Awareness Versus Acceptance of Systemic Change Among Secondary Science Teachers

Michael Dryden,
Dallas Independent School District

Barry Fraser, Director, SMEC
Curtin University of Technology

Abstract

Science teachers are very adept at describing an ideal learning environment, one that matches the goals of the national standards. Over 470 secondary science teacher surveys, 45 teacher interviews, and 29 secondary science classroom observations indicate that teachers desire more use of technology, more student-student interactions, real-life activity based instruction, and the use of oral and written reports. They moderately desire an emphasis on basics, use of lectures and notes, and alternative assessments. They desire a reduction in test preparation activities and excessive use of worksheets. When observed, they had excessive use of worksheets, no alternative assessments, extensive test preparation activities, and very few examples of real-life activities, student-student interactions, use of technology, or written reports. When interviewed and asked to explain these contradictions they gravitated towards issues of external control. In other words, the data show that teachers have moved towards an understanding or are aware of the basic philosophy and direction of the new reform movement and will even advocate they are attempting to implement it. While there are pockets of exploration at some schools, this awareness has yet to translate into system-wide acceptance. The data in this report implies that for the district to move forward and have teacher acceptance of reform there needs to be 1) an understanding of the interactions of control at all levels, b) a focus on children learning and not adults teaching, c) a feasible alignment of the various system components, and d) the customization of standards.

The Dallas Independent School District is currently in its fifth year of a six year joint effort with the National Science Foundation (NSF) to reform mathematics and science education through the Urban Systemic Initiative (USI). The objective of this study is to show that within this systemic reform effort there are differences between awareness, acceptance, and implementation of desired instructional practices among secondary science teachers. The study further hypothesizes that these differences can be explained by emerging theories on systemic change. Furthermore, it is the belief of the authors that the conditions described below are not unique to the Dallas schools but are representative of many large urban school districts. The system change theories espoused by Senge (1990), Anderson (1993), and Knapp (1997) form the basis of much

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of the discussion in this paper. While Senge's work is rooted in businesses as learning organizations, Anderson and Knapp directly address systemic reform in science education.

Theoretical Underpinnings

Science educators tend to view the teacher as the key to systemic change. This, despite the fact that Harold Pratt in this message to science teachers (1995) states that the burden of implementing the standards must not be placed solely on the teacher. The teacher is only one component of reform implementation. Science education researchers correctly view important components as key but rarely emphasize the interactions of the various components or subsystems as crucial elements towards understanding systemic change. For example, Powell and Boethel (1994) argue that equity must be addressed if reform is to succeed. Accongio and Doran (1993) state that assessment is one area that is crucial for determining what changes must be made to assure scientific literacy for all students. Gitlin and Margonis (1995) reveal that the restructuring of teacher's work is often ignored in school change literature. Donmoyer (1995) argues for clear vision and claims that the unifying vision of the National Science Education standards is vague. Fullan (1996) articulates the fact that existing school structures and cultures are opposed to change and that teacher overload and fragmentation reduces motivation to work towards reform. Jakubowski and Tobin (1991) show the importance of teacher metaphors and the need to shift teachers' realist epistemologies towards constructivist ones.

Beverly Anderson (1993) takes a more integrative approach by defining systemic change as six stages. These stages are old system maintenance, awareness, exploration, transition, emerging new structures and predominating new system. She also defines six key change elements which are vision, public and political support, networking, teaching and learning changes, administrative roles and responsibilities, and policy alignment. From the business community, Peter Senge and his colleagues (Senge, 1990, Senge and Lannon-Kim, 1991, Senge and McLagan, 1993) attempt to infuse learning organization theory into the field of education. In a learning organization there are systems thinking, a shared vision, mental models to work from, team learning, personal mastery and effective leadership. In particular, a knowledge-based organization, as in education, requires distributed leadership. This leadership requires a philosophy, attitudes and beliefs, skills and capabilities, and tools or artifacts.

Knapp (1997) reviews the evolution of systemic thinking in mathematics and science education reform and synthesizes the commonalities among recent reform efforts like the Urban Systemic Initiative. He states the different reform initiatives share the following premises.

1) a major constraint on the quality of science or math teaching lies in the lack of alignment among the key elements of the system.
2) Better teaching will result when the focus is on the classroom. This includes aligning the instructional delivery system with challenging standards.
3) The lack of alignment is best addressed at the policy level.
4) After a broad consensus is reached, local discretion in the way educators organize schools, design curriculum, and approach instruction should be encouraged.

