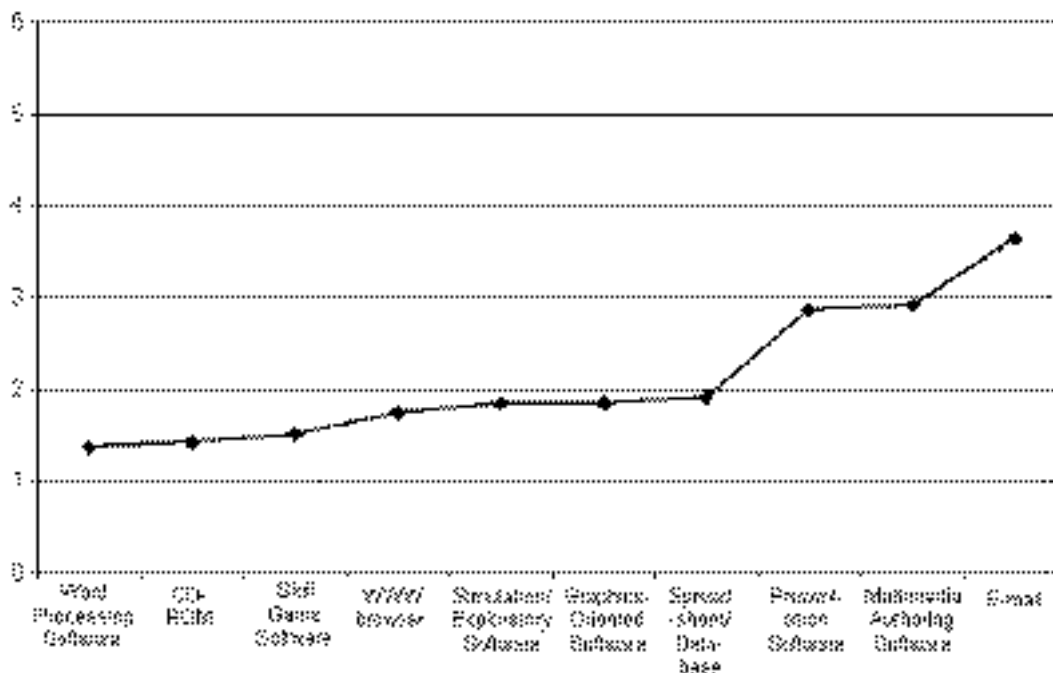


Figure 9 shows similar ratios for all ten types of software studied. (In this case, the comparison is between both groups of professionally engaged teachers together—Teacher Leaders plus Teacher Professionals—versus Private Practice Teachers.) Figure 9 shows that the greatest differences between Professionally Engaged Teachers and Private Practice Teachers in how frequently they have students use software is for electronic mail, multimedia authoring software, and presentation software. Those types of software are used primarily to communicate with other people and to produce products for an audience—activities closely associated with constructivist pedagogy.

FIGURE 9: RATIO OF (STUDENT) SOFTWARE USE BY PROFESSIONALLY ENGAGED TEACHERS TO USE BY PRIVATE PRACTICE TEACHERS, AMONG COMPUTER-ASSIGNING TEACHERS



Note: Probability and purposive samples
 Note: Excludes computer and business teachers.

Those findings about which types of software most distinguish Professionally Engaged Teachers and Private Practice Teachers are confirmed by findings concerning the three "objectives" for students' computer use which they felt were most important in their own teaching. (See Figure 10.)

