Framework and Methodology for The Exemplary Technology-Supported Schooling Case Studies Project*

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The Role of Technology in Educational Innovations

Information technology is pushing the boundaries of education conceptually and methodologically. Technology pushes education by expanding where and when learning can take place, by forcing changes in priorities for the curriculum, by giving new ways for students and teachers to communicate, and by repeatedly making teachers' "best practices" obsolete. These challenges for education are given more substance in Table 1, which shows the particular aspects of technology that yields these consequences for society and for education in particular.

Table 1. How Information Technology Implies Changes for Education

Technology & Technology Attributes	***Social Implications***	***Educational Implications***
Distance learning	Potentially improved access to learning by all social groups	• Virtual schooling, "schools without walls" • Anytime, anywhere learning required • Home schooling more feasible
Database technology	Information explosion	• Students need to learn knowledge management • Just in time learning required
Network-based communication technologies	Knowledge becoming more collective	• Both teachers and students can more easily collaborate across geographical boundaries • Project learning more important
Productivity, creativity tools	Knowledge as critical commodity	• Rise in value of knowledge construction • Inquiry skills essential
Rapid obsolescence	Renewal, social change	• Greater need for innovative teaching practices • Professional development of teachers more critical • Greater need for lifelong learning and relearning
Complexity	New job requirements, labor force changes	• Need to integrate IT subjects, skills into curriculum
High cost of newer	Digital divides	• Need for equity solutions for both

*Funding for this project was provided by a grant from the Office of Educational Research and Improvement, U. S. Department of Education.

technologies		school and home

The social implications of these new aspects of information technology are listed in the table because in some instances it is the interaction between the technology and society that produces the greatest impact on education. For example, the need for more emphasis upon collaborative projects results from a combination of trends toward knowledge as a collective process and networking technologies that facilitate this trend. Likewise, the need for policies that address inequities in access to technology at home and school arise from both cultural factors and the high cost of newer technologies and information infrastructures.

In addition to reducing dependence on geographically-based schools, information technology, by offering new capacities for teaching and learning, implicitly raises questions about appropriate teaching roles. Another anomaly that generates issues is the incongruence that many students have more technology knowledge and skill than their teachers and parents. Given the growing importance of knowledge acquisition, its application, and information handling in the global economy, decision-makers are reconsidering educational goals and pedagogical priorities. Also disconcerting is the discriminatory implications of the high cost of contemporary technology, making it nearly impossible for lower income parents and schools to benefit as much as those with higher income advantages.

The "Exemplary Technology-Supported-Schooling Case Studies" project exemplified the need for rethinking the methods for future research on the role of technology in education. Through this project we sought to select sites and employ methods that would allow us to learn about the types of student outcomes towards which educational technology is being applied, the roles of various actors---students, parents, teachers, administrators, and others---in helping to make successful school-wide technology integration and implementation happen, and how districts and schools are bridging the digital divide. This project also provides for the U.S. participation in two international studies, one organized by OECD and the other by the IEA. Over 30 countries are participating in these studies, each one conducting case studies similar to ours, but with each country determining its own selection criteria.

Conceptual Framework

The conceptual framework for this study is an adaptation of the frameworks of the OECD and IEA studies. The central focus of the OECD study is organizational innovation while the central point of the IEA study is pedagogical innovation. From the standpoint of our study, the U. S. component of these two international studies, this difference is not a problem as we are only selecting school sites where organizational changes have included or produced innovations in classroom practices.

At the core of our conceptual model is the innovative pedagogical practice, which is embedded in a concentric set of contextual levels that affect and mediate change (Cole, 1996). These levels for present purposes are (1) the classroom (micro), (2) the school organization and the local community (meso), and (3) the state, national, and international (macro) level. The accompanying diagram for the IEA SITES Module 2 study depicts these three levels and gives some specific examples of relevant factors at each of these contextual levels.

The diagram also shows an inner constellation of four interacting components critical to the learning process. These four elements: the teacher, the student, the curriculum content and goals, and the instructional materials and infrastructure, together have the most immediate impact on outcomes (Plomp, Brummelhuis, and Rapmund, 1996). These four contextual elements are

given special attention in this study because of the central role they play in facilitating or hindering learning, especially during a process of pedagogical innovation or change.

The micro level includes teacher and student characteristics and experiences, especially with innovation and technology. It also encompasses interaction patterns, classroom norms, patterns of technology utilization, assessments, and the curriculum as it is practiced. The research literature (Means & Olson, 1997) documents a strong association between new technology-based practices and changes in curriculum and pedagogy. For example in many countries, the use of educational technology is part of an instructional shift toward project-based learning within a context of school improvement or reform. Instead of focusing solely on increasing the acquisition of facts related to specific subject areas, teams of students are engaged in solving complex, authentic problems that cross disciplinary boundaries. This moves education beyond the notion of a place where knowledge is imparted, to one of classrooms, organizations, and societies as knowledge building communities (Bereiter, 1999; Scardamalia & Bereiter, 1994; Brown & Campione, 1994.