Michael Knapp states that evidence connecting reform initiatives with changes in classroom practices, especially at the district level are sparse. He also interprets the dynamics of systemic reform from three vantage points which will be detailed in the summary of this paper. The first dynamic is systemic reform as *innovation and change*. According to Knapp, "this perspective concentrates on the nature of educational innovations, the processes by which resistance to them can be overcome in an initially reluctant organizational system, and the dynamics of innovation adoption." The second dynamic is systemic reform as *policy implementation*. "Like innovation research, policy implementation studies are concerned with change, but their focus is typically on the larger dynamics by which policies make their way through an intergovernmental system and are reinterpreted in the process." The third dynamic is systemic reform as *professional and organizational learning*. This perspective has two sets of ideas according to Knapp. The first set "argues that if systemic reforms in mathematics and science are to be realized fully in the classrooms, teachers (and other actors) must engage in a long-term process of learning that resembles the kind of constructivist processes that they and reformers hope will characterize students' classroom experiences. The second set of ideas revolves around organizational learning. Organizational learning embraces the rules, procedures, strategies, rituals and routines that schools or districts use to respond to policy initiatives. According to Cook and Yanow, (1995) the collective enterprise of a school possesses qualities that are greater than the aggregate of the individuals, i.e. the sum of the parts is not the whole. In terms of Senge, a focus on detail complexity should be distinguished from dynamic complexity.

Design and Procedures

Taking the merits of combining qualitative and quantitative methods espoused by Fraser and Tobin (1991) and applying it to systems evaluation, the goal is to tell a story from multiple sources of converging data. For this study, these data sources include the district-wide survey of science teachers for three years, including written comments, the one-on-one interviews of 45 science teachers, and the observations of 29 science classrooms. While it would not be feasible to present the details of all the gathered information for this paper, the data revolving around the establishment of a model to explain teacher acceptance of reform will be presented.

Results

Baseline Fall 1993 Teacher Survey. Prior to the introduction of the Urban Systemic Initiative 1711 mathematics and science teachers in grades k-12 were surveyed. This represents a 77.8% response rate on an anonymous return survey. Of these teachers, 92 were middle school science teachers and 109 were high school science teachers. Table 1 shows their responses to instructional practices. Using 50% "often" as a criterion, high school teachers were most likely to state that students learn real-life applications and take notes of lectures. At the middle school, the 50% criterion shows students working in small groups, exploring problem solving strategies, learning real-life applications, using manipulatives, and dialoging with teachers for ideas. Prior to the start of the USI there was a middle school integrated science initiative.

When asked for their perceptions of potential barriers to reform, there was more consistency between middle and high school science teachers. Table 2 shows that teachers rate lack of equipment, pressure to cover state and district tests, too many directives from central administration, too little time to plan with colleagues, students not interested in learning, and prior courses do not prepare students as the main barriers to reform. Clearly, these barriers revolve around two issues, teacher control of the classroom and student detachment.

Fall 1995 Teacher Survey. Table 3 shows that during the fall of 1995 high school science teachers said their instruction emphasized students learning basic skills, learning real-life applications, working in small groups, analyzing data, focusing on student inquiry and doing problems from worksheets. When asked for their desired changes to instruction, Table 4 shows they wanted more use of technology, students to discuss with teachers to develop new ideas, and a higher emphasis on student inquiry. They least desired students doing problems from worksheets, taking notes of lectures, and taking practice exam questions. There has been a clear shift in the awareness to teachers towards a more student-centered and less teacher-dominated approach to instruction. However, the reader should be aware that the least desired instructional activities were the most observed and the most desired were least observed two years later.

Spring 1997 Teacher Survey. In the spring 1997 teacher survey, both high school and middle school teachers responded to a question on an ideal classroom. Table 5 shows results that are consistent with the fall 1995 survey. Teachers were also asked to rate various reform ideas. The science teachers gave the highest rating to use of multimedia with Internet access in each classroom. The second highest rating was more depth and less breadth, and the least favored idea was to change accountability measures to reflect student engagement. This could be interpreted two ways. Either the teachers do not want any accountability measures or they do not want changes that reflect student engagement. Perhaps the most revealing response was that only 44% of the high school teachers are teaching in the manner they would like to teach (see Table 7). In this same survey, teachers were asked to rate student learning as the acquisition of a body of knowledge or the understanding of thinking processes. Figure 1 indicates that science teachers thought both were important and balance was needed. Indeed, many teachers gave a 50-50 rating as an indication of desired balance. It should be noted that secondary science teachers had a slight bias towards learning as a way of thinking and both elementary teachers and mathematics teachers leaned towards a less biased and more balanced approach.

Teacher Interview Summaries. For reasons of brevity only highlights of salient issues related to teacher awareness and acceptance of systemic change from the teacher interviews will be presented. These interviews were conducted during the spring of 1997.

<u>Awareness of the Physical Support System for Science Instruction.</u> The answers to having adequate equipment varied widely, even within a school. Some teachers stated they had adequate supplies but often there was little visual evidence that labs were performed. On average, teachers stated they spend $200-600 out of their own pocket money. And while some labs looked well equipped, others looked sparse within the same school. Most teachers indicated they could use more equipment and supplies. A

big concern was the amount of district funds allocated for science. The district policy is $2.50 per student, not per student per course. Thus, the vision is to have four years of mathematics and science was not matched by an appropriate increase in funding for supplies.