FIGURE 10: COMPARING OBJECTIVES FOR COMPUTER USE OF TEACHER PROFESSIONALS AND TEACHERS LEADERS TO OBJECTIVES OF PRIVATE PRACTICE TEACHERS (RATIOS OF PERCENTAGES OF TEACHERS SELECTING THAT OBJECTIVE)

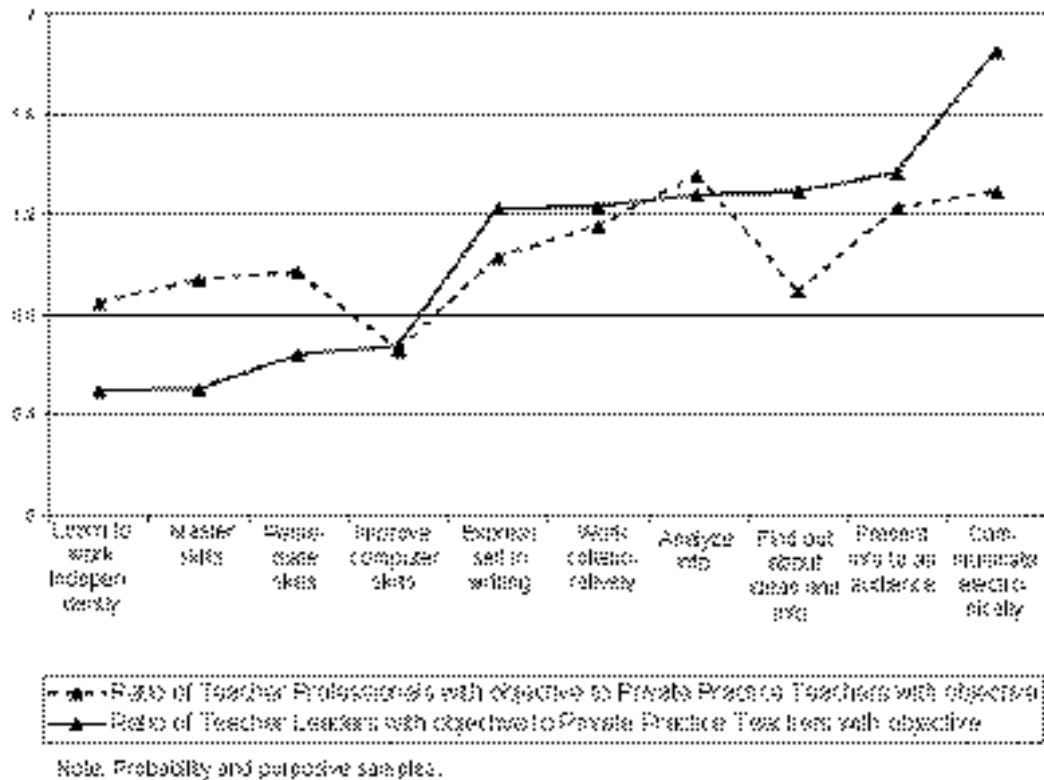
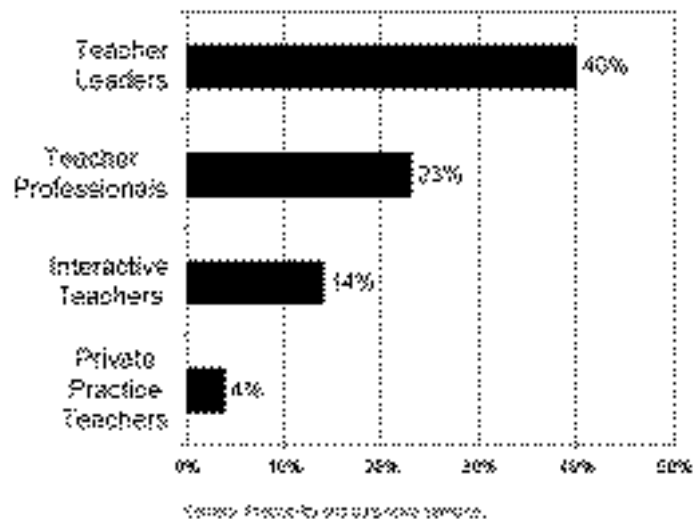


FIGURE 11: PERCENT HIGHLY ACTIVE COMPUTER-USING TEACHERS, BY LEVEL OF PROFESSIONAL ENGAGEMENT



Frequent student use of constructivist software like multimedia authoring programs is one indicator of a sophisticated computer-using teacher—a teacher who has substantial computer competence. Our comprehensive measure of Teacher Computer Involvement

incorporates frequent use of diverse software along with other measures of professional utilization and computer expertise. (See Operationalization of Constructs, above, p. 13, for more details on this measure's construction.) Overall, 10% of our sample's teachers passed the factor-analysis-derived criteria for being a Highly Active Computer User.

