Creating Practical Evaluation Templates for Measuring the Impact of Instructional Technology

Prepared by
Interactive, Inc.
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North Central Regional Educational Laboratory

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Contents

Executive Summary

During the academic year 2000-2001 the Montgomery County (Maryland) Public Schools (MCPS) is partnering with the North Central Regional Educational Laboratory (NCREL) in initiating the *Literacy Through Technology* project, a K-3 program aimed toward producing positive attitudes and skill development in students' reading and writing. *Literacy Through Technology* is part of the MCPS technology plan known as the *Global Access* project, a multiyear initiative in which technology is an essential tool for teaching, learning, and management.

Evaluation of technology implementation and the relation between technology use, student learning, and achievement requires appropriate measurement tools. Interactive, Inc., has been contracted to develop such instruments, under agreement with NCREL. Reflecting the current literature on effective technology use in the classroom, the Interactive, Inc.-developed instruments measure four domains of computer implementation and use across three instruments/reporting sources. The four domains are as follows:

- Technology infrastructure
- Teacher preparation
- Teaching strategies
- Student use patterns

The three reporting sources are as follows:

- Teachers
- Students
- School administrators (or other personnel responsible for technology census data)

In addition to providing measures for use by MCPS, this report also includes recommendations and considerations in choosing and using those measurement tools and measurement tools in general.

Purpose of This Report

Background

The North Central Regional Educational Laboratory (NCREL) is a not-for-profit organization committed to developing and testing technology-based educational innovations. NCREL's work is performed through partnerships with school districts. One such partner district is the Montgomery County (Maryland) Public Schools (MCPS).

During the academic year 2000-2001, MCPS is initiating the *Literacy Through Technology* project, a K-3 program aimed toward producing positive attitudes and skill development in students' reading and writing. *Literacy Through Technology* is part of the MCPS technology plan. The technology plan is known as the *Global Access* project, a multiyear initiative to equip and connect all MCPS classrooms, media centers, and offices with computers. The infrastructure of wiring, hardware, software, and training represents a vision in which technology is an essential tool for teaching, learning, and management. Key features of the technology plan include:

- Wiring early childhood classrooms for LAN, WAN, and Internet connections to provide easy access to local and global information sources for teaching, learning, managing, and supporting instruction.
- Each classroom will have six drops and a minimum of five computers per classroom, aimed toward a student-to-computer ratio of 3:1.
- School networks will be loaded with instructional software supporting the development and extension of students' skills in reading and writing.
- Teachers and specialists will be provided with instructional applications and training opportunities that will facilitate infusion of technology into instruction. The intention of training and application is to transform classrooms into student-centered, inquiry-based models supported by current technology.

MCPS wishes to test the value added to student achievement by inclusion of technology into their reading initiative. A preliminary and integral step to such tests is identification and selection of instrumentation through which technology implementation and use can be measured. Interactive, Inc., has been contracted by MCPS to advise them on how to proceed with their measurement decisions.

Goals

There are two general goals for this report. The first is to serve MCPS's effort to conduct an internal evaluation of the relation between classroom technology use and student achievement outcomes. The second is to do so in a manner that provides a template for making measurement/ instrumentation decisions relevant to technology implementations beyond *Literacy Through Technology*.

In addition, there are two specific goals that follow from the general goals and background of this report:

- To provide a briefing on the major concepts that cross previous efforts to measure technology use in the classroom
- To provide a measurement instrument that addressed those major concepts, which can be used for measuring classroom technology use

Technology in the Classroom

Infusion Into Schools and Conditions for Success

The penetration of technology into the classroom has become a fact of educational life. There has been a marked increase in the availability of computers to students in the United States, from one computer for every 125 students in 1983 (Glennan & Melmed, 1996) to one computer for every 5.7 students in 1999 (Education Week, 1999). By 1998, 93 percent of teachers in Grades 4-12 were using computers for professional purposes. In addition, 71 percent of teachers assign computer work to their students at least occasionally (Becker, Ravitz, & Wong, 1999).