The meso contextual level includes school administrators, support staff, and school policies and practices. In our framework it also includes parents, community characteristics, and local partnerships. Particularly critical at this level are the programs for organizational learning and those for professional development. It is well known (Fullan, 1991, 1993; van den Akker, Keursten, & Plomp, 1992) that innovation benefits from a supportive school environment. Innovative practices are likely to be sustained when the school management supports the practice by adjusting the curriculum as necessary, provides professional development and offers other incentives, resources, and services for the teachers (Louis & Miles, 1991). School improvement studies emphasize the central role of school culture in mediating change (Fullan, 1991, 1993; Dalin, 1973, 1978, 1994; Huberman, 1992; McLaughlin, 1993; Fuller & Clarke, 1994; Stoll & Fink, 1996).

The macro level encompasses a variety of cultural and policy characteristics at regional, national, or even international levels. Curriculum standards and assessment requirements are examples of such factors, as are professional development trends and telecommunication infrastructures. Current theories of comparative education (Arnove & Torres, 1999) identify a fundamental tension that affects contemporary educational change. This is a dialectical tension between massive global forces that affect social relations and institutions across national boundaries and the accommodation of these forces based on local cultural, political, and historical factors. Thus, the transnational, economically driven pressures to increase educational quality and efficiency may play out differently in the United States, England, and Australia (Berman, 1999) than in Asia (Su, 1999), Eastern Europe (Bucur & Eklof, 1999), or Africa (Samoff, 1999).

Each level suggests a set of research questions that are being explored in our study. For example, questions at the micro level include: What new teacher and student roles are emerging and how is the educational innovation changing what teachers and students do in the classroom? Questions at the meso level include: Who directed the change? What leadership role did the teachers play? How important was the role of staff development?

In addition to these contextual questions, there are some additional research questions on the nature of outcomes from the educational innovation, such as: What evidence is available, pro and con, regarding the effectiveness of the innovation for all participants? What sets of standards are being used in conjunction with the program? How equitably distributed are the benefits of the program? Finally, there are research questions that cross-cut the levels because they apply to multiple levels, especially the meso and micro levels. These cross-level questions include: What

special resources, if any, are required to sustain the innovation? What might be required to scale up the innovation to a much larger population of teachers and/or schools? All of these research questions have been used to guide the development of data collection instruments and protocols. Key factors implicit in each question have been used to develop one or more items in interview protocols, as described in the next section.

Methodology

Prior national surveys (e.g., Anderson, 1993; Becker, 1994) have documented the evolution of information technology in American schools. And the Teaching, Learning and Computing '98 (http://www.crito.uci.edu/tlc/) project systematically related Internet, as well as computer technology, to critical elements in the educational enterprise, such as teacher pedagogical beliefs and practices, school-wide staff development and teacher support systems, and the school's decision-making practices and organization. But research is needed that goes beyond these surveys to present detailed portraits of innovative pedagogical practices that are supported with technology. By collecting data about school-level context, research should help us to understand what contextual factors are most critical for creating an entire school environment where most of the teachers are exemplary in their uses of technology.

Due to the unique impact of technology upon learning and its special implementation needs as an innovation, revised conceptions and methods are needed. Because technology has pushed education to rethink its mission and practice in so many ways, it is difficult to investigate the resulting complexity with survey research methods. Given the complex interactions and inter-dependencies among contextual factors, new methodologies need to be applied so as to make possible the study of implementation success factors and their relative effectiveness; attributes of the technology itself as well as characteristics of the teachers and school; and multiple informants with diverse perspectives. Quantitative methods need to be combined with qualitative methods in order to gain richer strands of understanding at deeper levels than is typically acquired from surveys. We selected the case study method to allow us to combine qualitative and quantitative approaches and to learn about the integration and implementation of educational technology within the contextual system of a school or district.

Case study approach

A case study is an exploration of a bounded system over time through detailed, in-depth data collection involving multiple sources of information rich in context (Creswell, 1998). A case study can be exploratory, descriptive, or explanatory (Yin, 1994). While the purpose and theoretical orientation of case studies can vary, their common focus is on "the case," its context, and a commonly used set of techniques. A case may be bounded by a time period, an organizational structure, or a set of events. While there is no set criteria for selecting a case, the researcher must justify its selection on some grounds relevant to the focus of the study. Once the case is identified, the researcher collects data from multiple sources of information such as observations, interviews, documents, and audiovisual materials.

The focus of our case study is on the people, actions, and contextual conditions that are linked to the outcomes. Among conditions that may be important to the success of the practice are the way technology is used by teachers and students; how this application enables and/or draws on associated pedagogy or curricula; the kinds of skills, training, and/or technical support that the

teachers seemed to need to implement the application in this way; and the policies, norms, and cultural conventions that supported these practices. In the analysis of a case one or more of these factors might be identified as making a difference.

The identification of such relationships can promote the improvement of practice. They can provide practitioners and policy makers with a menu of practices that they can assemble for a particular design or situation, anticipating how these assembled causal relationships might interact with each other in ways that advance the intended outcomes. The beauty of the case study approach is that these causal relationships can retain their contextual nuance; they can be viewed within the "cloud of correlated events" (Scarr, 1985; Salomon, 1993) of a particular cases in which they were identified.