One of the most remarkable findings in this analysis is that Teacher Leaders were 10 times as likely as Private Practice Teachers to be designated a Highly Active Computer User (See Figure 11.) Forty percent of Teacher Leaders were compared to only 4% of Private Practice Teachers. About one-fourth of Teacher Professionals were Highly Active, six times as many as among Private Practice Teachers.

Of all of the dimensions of background, teaching responsibility, teaching philosophy, and teaching practice on which we have compared teachers in terms of their professional engagement, from Teacher Leaders to Private Practice Teachers, none of them has produced differences on the order of magnitude of this measure of Highly Active Computer Use. Of the three component factors comprising the overall Teacher Computer Involvement index, Teacher Leaders are most different from other teachers in having students use "tool" software (mean z-score of $+0.88$), and least different from other teachers in terms of frequent use of simple software (still more than one-half standard deviation higher than average, $z=+0.52$). On Professional Computer Uses and Teacher Computer Expertise, their superiority was extremely high ($+0.67$), but not as high as on Student Tool Uses.

DIFFERENCES IN COMPUTER USE AMONG PROFESSIONALLY ENGAGED TEACHERS

Our results have demonstrated so far that, as a group, teachers who are professionally oriented—that is, who are involved in the teaching lives of their peers both at their own school and elsewhere—are much more likely than other teachers to be constructivists in beliefs, practice and computer use. Their objectives for using computers in their teaching are consistent with constructivist teaching philosophies, and in the last section, we demonstrated that they are more likely to be Highly Active Computer Users overall.

However, not all Teacher Leaders are constructivists and not all Teacher Leaders are active users of computers in their teaching. Are there systematic patterns within the group of teachers identified as professionally engaged? Do computer-active Teacher Leaders and Teacher Leaders who don't use computers very much in their practice themselves differ in terms of their educational backgrounds, teaching philosophies and practices, and in how they use computers (when they do use them)? In other words, are the relatively few Leaders who are transmission-oriented in their teaching also those who don't use computers very much or is there a substantial group of Teacher Leaders who are as constructivist as the others, but who choose not to use computers in their practice?

First, it should be noted that Professionally Engaged Teachers who are Highly Active Computer Users and their similarly-involved peers who do use computers less (or not at all) are fairly similar in terms of personal background characteristics. The two groups

have identical average years of teaching experience and similar overall levels of educational investment.

Second, when examining the relationship between pedagogy and computer use across teachers in different subject areas, it is important to control on subject matter taught. This is because teachers of some subjects are more likely to be Highly Active Computer Users than others (i.e., vocational education more than math teachers), and teachers of those same subjects are more likely to be constructivist in practice (see Ravitz, Becker, and Wong, 2000).

To do this analysis, we employed "within-subject-matter z-scores" to measure aspects of teaching philosophy and practice. These are standardized scores where the mean value for teachers of each subject is set to zero (with a standard deviation of 1.0), so we can look at differences, say between Highly Active Computer Users and other teachers, without worrying that one group may contain teachers of subjects with a greater propensity to be constructivist.