Those labs that are better equipped seem to be due to the hustle of their teachers. They took in-service courses to get equipment, applied for small grants, and solicited the community and industry for support. Many teachers want modern equipment, like probeware and graphing calculators, and training on how to use the equipment. A few teachers have concerns that people in education do not comprehend the role of technology in education. These teachers seem very technically literate and from their perspective the district may not be moving fast enough or see the future role of technology. The exact nature of their concerns varies widely. Some teachers see technology as a new mode of instructional delivery using technology as a substitute for real-life experiences. Others see technology from an information processing perspective. They believe the Internet is the future. Most see technology as instruments to apply science. They want access to computer-based sensor probes, advanced microscopes, colorimeters, spectrophotometers, pH meters, and statistical/scientific calculators. While they see technology as the road to reform, they admit that a lot of good science can be done with inexpensive items. Examples include microchemistry, plants and animals, and toys in physics.

Awareness of Curriculum, Training, and Assessment Alignment In terms of the curriculum, most teachers say the blueprints (table of specification) for the district-wide end-of-semester examinations drive instruction, not the "official curriculum." The vast majority of teachers liked the training they had, especially in recent years (see Table 8). Those who taught the higher level courses seemed to prefer off-campus training at universities or summer institutes.

The assessment program was not well received. Teachers wanted more specific guidelines to district end-of-course examinations. Failing that, they wanted to design their own end-of-course or semester tests. While they said they saw the need for authentic or performance-based assessment, in general, teachers were not receptive to additional testing of any kind.

Teachers had concerns about the sequence of instruction caused by exams given on a semester basis. They wanted to know why plants are covered in the winter and not the spring semester for biology. They wanted to know why one approach to teaching chemistry or biology should have priority over another approach. To most of the teachers, this one-size-fits-all mentality ignores the individual differences of teachers and students. A number of teachers expressed the view that it is more important to teach with passion on a few topics that illustrate good science instead of a curriculum that is expansive but at a superficial level. They understood the need to ensure quality instruction and felt that as long as high standards are set, the teacher, not the system, should control the instructional delivery methods. Since teachers control the instructional delivery methods the real issue may be why they believe they do not have control.

The alignment of curriculum and training is also an issue. The USI Teacher Enhancement Institute is fundamentally a summer training program but many teachers have other jobs. Super Saturdays were attempted during the year but attendance never met expectations. Those who attend training like the training, but a core set of teachers rarely or never attend training. Cluster or subdistrict training rarely focuses on science since mathematics and reading are the priorities of the district and the state. Thus science training has a limited audience. Approximately one fourth of the eligible teachers attended training.

There is a misalignment between the planned curriculum, the implemented curriculum, and the assessment system. For most science courses the planned curriculum is based on State mandated essential elements and requires 40% lab time. Most teachers state that they spend 40% of their instructional time in labs. Some state they try to do labs twice a week but need to cover content for the test, or have too large of classes, or not enough time to do labs twice a week. While there is strong evidence that grades are partially based on lab work, there is no evidence that students are ever assessed on the psychomotor skills, techniques, or procedures they learn in labs. Thus the curriculum states that students will do hands-on activities and use the processes of science but the district and in-class assessment systems measure knowledge, recall and generic problem solving abilities. Another area of curriculum misalignment is that only two of the 45 science teachers interviewed have any idea about what is actually taught in middle school science.

Awareness of work environment issues. The most common answers to the issues of work environment dealt with ideas around teacher control of the classroom. Some teachers, state they want to write their own end-of-semester tests. They do not want to use a standard curriculum in a prescribed manner. Many teachers express great concern over the fact that some school and district practices are designed to benefit of adults and not children. For example, block scheduling (90 versus 45 minute classes) is easier for the teachers but limited student attention span and student absences influence the consistency of instruction. They think social promotion avoids hassles from administrators but social promotion is not in the best interest of students. Many teachers express concerns about being forced to give a minimum grade of 50. To them, a minimum grade of 50 with 70 passing is equivalent to 40 as passing on a 0-100 scale. They would rather see scores in the 0-100 range but give the students options to drop low scores. To them, the 50-100 grading system sets a climate where students start playing a numbers game to get a minimum pass instead of trying to excel.

Another common concern expressed is the feeling of being isolated from other science teachers and the need for more cooperation and collegiality. Additionally, they express a concern over the lack of available workspace during planning periods. In many, if not most schools the lack of sufficient number of science classrooms means that teachers usually work in a faculty room or an empty desk, somewhere, to do prep.

Awareness of student preparation. All teachers, regardless of science subject, say that both basic mathematics and simple algebra are the areas of greatest weakness. For some, poor reading and students coming with the lack of an inquiring attitude is an issue. The teachers have few problems with the academically motivated students. Their problem is how to deal with unmotivated, unprepared students. At a number of schools, the teachers comment on how thankful they are that the principal eliminates bad teachers.