Our main approach will be that of an instrumental case study, where the focus of the analysis is on underlying issues, relationships, and causes that may generalized beyond the case (Stake, 1995). Analysis will be done at the level of single cases and multiple cases. For the latter, cross-case analyses will be done to identify themes that unite and/or distinguish the cases. The conclusions-or more accurately "assertions"-are validated through the triangulation of findings across these various data sources (Stake, 1995; Miles & Huberman, 1994). The focus of our proposed case studies will be on the outcomes and the people, actions, and contextual conditions that "caused" the outcomes.

The knowledge generated by the cases is primarily in the service of policy and practice. The focus of the project is on the creation, implementation, sustainability, transferability, and effectiveness of technology-based practices that can improve educational systems. Our intent is to use knowledge to accomplish goals, in this case to use knowledge about successful technology-based practices to reform education.

Site visit methology.

Each site visit includes a team of two researchers working at the school site for 5 days. These 5 days are used for conducting interviews with the principal, one or more technology coordinators, other administrators relevant to the technology reform program, 4 to 6 teachers, several students in these teachers' classrooms, and several parents of these students. In addition, at each site 2 to 4 classrooms are systematically observed by the researchers. All interviews are recorded and most are videotaped. The classroom observation periods are videotaped with one or two cameras. Procedures approved by the University of Minnesota and SRI International IRB's human subjects review process are followed to obtain written consent from all participants prior to interviewing, classroom observation, and audio or video recording. As soon as the site visit has been completed, the interviews are transcribed into document files. The text segments in these files are then coded according to the coding scheme given in an appendix and described in the next section. Site documents are logged and filed for analysis and reference.

Analysis of data.

The following procedures have been applied to the five cases completed to date. All interview transcripts and documents were analyzed with a structured coding scheme that was derived from the conceptual framework for the study. This scheme contained seven main coding areas. (The full coding scheme is given in Appendix 1.) The first was about the innovation or reform itself and is designed to capture information about the technology-supported school-wide innovation

or improvement, the history and scope of the innovation, including its goals and origin, the curricular/subject areas involved and its instructional organization. This allowed us to compare reforms on the basis of their purpose and intent to improve the quality of instruction. A second code area is about the school itself and allowed us to organize information about the site, including background information on and the demographics of the school and its community. With this code we also tagged pertinent information about the school culture, its leadership, and any external relationships the school established to aid their technology implementation. This group of codes allowed us to capture relevant meso-level information about the school's setting and how together they helped to create a favorable context for the classroom uses of technology. Another set of codes focused on the technology and the technology support present at the site. These codes supported our analysis of the vision for technology and the specifics of what the site has put into place and how it keeps it working and teachers prepared for its use. The next two sets of codes focused on students and teachers and their roles, practices, and outcomes. Together, these codes support the description and analysis of the classroom-based teaching and learning with technology. The final two sets of codes allow us to capture the elements of the site that contribute to the sustainability and transferability of its innovation. We differentiated between elements of the innovation itself, the classroom, school, and district components. These two codes were often used as a second additional code to some other pertinent information.

Each team of two researchers divided up the interviews to code; codes were assigned to sections of transcripts with the qualitative analysis program NUD*IST NVIVO. This program allows any length of the segment of text to be coded with as many codes as the analyst sees fit to apply. After all coding was complete, the NVIVO program was used to gather all text segments from that site's transcripts into a report for each code. These reports were then analyzed to determine the main points and themes within each code area. These points provided the basis for the conclusions that are reported in the other papers in this symposium.

Site selection.

To help us select sties that provided us the best opportunity to learn, with OERI, the Expert Panel, and the prospectus from the two International studies we generated the selection criteria, disseminated them through a variety of methods, and screened the resulting nominees.

The six criteria that were used for selecting the sites were as follows: (1) a majority of teachers at the public school are engaged in a school-wide reform or school improvement; (2) a majority of teachers are engaged in an innovative, technology-supported pedagogical practice; (3) the school is committed to meeting high content standards in core subjects; (4) the students are drawn from diverse backgrounds including a number of low income students; (5) the reform effort and the innovative technology-supported teaching practices appear to be sustainable and transferable; and (6) there is compelling evidence that the reform effort and the innovative technology-supported teaching practices have resulted in educationally significant outcomes or gains for the students involved.

We began by sending a solicitation letter to the State technology directors in all fifty states. The letter was drafted and sent by Linda Roberts, Director of the Office of Technology, U. S. Department of Education. Any State technology directors that had not responded by June were called and in many cases another copy of the letter was faxed to them. Nominations of districts and/or schools were received from 35 States.