FIGURE 12: CONSTRUCTIVIST TEACHING PHILOSOPHY AND PEDAGOGY OF PROFESSIONALLY ENGAGED TEACHERS, BY COMPUTER USE (Z-SCORES)

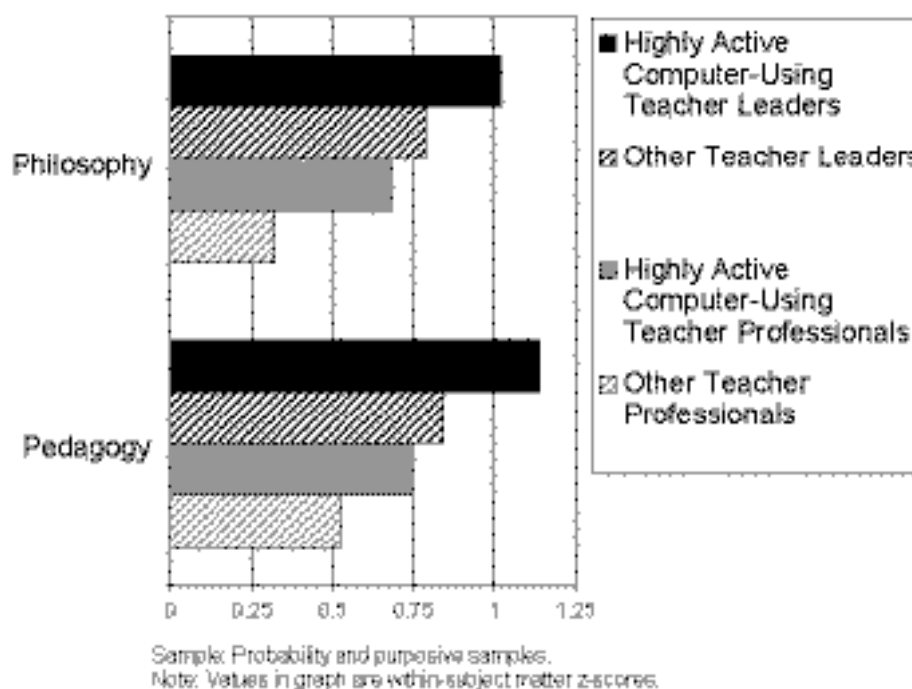
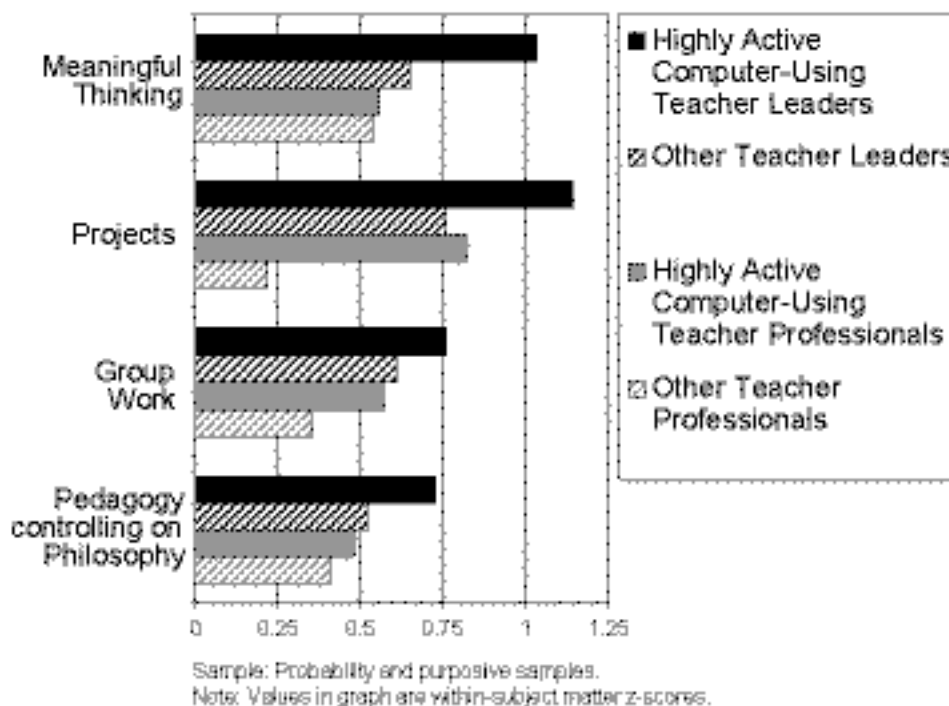