As science teachers they agree there should be a strong emphasis on learning being relevant and having real-life applications. While they agree with this philosophy many state they have not reached this desired level of instructional delivery. At three schools teachers suggest that the district differentiate between regular and pre-AP courses by making the pre-AP (pre Advanced Placement) more theoretical and the regular more practical or conceptual with applications to everyday life as in SEPUP or ChemCom.

Classroom Observation Summaries. During the fall of 1997, five evaluators observed 29 secondary science classrooms. These observations are complemented by over 200 mathematics classroom observations over the past three years by over fifteen different evaluators. The results from both sets of data are similar. For the set of science observations, the content was accurately presented in most cases but there was about 10 classes where the teachers exhibited naive understanding of concepts. This included confusion between velocity and acceleration, treating cell division too simplistically, and confusing chance and probability when using Punnett squares for genotypes/phenotypes. In a number of classes there was 'paper art/science.' For example, the teacher passed out a human chromosome map on construction paper. Another teacher had students build "DNA molecules" using construction paper. One teacher used perforated computer paper to have students construct an evolutionary timeline. Still another class used cards in a bag to demonstrate the Hardy Weinberg principle (random selection). In an integrated science class a teacher had students cut the shapes of continents to demonstrate continental drift. In some science classes mathematics was taught instead of science. At no time were any of the NSF-approved curriculums or technical materials that teachers were trained on over the past three years ever observed in either the middle or high school. This does not mean they are not used but it does give a good indication that things have not really changes that much.

In general, the teachers lectured and sometimes gave demonstrations. What was interesting is that some teachers built their lessons around consecutively deeper understanding using concepts like the kinetic theory of gases, probability, or system equilibrium, while others just presented facts.

Each of the evaluators was asked to rate the learning environment on nine dimensions; instructional pacing, high expectations, informal assessment, respect and equity, enthusiasm for teaching, meaningful instruction, student-centeredness, student involvement and student thinking. Table 9 shows higher ratings for those dimensions related to instructional delivery and lower ratings for student engagement activities. The results of the classroom observation show that, in general, there is a stronger emphasis on instructional delivery and teaching compared to meaningful student engagement and learning.

<u>Discussion</u>

Science teachers are very adept at describing an ideal learning environment, one that matches the goals of the national standards. Over 470 secondary science teacher surveys, 45 teacher interviews, and 29 secondary science classroom observations indicate that teachers desire more use of technology, more student-student interactions, real-life activity based instruction, and the use of oral and written reports. They moderately desire an emphasis on basics, use of lectures and notes, and alternative assessments. They desire a reduction in test preparation activities and excessive use of worksheets. When observed, they had excessive use of worksheets, no alternative assessments, extensive test preparation activities, and very few examples of real-life activities, student-student interactions, use of technology, or written reports. When interviewed and asked to explain these contradictions they gravitated towards issues of external control. They wanted to write their own end of semester tests. They did not like district policies like block scheduling, minimum grades of 50, or alternative schools for disruptive students. The principals told them to teach towards the test, or in some cases, teach mathematics not science. They stated they felt isolated from their colleagues but were too overworked to take the time to plan together. With the exception of teachers of honors or advanced classes, almost all of the science teachers interviewed stated their students were very weak in mathematics, especially algebra, and this hindered what they could do in the classroom. When asked how many labs they performed most stated the required 40% or two days a week policy requirement but the sinks had cobwebs, teachers complained of other teachers hoarding equipment, and the students said they rarely did labs.

In other words, the data show that teachers have moved towards an understanding or are aware of the basic philosophy and direction of the new reform movement and will even advocate they are attempting to implement it. Classroom observations, however, do not support their contentions. The six stages of systemic change articulated by Anderson seem to be useful. After five years of reform efforts, this district is still at the first two stages of old system maintenance, and awareness, and is just starting to emerge into the third stage of exploration. Unfortunately, the system also seems to be at a standstill. As teachers are made aware of the curricular programs that match the national standards there is a reluctance to try them.

From the reform dynamics espoused by Knapp (1997), the district is currently attempting both policy implementation dynamics and innovation-change dynamics. However, the implementation of these two dynamics is out of synchronization with the third dynamic of organizational learning. The issue seems to be one of absolute control in the name of reform. We have already seen that teachers desire control of their classroom and this study, along with a companion study by the authors show that shared control among teacher and students is low and has not changed as a result of the reform process (Dryden and Fraser, 1998). The policy implementation dynamics follow processes of mandate, monitor, and evaluate. This fear-driven process is about organizing, training, and holding adults accountable. Likewise, most other policies are not about learning and improving opportunities for students despite the infusion of a policy of four years of mathematics and science for all students in high school,.

The innovation-change dynamic also suffers from the absolute control syndrome. At one end is the 'old guard' with the maintenance of the system based on the beliefs that basic skills must be mastered before instruction can go on and the external control of the teacher. This is accomplished through the use of test results as key leverages acting as driving forces of instruction. At the other end are the reform-minded individuals in the district who demand that their chosen innovative curriculum (and NSF approved, also) be used. These individuals tend to view teachers as compliance managers, not innovators.