Concurrently nominations were solicited from numerous other sources. Flyers asking for nominations were distributed by U of MN and NCREL staff at all three "Evaluating the Effectiveness of Technology" conferences (held in April, May and June of 2000). In addition, nominations were received from U. S. Department of Education staff including Linda Roberts, Jenelle Leonard, Judy Segal, Sharon Horn, and Diane Reed. The staff of the Center for Technology in Learning at SRI International, including Robert Kozma and Barbara Means, provided names of schools and districts as well. By August the list of nominations had been narrowed down to about 20 schools, and we sent this list to our project Advisory Group asking them for their evaluation of each candidate site and requesting that they nominate any other schools or districts that they felt met the criteria. In December we sent another list of the 11 "finalists" asking for another round of their opinions.

Another source of nominations came from directly contacting representations of school reform programs and projects known to have a major technology component. We began with the projects designated by the Secretary of Education's Expert Panel on Educational Technology. This Panel worked for two years reviewing over 125 applications for status as promising or exemplary with respect to educational technology. In September two educational technology programs were awarded "exemplary" status and five were award "promising" status. Nominations were solicited from numerous additional programs emphasizing educational technology including the following: Carnegie Learning, Edison Schools, NetSchools, New American Schools, the IMMEX project, Children Connecting Classrooms Community Curriculum (C5), Challenge 2000 Multimedia Project, One Sky, Many Voices, Apple Classroom of Tomorrow (ACOT), Schools for Thought, Lightspan, and Co-nect. In most instances we received one or more nominations from each of these projects.

As of 3/26/01 we had received nominations for 86 different school districts and approximately 110 schools. Nominated districts were contacted for a specific school name to contact. Of the 110 individual schools nominated by districts, 33 were high schools, 36 were middle school or junior highs, 37 were elementary and 4 were K12 or other combinations of grades.

Numerous requests for information were sent to all schools nominated, but not all responded. To gather sufficient information on the 50-some schools in our database who did respond, the University of Minnesota team placed many telephone calls. Schools are busy places, and rarely did one telephone contact result in the completion of an interview that yielded significant additional information. For example, during one month, we completed over 90 calls, and sent over 50 faxes and e-mails to possible candidate sites. After reaching a school e attempted to conduct a telephone interview with the principal or a technology coordinator. We supplemented the interview with any information available on the Web. If all this information indicated that the school might meet our selection criteria, we attempted to interview a teacher involved in the technology reform activity. Each telephone interview ranged from 45 to 60 minutes in length and included supporting questions for each of the six criteria.

The six selection criteria provided the foundation that framed the telephone interview questions. A very important part of the selection process was the use of interviews to gather essential information about the school-wide reform and use of technology from district administrators, technology leaders, and classroom teachers. To determine the match between our the six site selection criteria and a site's characteristics we crafted a number of relevant questions that allowed the researcher to probe deeper into how wide-spread and embedded a school improvement effort was, and the extent to which technology was integral to that improvement effort.

For example, to gather support for criteria 1, a majority of teachers at the school are engaged in a school-wide reform or school improvement, interviewees were asked to "describe the major school reform or improvement efforts at the school." This question was followed up by several probing questions on additional details about the school-wide reform effort. During each telephone interview we sought to ascertain the congruence between the various interviewees' beliefs about the stated reform of and the actual practices of district administrators, classroom teachers, and students. For example, according to one school administrator's report of the various reform efforts and use of technology at his district's school, it met the study criteria; but we did not select it as a study site. on the basis of two additional follow-up interviews of classroom teachers. These interviews attempted to triangulate these teachers' descriptions of reform and their actual classroom practice with the administrator's statements. . In this instance, teachers' interviews revealed that there were a couple of "maverick" teachers at the high school who were doing interesting things with technology, that technology use was not wide-spread, the school was re-framing its reform efforts, and that there were only 20 computers in a computer lab for the entire K –12 school of over 400 students. The teachers' interviews revealed that technology was not extensively used by most teachers, there was very limited computer access and there appeared to be a disconnect between teachers and school administrators view of what constituted school-wide reform. This lack of congruence across interviews concerning the details of the school-wide reform and how technology was used resulted in this candidate site not being selected. In conducting each candidate site interview it was imperative that during the interview session the researcher paid attention to details given about the school-wide reform efforts and descriptions of technology use to formulate additional probing questions that would facilitate identification of incongruence, or important salient details about the infrastructure that the interviewees might not have explicitly state.

Upon receiving the initial screening call some suggested candidate sites, immediately refused to participate and were dropped from our database. Those schools gave various reasons for not wanting to participate in the study, including, 1) they felt that they had been overly studied by other research groups, 2) district priorities would not allow them time to get involved with outside research, 3) the principal and/or district administrators perceived that the amount of time required to participate in the study was too demanding, or 4) the district was undergoing re-structuring and was not willing to participate. We dropped some sites from further consideration for a variety of reasons. Some reasons included, 1) the site did not meet all the selection criteria, 2) there was a lack of consonance about details of school-wide reform and/or use of technology across interviewees, 3) the site's technology-related programs were being re-evaluated and/or re-designed and undergoing substantial change, or 4) the school's technology-related programs were in the beginning stages of implementation and thus and too new for our study's purposes..