Figure 12 shows that for both Teacher Professionals and Teacher Leaders, the highly active computer users among them are much more constructivist in philosophy and in practice than are their lesser computer-using peers. The difference in pedagogy is true even when controlling on philosophy—i.e., among professionally-involved teachers in the same subject-areas and with similar teaching philosophies, the Highly Active Computer Users are more constructivist in practice than the ones who use computers less. Most of the differences between highly active computer users and others are at least one-

fourth of a standard deviation. The two computer use categories (Highly Active vs. all others) differ in philosophy and pedagogy nearly as much as do the two categories of Professional Engagement—Teacher Professionals and Teacher Leaders.

Overall, the most constructivist category of teacher identified—the Highly Active Computer-Using Teacher Leader—is more than a full standard deviation more constructivist than the average teacher of the same subject, placing her roughly at the 87th percentile on that dimension. This is true for pedagogy overall and for both the "Projects" and "Meaningful Thinking" components of pedagogy, as shown in Figure 13. The difference is not as great for the "Group Work" component, nor when philosophy is controlled; however, even for those, the typical Computer-Using Teacher Leader is .75 standard deviations more constructivist than the average teacher of the same subject, putting her at the 77th percentile.

FIGURE 13: CONSTRUCTIVIST PEDAGOGY COMPONENTS OF PROFESSIONALLY ENGAGED TEACHERS, BY COMPUTER USE



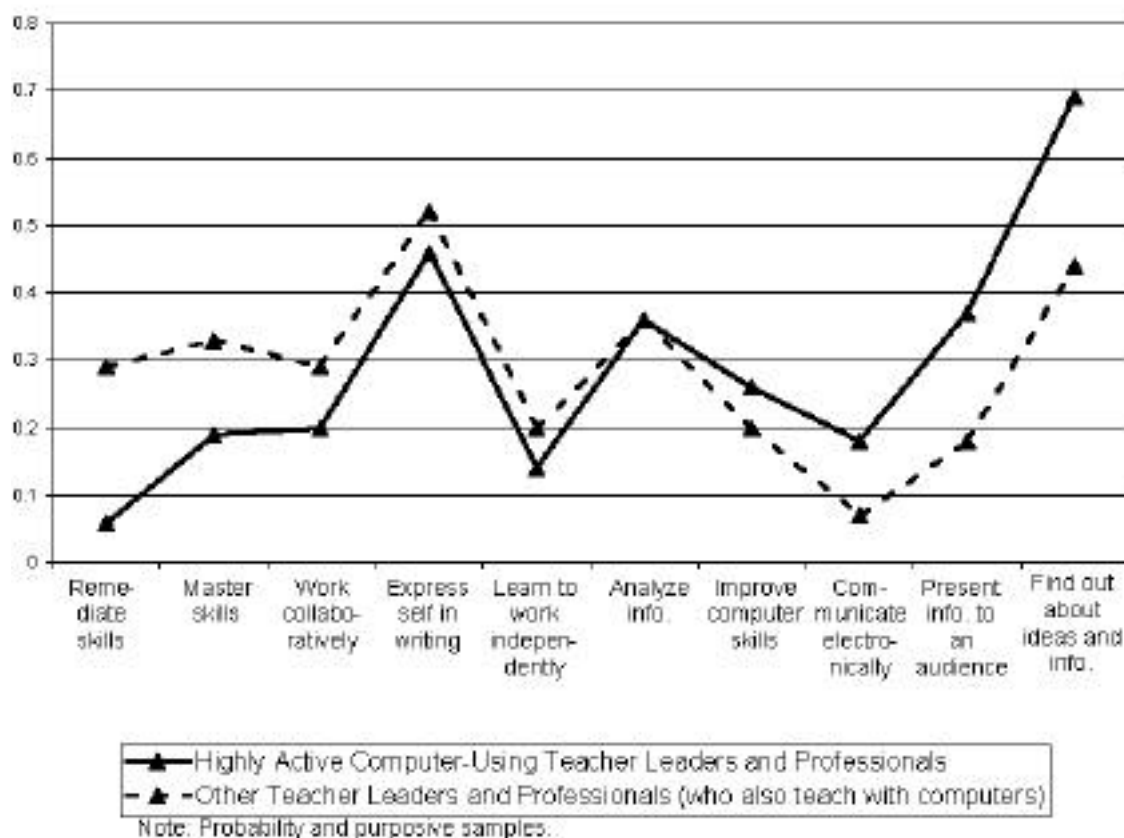
The final area on which we compared Professionally Engaged Teachers according to the depth of their involvement in computer use was in terms of the objectives that they had for student computer use. Here, we omit the few Teacher Professionals and Teacher Leaders who did not have students use computers at all. Among the remaining Professionally Engaged Teachers, though, there were substantial differences between the Highly Active Computer Users and the remaining Professionally Engaged Teachers in the objectives that they held for students when computers were in use. Figure 14 shows the percentage of each group of teachers that selected each objective as being among their three most important ones. The objectives are shown in order from the ones chosen