Knapp’s third reform dynamic may be the key to explaining the discrepancy between awareness and acceptance of systemic change. In terms of organizational learning there should be distributed leadership and mental models that the system endorses. The Dallas Urban Systemic Initiative through pressure from the NSF has attempted to adopt NSF-approved standards-based curricula. Most of these curricula advocate constructivist processes forwarded by the national standards. The constructivist process should assist teachers in forming a mental picture of what is happening in the classroom. This picture is very student-centered where the children engage in meaningful activities, not activities for activity sake. They come to understand that what they know or understand is dependent on what they previously knew and that science is not a fixed body of knowledge waiting to be discovered. They are made to feel comfortable discussing issues and solutions with other students because this is one of the best ways to improve comprehension. Perhaps the most important feature in relationship to this study is the notion that students have a sense of ownership of their own learning process. They share control over what and how they learn and they feel free to discuss impediments to their own learning with the teacher and other students. This mental picture that focuses on students and not adults is the antithesis of the realist epistemology advocated by most in the district. For most of the district, including the USI, the mental picture is one of organizing and training adults. It is about teachers and those above teachers establishing control through mandates that react to symptoms and not root causes. Most adults in the system treat students as absorbers of knowledge instead of synthesizers of knowledge. Teachers mimic the mandate-monitor-evaluate process discussed earlier with their own teach-discuss-test process in the classroom. In other words, change is very difficult and the district as an organization has a learning problem. This district has had a history of difficulty in learning as an organization. Dr. James Comer's School Development Program had its emphasis on the whole child. IBM's Restructuring Education attempts to infuse technology into an integrated curriculum, and the National Science Foundation's Urban Systemic Initiative has its emphasis on standards-based instruction. Whatever the attempt at restructuring, the issue has always been one of maintaining the old system and re-establishing the control hierarchy. This control hierarchy can be explained by the "shifting the burden" model of Senge.

Senge forwards three basic components or building blocks to systems thinking. These are reinforcing feedback, balancing feedback and delay. Reinforcing feedback occurs when small changes are built upon themselves. In a balancing feedback you try to determine the sources of stability and resistance and move towards a goal of stability. There is an external push and an internal resistance. Delays are the normal time gaps between action and consequences. Every system has a natural rhythm and understanding these rhythms is important. The issue in not to reduce the time delays but to coordinate events. The "shift the burden" model has no reinforcing feedback loop but two balancing feedback loops. One balancing feedback loop attempts to fix the symptoms. The other feedback loop attempts to come up with a fundamental solution. Sometimes there is an illusion that the symptomatic solution is working and this creates a reinforcing loop that never addresses the real problem.

As a very common example of "shift the burden" within the district, consider low test scores and the district's reaction to them. According to the test results the students are not learning. The response is to shift the burden on both the teachers and the students from learning to test-taking performance via basic skills. One balancing feedback attempts to fix the symptoms (poor test performance) by focusing on examination type items as a means of instruction. The other balancing feedback attempts to come up with a solution of increasing test scores by focusing on basic skills. Scores do go up and the practice of teaching test items and focusing on basic skills is reinforced by the system. The reality is the students are not learning the fundamental knowledge necessary for them to move into high level courses. When they do go on they are not prepared. The system never admits their wrongdoing. Instead, they will vehemently deny they caused the shift and will blame the teachers, or worse, they privately blame the students. Since everyone knows it is politically incorrect to blame the students, the teachers take the brunt of the districts reactions. The system continues to focus on adults and how to organize them. These are minor surface details that never get to the real issue of students not learning. The teachers are reluctant to participate because from the beginning they never had ownership of the process. This is where the USI can step into the picture as a reform catalyst. The role of the USI is to provide reinforcing feedback where the small incremental changes that result from using the standards-based programs start to have an accumulative effect. Unfortunately, small changes are not tolerated in a reactive system where the goal is to look good, not be good. The reward system in public education is based on the immediate or at best , one year. For the USI to be successful in this district, and perhaps elsewhere, it will need to prove that customization of the standards works in a few schools and then have these practices spread across the district. The standardization of standards, as opposed to customization of standards, is merely another form of hierarchical control to the teachers.

Conclusion

Based on teacher surveys, teacher interviews, and classroom observations, there is a growing awareness of what is expected of teachers in the new reform movement. While there are pockets of exploration at some schools, this awareness has yet to translate into system-wide acceptance. The data in this report show that for the district to move forward and have teachers accept reform there needs to be 1) an understanding of the interactions of control at all levels, b) a focus on children learning and not adults teaching, c) a feasible alignment of the various system components, and d) the customization of standards. Until the vision of the district is the vision of the teachers and the support for that vision, including proper system alignment, is rooted in the same philosophical beliefs about how children learn, teacher acceptance of systemic reform will remain difficult to implement at the classroom level.