Further, there is accumulating evidence that computers and related technologies can be effective tools for improving student learning and achievement when utilized systematically (Schacter, 1999; Wenglinsky, 1998). Such uses include support for individual learning (e.g., in skills drills, using the Internet, and word processing), for group learning (e.g., in presentation software and collaborative communication), and for instructional management (e.g., in integrating standards and assessments and in coordinating and integrating lessons) (Becker, Ravitz, & Wong, 1999; Wenglinsky, 1998).

However, we now know that the allocation (or presence) of computing and technological resources does not equate to successful utilization and learning benefits for students. Indeed, it is only when programs are well implemented that positive effects on learning and achievement can be expected (Collis, Knezek, Lai, Miyashita, Pelgrum, Plomp, & Sakamoto, 1996; Knapp & Glenn, 1996).

Implementation quality depends on a combination of adequate technical resources, teachers being well trained in application strategies and techniques (Anderson & Ronnkvist, 1999; Becker, 1998), and student engagement in using the technology (Hickey, 1997).

In short, technology in the classroom only translates into learning and achievement gains when the hardware and software are appropriate to program objectives, teachers are trained in—and follow through on—applying the technology to curricular and learning goals, and students "buy in" to using computers as learning devices.

Measuring Allocation and Utilization

The research literature on the conditions for successful employment of classroom technology (as described above) indicates the need to measure four key domains in order to (a) understand the allocation of technology resources and their utilization patterns and (b) predict student outcomes from those allocation and utilization patterns. These four domains are as follows:

- *Infrastructure*, which refers to the availability of technology resources (hardware, software, connections) to teachers and students. Key considerations are provision and maintenance of up-to-date computers and connections, numbers of computers (as well as ratios of students to computers), technical support, software availability, and ease of access to both hardware and software.
- *Teacher preparation*, which refers to training in basic and creative uses of technology for instructional purposes. Key considerations include developing expertise in applications (e.g., word processing, graphics), ability to instruct students on the use of those applications, and understanding how to integrate technology and curriculum.
- *Teaching strategies,* which refers to two interrelated strategic areas. One area is integration of technology applications into student learning activities. Key considerations include the use of technology as providing resources for instructional support (e.g., locating information and programs through the Internet and networks) and as a medium for instruction (e.g., drills). The other area is pedagogical style. The key consideration is the degree to which the teacher is "instructivist" (i.e., treats learning as a process of students receiving knowledge) versus "constructivist" (i.e., treats learning as an active discovery process in which the teacher sets up experiences through which the students can generate deep understanding of curriculum). The former pedagogical style makes minimal use of technology while the latter maximizes the use of technological resources.
- *Student use patterns*, which refers to the technological activities in which students are engaged. One area is simply the amount of use or the proportion of time that a student is actively using a computer (as opposed to doing other things or being logged-on but not active). Another area is what the student is doing when he or she is actively using the computer. Key considerations include the types of connections (e.g., Internet, networks) and software programs being utilized.

The MCPS *Global Access* program is well conceived in that it explicitly addressing each of the four domains as a means to improve student learning and achievement. More specifically, the plan conceptually coordinates infrastructure availability and teacher preparation, and promotes teaching strategies valued as linkages between infrastructure/preparation and student use patterns.

The following section presents instruments designed to measure program performance in each of the four domains. These instruments are intended to assess the degree to which MCPS attains their program objectives.

Measurement Tools

For the purposes of documenting learning technology programs, numerous instruments have been developed by a variety of authors. Most instrumentation is necessarily specific to the particular intervention or program it was developed to measure.[1] However, a number of

[1] In fact, pursuant to the "Recommendations" section of this report, it is our belief that tailoring instruments to particular projects is absolutely necessary to capture or document the essence of the program as it is developed, implemented, etc.

instruments have been developed that are relatively standard and applicable to virtually any learning technology evaluation.

The instruments included as appendices to this report are syntheses of a number of preexisting measures. The table below demonstrates the relationships between the four domains and the instruments. After that, we offer recommendations for using the instruments.