proportionally more often by less-active computer-using professionals to the objectives chosen proportionally more often by the Highly Active Computer-Using professionals (Teacher Leader and Teacher Professional categories combined for this analysis).

The less active computer-users chose skills-oriented objectives (e.g., remediation and skills mastery) and collaboration objectives more than those Teacher Professionals who were Highly Active Computer Users. In contrast, Teacher Leaders and Professionals who fell into the high computer use category were more likely to select communications, presentation, and information gathering as their most important educational objectives for using technology.

This suggests that even among Teacher Leaders, depth of involvement with computers translates into a more constructivist exploitation of computer resources.

FIGURE 14: OBJECTIVES FOR COMPUTER USE AMONG PROFESSIONALLY ENGAGED TEACHERS: HIGHLY ACTIVE COMPUTER USERS VS. MEDIUM TO LOW USERS



Summary and Discussion

In this paper we have contrasted Teacher Leaders—teacher who are involved in teaching their peers through mentoring, partnerships, teaching and publishing—with teachers who are disengaged from the professional community working in a “private practice.” We want to end with a summary of the findings as well as some of the implications that we draw from this research.

Expert Students make Expert Teachers

The first point we want to underscore is that prior educational experience of teachers is linked with later expertise in teaching. What is evident from comparing the educational background of professionally engaged and disengaged teachers is that Teacher Leaders have made and are continuing to make a substantial investment in their own education. 50% of Teacher Leaders report a GPA of 3.5 or higher. They were more likely to be educated at selective schools, and 64% have earned graduate degrees.

Teacher Leaders report spending twice the amount of time in professional development as Private Practice Teachers. In short, good students from good schools become Teacher Leaders. Given the continual learning experiences of the teachers, it is likely that individuals who enjoy learning, who excel led at school develop expertise in teaching. These teacher characteristics--their education, ability, and experience--have been strongly associated with significant increases in student achievement (Fergusson, 1991; Greenwald, Hedges & Laine, 1996; William & Rivers, 1996).

In a previous analysis of relationships between school culture and leadership (Becker & Riel, 1999) we found a correlation between schools that had a highly collaborative school culture and Teacher Leaders. This raised the following question: Do better teachers create collaborative teaching contexts or do the collaborative contexts promote teacher excellence? The formation of an Educational Investment Index for this analysis provides some clues, although not a definitive answer. We can see from this data that higher educational investment results in Teacher Leaders who have substantially different philosophy and practice and who use computers regularly with students in ways that support constructivist learning. Teacher Leaders have a strong commitment to their own education.