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Table 1

Baseline Instructional Practices.
How often do students perform the following activities ?
Fall 1993

	OFTEN	SOMETIMES	RARELY	NEVER
WORK IN SMALL GROUPS				
7-8	68.5%	29.3%	1.1%	
9-12	49.5%	38.5%	9.2%	
WORK ON INDIVIDUAL PROJECTS				
7-8	29.3%	54.3%	13.0%	1.1%
9-12	31.2%	52.3%	10.1%	3.7%
WORK AT HOME ON PROJECTS				
7-8	6.5%	51.1%	37.0%	4.3%
9-12	20.2%	45.0%	24.8%	6.4%
EXPLORE PROBLEM SOLVING STRATEGIES				
7-8	66.3%	29.3%	3.3%	1.1%
9-12	53.2%	38.5%	5.5%	.9%
LEARN REAL LIFE APPLICATIONS.				
7-8	72.8%	25.0%		1.1%
9-12	66.1%	28.4%	.9%	1.8%
USE MANIPULATIVE MATERIALS				
7-8	60.9%	33.7%	3.3%	
9-12	36.7%	48.6%	9.2%	1.8%
TAKE NOTES OF LECTURE				
7-8	26.1%	52.2%	17.4%	3.3%
9-12	51.4%	32.1%	13.8%	
DO PROBLEMS FROM THE TEXT				
7-8	16.3%	50.0%	25.0%	7.6%
9-12	46.8%	40.4%	9.2%	
DO PROBLEMS FROM WORKSHEETS				
7-8	25.0%	56.5%	15.2%	1.1%
9-12	46.8%	41.3%	7.3%	.9%
USE COMPUTER SIMULATIONS				
7-8	2.2%	13.0%	17.4%	66.3%
9-12	6.4%	6.4%	24.8%	56.9%
USE COMPUTERS/CALCULATORS TO MASTER BASIC SKILLS				
7-8	5.4%	22.8%	22.8%	47.8%
9-12	21.1%	17.4%	22.0%	35.8%
USE COMPUTERS/CALCULATORS FOR CONCEPTUAL UNDERSTANDING				
7-8	4.3%	19.6%	26.1%	47.8%
9-12	19.3%	21.1%	20.2%	36.7%
READ FROM TEXTBOOK				
7-8	27.2%	39.1%	26.1%	6.5%
9-12	30.3%	51.4%	11.0%	4.6%
DIALOGUE WITH TEACHERS FOR IDEAS				
7-8	57.6%	34.8%	5.4%	2.2%
9-12	47.7%	41.3%	4.6%	
WATCH FILMS, VIDEO, ETC.				
7-8	7.6%	59.8%	28.3%	3.3%
9-12	11.9%	47.7%	31.2%	6.4%
GIVE ORAL REPORTS				
7-8	10.9%	54.3%	25.0%	8.7%
9-12	7.3%	45.0%	33.9%	11.9%
GIVE WRITTEN REPORTS				
7-8	26.1%	55.4%	12.0%	5.4%
9-12	22.9%	47.7%	22.9%	4.6%
ANALYZE DATA				
7-8	68.5%	28.3%	1.1%	1.1%
9-12	47.7%	45.0%	4.6%	.9%
USE COMMERICIAL MATERIALS				
7-8	38.0%	45.7%	15.2%	
9-12	22.0%	52.3%	18.3%	5.5%
USE TEACHER BOUGHT MATERIALS				
7-8	42.4%	46.7%	8.7%	1.1%
9-12	28.4%	59.6%	8.3%	1.8%

Note: 92 middle school and 109 high school science teachers responded to this survey

Table 2

Teachers' Perceptions of Barriers to Change.
How would you rate the following barriers? Fall 1993