The site selection process was arduous, and included the input from a variety of sources. After numerous hours spent interviewing key personnel at candidate study sites, discussing extensively each proposed study site with OERI, and an Advisory Board and examining countless documents and Web sites the site selection process is near completion. The close work with an Advisory Board and OERI staff has resulted in 11 of 12 school sites having been selected (see Table 2).

The Cases

To date, six site visits have been completed and these data have been coded and analyzed. In Table 2 below those schools that have been visited and the data included here are shaded in gray. In subsequent discussion we will concentrate upon only these first six schools.

Table 2. Demographic Information for School Sites

School Name	Grades Served	Enroll-ment	Size of Place	Percent Minority	Percent Poverty*
Walnut Grove	K-5	768	Urban	60%	60%
Harland	K-6	618	Suburban	25	7
Mountain	6-8	1,338	Suburban	12	7
Pine City	6-8	800	Suburban	65	75
Future High	11-12	240	Small town	46	-
Joshua Junior	7-8	500	Urban	95	80
Carver	K-6	665	Suburban	95	100
Fortress	K-5	891	Suburban	11	35
Mastery	4-8	450	Urban	95	80
ElectricHigh	9-12	1,343	Urban	90	92
Victory High	9-12	-	-	-	-
To be named	-	-	-	-	-

*Poverty indicator was percent of students eligible for free or reduced cost lunch.

There are two elementary schools, three middle schools, and one senior high school. One middle school is quite large with over 1,300 students and the senior high is small with only 240 students. Otherwise, the schools tend to be somewhat average or typical in size. Walnut Grove and Future High are magnet schools and only about 5 years old. The remaining schools are older, more established schools. Two schools are in sizable urban areas, three are in suburban communities, and the high school is in a small town.

There is considerable variation in the racial diversity and family poverty of the schools. Two schools have relatively little diversity and poverty: Harland and Mountain. Three schools have 60% racial minority or greater and very high poverty levels. The remaining school's student body, Future High, is nearly 50% minority. . Because the school does not have a lunch program we were unable to obtain the percentage of students receiving free and reduced lunch. However, the staff told us that students are from diverse income backgrounds.

Overview of the Reforms

Table 3 summarizes in a phrase for each school the investigated school reform and gives the share of teachers participating in the reform.

Table 3. Summary of Innovative Technology-Supported Reforms

School	Reform/Innovation	Teachers Participating	Students per Computer
Walnut Grove	Project learning using wireless laptops	100%	5

Harland	Basic school powered by technology	100	1
Mountain	Technology to support standards-based achievement	80+	4
Pine City	Thin clients supporting academic performance	100	2
Future High	High-Tech preparation for a High-Tech World	100	1
Joshua Junior	Technology and curriculum integration	75	2

It also gives the students per instructional computer in the school. In every instance all of the teachers were participating in the reform activity, which involved the use of ICT for instructional improvement. Of course, the degree of teacher participation varied across teachers, and in Mountain a technology specialist said that 20% of the teachers did not have a heavy, regular involvement in the ICT activities, which is why the table shows only 80% of the teachers participating. Technology implementation at Joshua (75%) focused on providing training to all core subject (English, social studies, science and mathematics)teachers. Twelve of the 16 core teachers have completed, or are undergoing technology training.

Two of the schools had a student-computer ratio of four to five, which is approximately the national average. Two of the schools, Harland and Future High, had a computer for every student, i.e., a ratio of one, and Pine City had nearly as high a computer density with a ratio of two.

The school-wide reform of the first school, Walnut Grove, was "project-based learning using wireless laptop computers." This strategy was supported by an intensive 45-hour technology-based professional development in which 38 of 40 teachers had participated. The reform program included a variety of software packages and learning activities for the teachers and students to use.

Harland called itself a "basic school powered by technology." This approach was derived from their attempts over a decade to adapt the Boyer Basic School philosophy, which emphasizes a learning community with a coherent curriculum. The teachers with the help of technology specialists developed a variety of strategies for pursuing this philosophy using technology. Among their strategies are a computing unit for every student, a video conferencing center and a full range of assistive technologies. A number of the reform activities appeared to have been initiated by the teachers.

Mountain Middle, a large suburban school has a reform program that can best be described as "technology to support standards-based achievement." For some time its school district leadership has pioneered an approach to promote improvements in achievement using technology in a variety of ways. Some of their innovations include a new teacher-support role called "Student Achievement Specialist" and innovation groups called Vanguard Teams.

Another suburban middle school, Pine City, emphasizes student achievement but takes a much different approach with technology. Their reform effort is summarized as "thin client computing supporting students' academic performance." "Thin clients" refers to the computer stations which have very little independent capability (either hardware or software) apart from the local network

to which they are connected. This ICT strategy has made it possible for them to attain a very high computer density and quality maintenance with centralized control

Joshua Junior High is a medium sized school in a first tier suburb of a major metropolitan Midwestern city. Like many major metropolitan city schools, Joshua has faced the challenge of improving students' academic achievement. A district-wide reform plan centered on providing teachers with the needed technology training, equipping classrooms with extensive technology and supporting technology use was implemented. The multifaceted technology curriculum integration plan has resulted in the majority of core teachers at Joshua having modernized technology rich classrooms.