The Voice of Experience Defines Teaching and Learning as Co-Construction

A clear and consistent finding is that Teacher Leaders and Teacher Professionals share constructivist philosophy and practice. They view teaching and learning as a co-constructive process in which students are asked to think deeply about issues, generate their own ideas, work collaboratively in projects, and share and evaluate their work within a public classroom forum.

The survey we analyzed contained 40 separate items concerning teachers' beliefs and practices. This made it possible to characterize, with a great deal of reliability, teachers' philosophy and their reported day-to-day practice as either closer to a knowledge

construction or instruction—one that emphasizes transmission of information or one that places an emphasizes on a co-construction of ideas. When we examined the pedagogy of the Teacher Leaders we obtained two important results. One was expected, that the pedagogy of the Leaders was closely tied to their constructivist philosophy. This was true for the overall scale and for each of the sub-indices that we used. The teachers classroom activities as described by the teacher supported more cognitive challenges, encouraged project work that was extended through time, and encouraged students to work together and to share what they had learned with one another.

The second finding is one that we want to underscore. Even when teachers shared similar beliefs concerning an active student role in constructing deep knowledge through collaborative project-based work, Teacher Leaders and Teacher Professionals were more effective than Private Practice or Interactive Teachers *in translating these beliefs into practice*. Teachers everyday are faced with many small decisions that construct classroom learning. Quality teaching requires thoughtful reflection on theory and practice to make principled decisions. This is a conceptually difficult task, but one that the Teacher Leaders were most likely to show an alignment between the ways that they think that students learn best and their own teaching practices. Perhaps because these teachers have invested heavily in their own education, and did well as students in school themselves, they have a deeper understanding of the importance of intellectual investment in teaching and may have greater skill in being able to help students learn. Teacher Leaders can accomplish instruction of students in ways that are difficult, but consistent with a philosophy in which they believe.

Although many leaders in the field of education argue persuasively for the need to engage practicing teachers towards a collaborative culture, educational decision making is often made by people who have no field experience. Decisions are often made by politicians, legislators and school administrators who are committed to fixing the problems that they see facing American education. Their solutions, while sometimes research-based, often focus on single issues which fail to deal with the complexity of challenges that face practicing teachers.

This research gives voice to the beliefs and practices of over 800 Teacher Leaders and Teacher Professionals from across the country. They are teachers who have been actively engaged among their peers, selected to mentor other teachers, share their wisdom through conference presentations, teach in universities and write for publication. It is our goal to add their voices to national debate about best practices and overall goals for education. They are framing education in terms that are consistent with inquiry learning (Dewey), teaching for understanding, conceptual problem-solving, activity theory, reciprocal teaching and collaborative learning. The findings are quite clear. *The more markers of collaborative, professional engagement, the more likely a teacher is to display and to act from a conception of knowledge that is consistent with constructivism*

Teacher Leadership and the Use of Computers

Teacher Leaders and Teacher Professionals were much more likely to be frequent users of technology than were the other teachers in the sample. In fact, Teacher Leaders were *10 times more likely to be highly active computer users* when compared to Private

Practice teachers. The way in which they used computer technology was consistent with their philosophy. They view computers as tools to help students to research, understand, and explain their ideas through text and graphics.

A central issue raised by this research is the relationship between teacher use of computers and their beliefs and practices. To explore this issue, we used only the group of Teacher Leaders and Teacher Professionals in our survey (excluding the computer and business education teachers because they use computers as part of their discipline). We then separated them into two groups-- Highly Active Computer Users in one and medium to low computer users in the other. Then we examined the philosophy and pedagogy of these two groups. The Highly Active Computer User-Leaders were the most constructivist. What does this tell us about computer use? One account for this finding is that the most talented Leaders with a strong constructivist orientation could not possibly ignore one of the most powerful tools for constructivist learning, and so they would naturally invest their time and energy in learning how to use them. The other reverses the causality relationship. Teacher Leaders who become involved in using computers become more constructivist as a result of seeing what their students are able to accomplish through computer mediated learning.