	AGREE	DISAGREE	UNDECIDED
PRIOR COURSES DO NOT PREPARE STUDENTS			
7-8	55.4%	30.4%	9.8%
9-12	61.5%	22.0%	14.7%
CLASS TIME TOO SHORT			
7-8	34.8%	55.4%	7.6%
9-12	33.9%	61.5%	3.7%
ADMIN. DO NOT ENCOURAGE ACTIVITY BASE			
7-8	5.4%	78.3%	14.1%
9-12	20.2%	56.0%	21.1%
EXPECTED TO CONCENTRATE ON READING, NOT MATH OR SCIENCE			
7-8	28.3%	58.7%	12.0%
9-12	34.9%	50.5%	12.8%
LITTLE TIME TO PLAN WITH COLLEAGUES			
7-8	59.8%	31.5%	7.6%
9-12	67.9%	25.7%	5.5%
DISD DOES NOT STRESS MST			
7-8	22.8%	56.5%	19.6%
9-12	33.0%	48.6%	15.6%
TCHS NOT TRAINED FOR DISADV. STUDENTS			
7-8	43.5%	32.6%	20.7%
9-12	58.7%	25.7%	13.8%
DISD STAFF DEV DOES NOT ADDRESS MST			
7-8	47.8%	29.3%	19.6%
9-12	57.8%	25.7%	15.6%
STD MOBILITY MAKE INSTRUCTION DIFFICULT			
7-8	44.6%	41.3%	13.0%
9-12	53.2%	33.0%	11.0%
PARENTS OF DISADVANTAGED STD FEEL ALIENATED			
7-8	53.3%	16.3%	27.2%
9-12	53.2%	18.3%	26.6%
STAFF HAVE LOW EXPECTATIONS OF STUDENTS			
7-8	43.5%	40.2%	13.0%
9-12	44.0%	44.0%	10.1%
TEACHER TURNOVER IS PROBLEM AT SCHOOL			
7-8	15.2%	60.9%	18.5%
9-12	25.7%	56.0%	17.4%
TCH PROFESSIONALISM NOT TAKEN SERIOUSLY			
7-8	34.8%	48.9%	12.0%
9-12	43.1%	44.0%	11.0%
LACK OF AFTER SCHOOL OPPORTUNITIES			
7-8	35.9%	53.3%	9.8%
9-12	32.1%	51.4%	12.8%
MANY STUDENTS NOT INTERESTED IN LEARNING			
7-8	70.7%	21.7%	6.5%
9-12	73.4%	20.2%	5.5%
MANY TEACHERS INADEQUATELY TRAINED IN MATH OR SCIENCE			
7-8	23.9%	51.1%	23.9%
9-12	25.7%	51.4%	20.2%
SCHOOL LACKS EQUIP. FOR PROPER TEACHING			
7-8	69.6%	15.2%	12.0%
9-12	61.5%	26.6%	10.1%
UNIVERSITIES DO NOT PREPARE TCH IN MST CONTENT			
7-8	27.2%	42.4%	28.3%
9-12	21.1%	53.2%	24.8%
TEACHERS PRESSURED TO COVER STATE/DISD TESTS			
7-8	78.3%	6.5%	13.0%
9-12	83.5%	11.0%	3.7%
STATE/DISD TESTS ENCOURAGE ISOLATED FACTS			
7-8	51.1%	30.4%	15.2%
9-12	65.1%	23.9%	9.2%
TOO MANY DIRECTIVES FROM CENTRAL ADMIN.			
7-8	67.4%	14.1%	10.9%
9-12	68.8%	12.8%	12.8%

Note: 92 middle school and 109 high school science teachers responded to this survey

Table 3
Instructional Practices
How often do students perform the following activities?
Fall 1995

	7-8	9-12
learning basic skills	86.4	91.6
learning higher thinking skills	72.3	67.3
using manipultative materials	70.5	59.5
learning about real life applications	79.1	74.1
integrating content areas	63.4	69.6
working in learning activity centers	25.0	27.5
working in small groups	78.6	71.2
taking notes of lectures	50.9	63.3
reading from the textbook	32.7	46.8
analyzing data	73.1	73.4
watching films, videos, CD-ROMS, etc.	18.8	31.6
using computers/calculators	21.4	34.8
using traditional technology	39.8	40.3
using computer based probeware	7.5	5.9
using computer simulations	6.6	5.3
discussing MST and society	58.0	56.7
discuss with teacher to devel. new ideas	48.2	40.9
negotiating meaning with other students	62.3	47.4
emphasizing student inquiry or discovery	75.0	67.5
taking practice TAAS or ITBS exams	52.7	44.6
profiling student performance	55.5	54.5
doing alternative/performance assessment	57.4	48.7
building assessment portfolios	46.3	36.7
doing problems from text/worksheets	42.6	67.9
giving oral or written reports	45.5	44.2

Note: Scale 100 = often 50 = sometimes 0 never
N= 57 middle school and 79 high school science teachers.

Table 4
Desired Changes in Instructional Practices
Fall 1995

	7-8	9-12
learning basic skills	69.6	60.9
learning higher thinking skills	80.0	85.0
using manipultative materials	78.0	81.4
learning about real life applications	82.4	82.4
integrating content areas	77.6	79.1
working in learning activity centers	56.3	81.8
working in small groups	64.9	66.4
taking notes of lectures	51.0	50.7
reading from the textbook	52.1	61.2
analyzing data	82.3	81.9
watching films, videos, CD-ROMS, etc.	76.5	76.1
using computers/calculators	89.0	90.6
using traditional technology	81.0	88.3
using computer based probeware	95.0	97.1
using computer simulations	90.8	95.4
discussing MST and society	84.7	78.0
discuss with teacher to devel new ideas	86.5	85.1
negotiating meaning with other students	84.4	80.8
emphasizing student inquiry or discovery	84.4	87.9
taking practice TAAS or ITBS exams	43.0	46.9
profiling student performance	40.2	50.0
doing alternative/performance assessment	63.0	63.5
building assessment portfolios	52.0	55.1
doing problems from text/worksheets	47.1	52.4
giving oral or written reports	69.6	70.3

Scale = 100 = more 50 = Remain the Same 0 = Less
N= 57 middle school and 79 high school science teachers.