The high school, Future High, was established about five years ago to give students "High-Tech preparation for a High-Tech world." They think of themselves as a high-tech "start-up" company where the students are learning to fill technically demanding jobs, but unlike a vocational school, their education is not seen as ending, and in fact almost all of the students go on to college. A number of radical improvements have been implemented and their school has become known as a showcase to which visitors come from all over the world.

Carver Elementary is a medium sized rural school, which serves a majority (94%) Hispanic student population. In addition, all (100%) of students qualify for free and reduced lunch. The main reform effort focus is to use technology as a tool integrally embedded into the school's reading improvement program. In addition to the regular school year reading reform effort, students in grades K-6 have the opportunity to further develop their reading and technology skills through a summer "Reading Renaissance Camp."

Fortress, opened as an extended year technology rich elementary school six years ago. Eleven per cent of students are from diverse ethnic backgrounds, of which 35% qualify for free and reduced lunch. The use of student data is embedded into nearly every aspect of the school and classroom processes. The district-wide supported student database makes available to teachers continuous, up-to-date data on students' performance and personal history. Teachers are able to use current data to inform their decisions about individual student curricula and instructional needs.

A highly recognized school within a very large eastern city, Mastery, has pioneered a "Anytime, Anywhere Learning" laptop program. 100% of students and teachers have their own laptop. This largely Hispanic (80%) gifted population of students are not bound by stationary desk top computers, but can readily use their laptops 24 hours a day. These high achieving students are developing computing and researching skills that will allow them to extend and enrich their own learning.

Electric High is a large urban 9-12 school. Students at Electric are mostly (90%) Hispanic and 92% receive free and reduced lunch. " Project Bulldog" provided the major impetus and structural foundation for the school 's technology and curriculum integration effort. Through "Project Bulldog" participating students receive desktop computers for their homes, and can select courses that integrate technology into the curriculum. Electric High selected the "Coalition of Essential Schools" model to guide the framing of its school-wide reform efforts.

Victory High School is a consortium of high schools that provides Internet-based courses for students in member schools. This innovative course delivery method provides one type of "school without walls." The high quality curriculum content must adhere to a rigorous set of standards developed by an expert panel of teachers and evaluators. This organizational arrangement makes it possible for many students to take high caliber course work in specialized areas that their own school does not offer.

Summary

New conceptual and methodological models are needed to cope with the changes that result from integration of information technology into education. The boundaries of the school are expanding as the virtual activities become more common. The curriculum evolves as the needs of students shift toward information handling and knowledge construction. And new policy issues are emerging. These rapid changes mean that qualitative methods are needed to identify key factors, uncover hidden meanings, and explore alternative conceptual models. The “Exemplary Technology-Supported-Schooling Case Studies" project exemplifies the need for exploration of new concepts and methods. A new conceptual framework for a study was designed for studying technology-supported instructional innovations in leading-edge schools. The methodology and selection of sites for the case studies is described in this report. Overall the approach exemplifies approaches that can be used to study sites successful in dealing with rapid changes due to technology.

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Appendix 1

1(1) /IPPUT- history and scope
Description: M2: The history and scope including the goals and origin, the curricular/subject areas involved and the instructional org. of the IPPUT.

1 1) /IPPUT- history and scope/goals, obj of
Description: Objectives of IPPUT.

1 2) /IPPUT- history and scope/Origin, history of
The history behind the IPPUT; the needs and relevance on which it is based. OECD diffusion code (e.g. who adopted first, any patterns to adoption and implementation, adopter's characteristics, etc.).

1 3) /IPPUT- history and scope/Curr areas & org of
The IPPUT's curriculum goals, content and organization (e.g. cross-curricular links, relations with real-world-like problems), flexibility of the curriculum.

1 4) /IPPUT- history and scope/assessment practices of
This IPPUT's forms (e.g. tests, portfolios, project performances) and organization of assessment (e.g. formative or summative, role, students). This is mainly school-wide shared practices. See 5.2 for individual teacher practices.

2(2) /School
Description: M2: Information about the site itself including background, culture, and relationships.

2 1) /School/background
Background of school: type, location, size, student pop characteristics to understand school setting.

2 2) /School/relationships
Relationships of school (relevant to IPPUT) with: school board; parents; external - such as business partners, colleges. Include also special external funding such as grants or donations.

2 3) /School/culture, ldrshp
The culture (artifacts, symbols, basic assumptions, espoused values) of the school, including its collegiality and general professional development practices i.e. perhaps focused more on the adult's experience as an employee in their workplace (see 3.3 for ICT-specific professional development). The leadership style and practices of: Principal; other leaders, including teachers; site council.

2 4) /School/Schoolwide reform, imprmt
OECD code: for school-wide improvements or reform that are related to , but larger than, the innovation we are focusing on and considering the IPPUT.

3(3) /ICT
Description: M2: ICT at the site itself and related to system plans; ICT support structure; ICT in the IPPUT.

3 1) /ICT/Role of in school
Vision of ICT, use of (other than for IPPUT), school policies/ plans for ICT. Goals of ICT distribution e.g., equity in access, etc.