Closed Classroom Doors Should Open Concerns about Quality of Teaching

This research also shows that teachers who earned lower grades in school, who spent less time in previous years in school and who now spend less time in professional development are more likely to be what we have called Private Practice Teachers. They have an educational philosophy and practice that is opposite from that of the Teacher Leaders. They support direct instruction tied closely to textbook materials with a high value on convergent thinking and view tests as a valuable strategy for assessing this content accumulation. They engage in a practice dominated by knowledge transmission where students are rewarded for acquiring factual information.

This research indicates that there are huge differences between professionally engaged teachers and "Private Practice" teachers in both the frequency and method of how they use computers. *Only 4% of the Private Practice Teachers fall in the category of Highly Active Computer Users.* Out of all of the data we report, this difference is the strongest and most consistent. Again, it is the isolated teachers, a majority of the teachers in classrooms today, who are less likely to use the intellectual resource that is transforming many teachers' practices in this new century—the networked personal computer. Their isolation is both physical and intellectual.

The current institutional structure of schools supports private practice teaching providing minimal incentives to reward teachers who invest heavily in their continual learning. Yet, this data suggest that behind closed doors, everyday, children are being denied access to the quality of teaching that is the promise of free public education. We have dramatically altered the "grammar" of schooling in the past when we moved from one room school houses to graded elementary students and subject periods for high school students (Tyack, & Tobin, 1995). Perhaps it is time to rethink the current structure that

provides so little opportunity for teachers to share their knowledge with one another and to provide for the diffusion of teaching expertise.¹⁰

Classroom Practice Mirrors Professional Engagement

The final point is an observation that is relevant to programmatic policy decisions concerning professional development of teachers. Across all of this data what we find is that the role of a teacher in the larger educational community mirrors the role of students in that teacher's classroom.

On one hand we have teachers who participate in collaborative project-based efforts and activities to help shape education. They have a voice in constructing meaningful understandings of their practice and are respected for their innovative contribution to the field. They work with other experts building new knowledge.

These teachers were found to create within their classroom a similar environment for their students. They engage their students in collaborative projects, expect their students to contribute new insights and provide an atmosphere of respect for divergent innovative thinking. They teach students in ways that support their understanding of learning.

On the other hand, teachers isolated in classrooms with no sense of agency or authority in the larger field of education, appear to teach in ways that reflect this position. The education structure provides a set of directives, mandated procedures and policies and textbook materials. They test to assure compliance and threaten sanctions to teachers who are not successful. These teachers, either by indifference, lack of time, acceptance of an implementation role of teaching, or lack of intellectual competence or authority *play little or no role* in making these decisions. Professional development is delivered to the teachers by outside experts who come and leave explicit directives for classroom teaching. However, inside the classroom the Private Practice Teachers assume a position of power and authority. They are less focussed on giving students a sense of agency or authority in their learning. They mandate policies and expect compliance from the students. Their teaching practice leaves little room for student voice or authority in the learning process. They teach in ways that support their understanding of learning.

To summarize, teachers who assume a professional orientation to teaching are far more likely to have made high investments in their own education, to have constructivist-compatible philosophical beliefs about education to develop the instructional practices that are related to their beliefs and to integrate computers into their classrooms in ways that support meaningful thinking and the sharing of ideas with their peers—professional behavior! The social structure that teachers create for student learning in their classroom mirrors their own relationship to their colleagues in the larger educational community.

¹⁰ For an alternative structure that encourages both the diffusion of good teacher practices and a form of accountability, see Riel, M., (1995). *The future of teaching*. In *Education and Technology: Future Visions*, Commissioned Paper by the U.S. Congress, Office of Technology (Eds.) OTA-BP-EHR-169 Washington, D.C. Printing Office. Available online: (www.wws.princeton.edu/~ota/bin/byteserv.prl~ota/disk1/1995/9522/952206.PDF) U.S. Congress Office of Technology Assessment alphabetic listing of OTA reports (www.wws.princeton.edu:80/~ota/ns20/pubs_f.html).

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