Table 5
Teachers' Ratings of an Ideal Classroom
Spring 1997

	m.s. science	h.s. science
Highly rated activities		
1 students learn techniques/procedures to solve problems.	93	88
2 students apply knowledge to new situations.	86	83
3 students actively engaged with hands-on activities.	88	77
4 teacher uses variety including small groups, explore etc	84	75
5 teacher illustrates real-life applications.	79	77
6 students are given continuous reinforcement.	70	65
7 students encouraged to give multiple solutions.	84	73
8 teacher determines instruction causing difficulty.	71	63
Mid-range activities		
9 teacher provides exploration time for students.	74	68
10 students use technology: calculators, computers, CD-ROM	78	70
11 students perform open ended problem solving projects.	75	62
12 teacher connects math/ science/ reading/SS/LA/etc.	64	61
13 students use estimation in solving and checking results.	62	56
14 students presented integrated activities	65	54
15 teacher presents subject matter content.	62	66
16 teacher makes assessment integral part of instruction.	65	64
Average rated activities		
17 students listen and take notes.	51	64
18 students prepare for TAAS/ ITBS.	42	36
19 teachers profile student data.	28	33
20 teacher controls all classroom decisions.	47	49

Note: scale is 100 = often, 50 = seldom, 0 = never.
n = 134 middle school and 355 high school science teachers

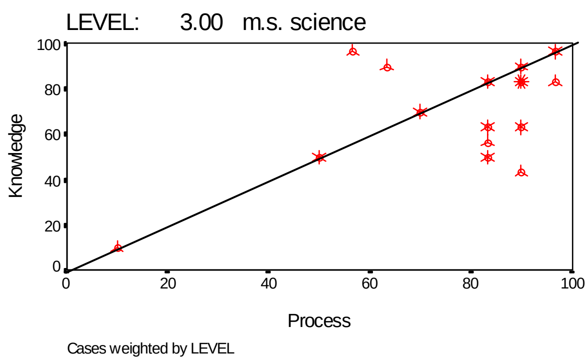
Table 6
Teacher Ratings of Various Reform Ideas
Spring 1997

	m.s. science	h.s. science
Highly rated activities		
1 focus on reading and math basics	64	68
2 multimedia with Internet access in each classroom	90	90
3 change accountability measures to reflect std engagement	71	63
4 vertical teaming and local control of curriculum	80	68
5 LESS is MORE or depth versus breadth	83	75
Average rated activities		
6 math and science for all students -equity	51	38
7 develop a standard, district-wide curriculum	52	57
8 give master teachers release time for in-class modeling	54	64

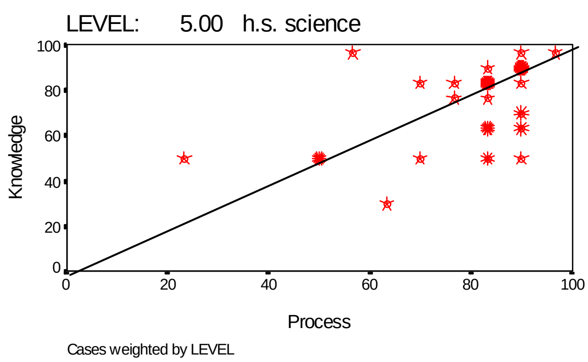
Note: Scale is 0 = disagree 100 = agree
Note: n = 134 middle school and 355 high school science teachers

Table 7
Teachers' Perception of Role in the Classroom
Spring 1997

		m.s. science	h.s. science
Do you consider yourself an important decision-maker?			
	yes	126	300
	no	9	40
	not sure	0	5
Are you teaching in the manner you would like to teach?			
	yes	78	155
	no	33	180
	not sure	15	20



n= 134



n = 355

Figure 1. Teachers ratings of student learning as the acquisition of a body of knowledge versus learning as understanding the thinking process.

Table 8

Teacher rating of Training by USI Implementation Phase

	m.s. sci.	h.s. sci.
My Principal supports prof. dev. for class teachers		
USI Phase 1		
% Strongly agree	56	50
% Agree	36	47
USI Phase 2		
% Strongly agree	35	33
% Agree	44	36
USI Phase 3		
% Strongly agree	52	38
% Agree	26	39
The staff devel. I attended improved my instruction		
USI Phase 1		
% Strongly agree	28	21
% Agree	52	38
USI phase 2		
% Strongly agree	18	15
% Agree	38	35
USI phase 3		
% Strongly agree	25	19
% Agree	46	38

Table 9

Evaluator's Rating of Classroom Learning Environment

	often	sometimes	not observed
Instructional delivery			
Instructional pacing	65.5%	27.6%	6.9%
High expectations for all	58.6%	24.1%	17.2%
Informal assessment	34.5%	51.7%	13.8%
Respect and equity	65.5%	24.1%	10.3%
Enthusiasm for teaching	55.2%	37.9%	6.9%
Meaningful instruction	37.9%	41.4%	20.7%
Learner engagement			
student-centeredness	34.5%	31.0%	34.5%
student involvement	27.6%	41.4%	31.0%
student thinking	24.1%	34.5%	41.4%

Note n = 29 observations