3 2) /ICT/Rel w~ plans
Relationship of ICT in school to local district, state, or national plans (beyond the scope of the IPPUT).

3 3) /ICT/ICT support
ICT technical AND instructional support, including facilities, staff (such as Tech. Coord. or other), ICT-specific prof. Dev. (see 2.3 for gen'l. prof. dev), or however staff gained tech competencies, and incentives.

3 4) /ICT/descript of school's
Descriptions of the amt, and nature of ICT in school.

3 5) /ICT/ICT use in IPPUT
Use of ICT by students: communications; information retrieval and processing; multimedia; simulations, data collection and analysis; drill and practice; student-, teacher- and other actor-to-computer interactions; added value (unique contributions of ICT) to learning and teaching of ICT.

4(4) /Students
Description: M2: Which students are involved, their practices and outcomes.

4 1) /Students/describe involved
Description of involved students, including # of, grade level, experience with, socio-eco, and cognitive ability.

4 2) /Students/practices in IPPUT
Description: Roles, collaborations, and activities in IPPUT.

4 3) /Students/outcomes and impact of IPPUT & ICT
Student outcomes from IPPUT, including student competencies, attitude and motivation, career skill development. Include differences between classes or groups that have access to IPPUT and ICT and those who do not. OECD Equity hypothesis (#3): equity issues, gaps between high and low students' access to and abilities with and benefits from.

5(5) /Teacher
Which teachers are involved, their practices, and their outcomes. May also include important non-licensed teaching staff in these categories too, to outline their background (use 5.1) and roles in the IPPUT (use 5.2).

5 1) /Teacher/bkgrd, exp, beliefs
Description of involved teachers, including ed background, experience with ICT, norms and beliefs on teaching and ICT, and their innovation history. May also include important non-licensed teaching staff in these categories too, to outline their background.

5 2) /Teacher/practices in IPPUT
Teacher practices in IPPUT, including instruction methods used, roles, interaction with students, use of curriculum materials and assessment. This is for individual teacher practices. See 1.4 for school-wide shared assessment and practices. May also include important non-licensed teaching staff too, to outline their roles in the IPPUT (use 5.2).

5 3) /Teacher/outcomes and impact of IPPUT & ICT
Teacher (especially self-identified) outcomes from IPPUT and/or school-wide reform, including competencies, attitudes and beliefs. See also 2.3 for professional development and professional collaboration.

6(6) /Sustainability
Description: the innovation characteristics and the micro, meso and macro level factors that impact the IPPUT. NOTE: These codes might often be used as a second code to some other descriptive information about the school or IPPUT.

6 1) /Sustainability/IPPUT charac~ &
Characteristics of the IPPUT that contribute to or impede sustainability, including implementation issues, barriers, solutions (for OECD future projections). NOTE: This code might often be used as a SECOND, ADDITIONAL code to some other information (e.g. 1.x, 2.2, etc.).

6 2) /Sustainability/micro &
Micro level factors (teachers, classroom factors, students)that contribute to or impede the sustainability of the IPPUT. NOTE: This code might often be used as a SECOND, ADDITIONAL code to some other information (e.g. 2.x, 4.x, 5.x)

6 3) /Sustainability/meso &
Meso level factors (student pop, school-level staff (e.g. prin., tech coord), ICT and ICT support) that contribute to or impede the sustainability of the IPPUT (for school culture use 2.3). NOTE- This code might often be used as a SECOND, ADDITIONAL code to some other information.

6 4) /Sustainability/ macro &
Macro level (district-level actors or context; district, state, national ed system and ICT or Ed reform policies) factors that contribute to or impede the sustainability of the IPPUT. NOTE: This code might oftern be used as a SECOND, ADDITIONAL code to some other information.

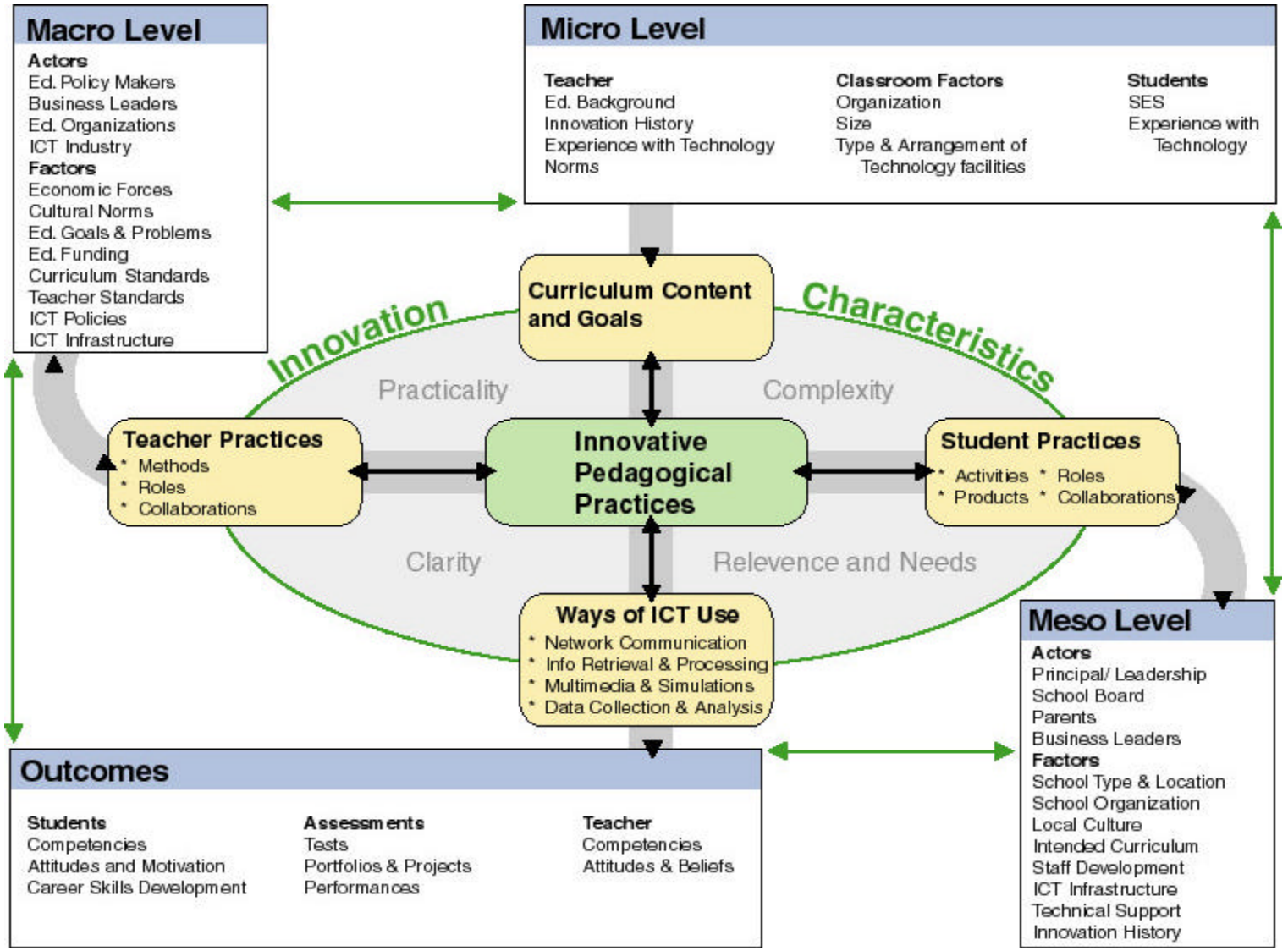
7(7) /Transferability/Scalability
Description: M2: The transferability of the innovation and the micro, meso and macro level factors that impact its transferability.

7 1) /Transferability/IPPUT charac &
M2: The transferability or scalability of the innovation and the micro, meso and macro level factors which impacts its transferability. NOTE: These codes might often be used as a second code to some other descriptive information about the school or IPPUT.

7 2) /Transferability/meso &
Meso level factors (student pop, school-level actors [beyond classroom, e.g. prin or tech coord], context and culture, ICT and ICT support) that contribute to or impede the transferability or scalability of the IPPUT. NOTE: This code might often be used as a SECOND, ADDITIONAL code to some other information (e.g. 3.x, 4.2).

7 3) /Transferability/macro &
Macro level (district-level actors or context; district, state, national ed system and ICT or Ed reform policies) factors that contribute to or impede the transferability or scalability of the IPPUT. NOTE: This code might often be used as a SECOND, ADDITIONAL code to some other information.

(8) /Does not fit
Description Use sparingly and only when info absolutely does not fit any other existing category. Please do not add sub-codes to the node.


Macro Level
Actors
Ed. Policy Makers
Business Leaders
Ed. Organizations
ICT Industry
Factors
Economic Forces
Cultural Norms
Ed. Goals & Problems
Ed. Funding
Curriculum Standards
Teacher Standards
ICT Policies
ICT Infrastructure
Micro Level
Teacher
Ed. Background
Innovation History
Experience with Technology
Norms
Classroom Factors
Organization
Size
Type & Arrangement of Technology facilities
Students
SES
Experience with Technology
Curriculum Content and Goals
Innovation
Characteristics
Practicality
Complexity
Teacher Practices
* Methods
* Roles
* Collaborations
Innovative Pedagogical Practices
Student Practices
* Activities * Roles
* Products * Collaborations
Clarity
Relevence and Needs
Ways of ICT Use
* Network Communication
* Info Retrieval & Processing
* Multimedia & Simulations
* Data Collection & Analysis
Meso Level
Actors
Principal/ Leadership
School Board
Parents
Business Leaders
Factors
School Type & Location
School Organization
Local Culture
Intended Curriculum
Staff Development
ICT Infrastructure
Technical Support
Innovation History
Outcomes
Students
Competencies
Attitudes and Motivation
Career Skills Development
Assessments
Tests
Portfolios & Projects
Performances
Teacher
Competencies
Attitudes & Beliefs