Table 1: How the Instruments Measure the Four Domains

Domain	Instrument	Concepts Measured	Questions/Location
Infrastructure	Technology Audit	Number and type of computers available for instructional use	Page 1 chart
		Location of computers used for instruction	Page 1 chart
		Number of computers available for administrative purposes	Page 1 chart
		Connectivity	Page 2 chart
		Types of software content and applications available	Page 3 chart
	Teacher Questionnaire	Number and type of computers available for instructional use	Section II, Question 6
		Location of computers used for instruction	Section II, Question 6
		Connectivity	Section II, Question 7
Teacher preparation	Teacher Questionnaire	Technology literacy	Section III, Questions 8-19
		Attitudes toward technology	Section IV, Questions 20-27
		Professional development received	Section VI, Questions 31-34
		Professional development needed	Section VI, Question 35
Teaching strategies	Teacher Questionnaire	Teaching style	Section V, Questions 28-30
		General computer use	Section VII, Questions 36-38
		Computer use by content area or application	Applications charts, pp. 13-14
		Curriculum integration	Section VII, Question 39
Student use patterns	Student Questionnaire	Attitudes toward computers	Questions 1-10, 25-30
		General school computer use	Questions 11-13
		School computer use by curriculum area	Questions 14-19
		General home computer use	Questions 20-24

Standards

As a complement to the instruments included as appendices, a number of organizations have devised a set of standards by which an educational unit could judge or compare itself to others. These standards establish criteria for judging quality of teacher and student involvement with technology. The two most commonly cited sets of standards are:

- The CEO Forum School Technology and Readiness Report (STAR) Chart
- The International Society for Technology in Education (ISTE) National Educational Technology Standards (NETS) Project
    - NETS for Students: Connecting Curriculum and Technology
    - NETS for Teachers: Preparing Tomorrow's Teachers to Use Technology

Domain	Possible Measurement Standards
Infrastructure	CEO Forum STAR Chart
Teacher preparation	CEO Forum STAR Chart
Teaching strategies	ISTE Standards for Teachers CEO Forum STAR Chart
Student use patterns	ISTE Standards for Students

These standards are available online at www.ceoforum.org and www.iste.org for schools or districts to use as technology standards against which to evaluate a technology program.

Recommendations for Determining How to Use Measurement Tools

Prioritize Goals and Issues/Questions

In order to glean the knowledge necessary to make program and policy decisions, the research process requires a map linking goals (including understanding of program effects and possible action decisions), the information that needs to be obtained, and measures appropriate to providing that information. Such mapping gets conducted on a study-by-study basis. Put differently, effective evaluation research relies on critical thought and planning rather than on exercising cookie-cutters.

In the present case, we have worked from a general understanding of the MCPS *Literacy Through Technology* program structure and goals to provide a set of measures that are applicable to measuring the program as well as for more widespread use. However, we recommend that the program principles convene and reach agreement on their specific goals for evaluating the program, and apply those goals as a context for collecting and making sense of the data.

Such planning is recommended because it is necessary to ensure that the questions most important to MCPS are answered. Analogously, if you want to build a house, you start with a blueprint and then begin building. This process is necessary to winding up with a product that suits your specified needs. You would never start building without knowing the house design. Yet, there are many cases of well-intentioned and smart people collecting survey data and then

beginning to think of their questions—and ultimately winding up frustrated with trying to form the raw materials into a structure that is coherent and suitable to their needs. Such coherence and suitability is the result of planning from the beginning.

In that vein, please note that the provided instruments need not be "set in stone." Adjustments can be made if MCPS wants to (a) add items to meet specific needs (bolstering measurement) or (b) omit administration of portions of the surveys if those survey portions are extraneous to the current evaluation goals (and thereby reduce time taken for the survey administration sessions).

Consider Demands on Teachers and Students

As noted above, there are practical concerns in administering surveys. A primary concern is time demands. For example, data gained from survey administrations is often instructional/learning time taken from the teacher and class. MCPS should therefore weigh the costs and benefits involved in how extensively to survey respondents (and make adjustments accordingly).

Another demand is on student capabilities for answering surveys independently. With proper instruction, the Student Technology Questionnaire is appropriate for third-grade (or older) students to complete in group format. As with most surveys, it is likely that first- and second-grade students will require assistance from aides or older students to provide valid data.

Consider Linkages With Other Projects

When tailoring survey use to this (or another) project, MCPS should consider other potential projects for which they might like to compare data. For example, one might wish to compare technology use across reading and mathematics programs. If so, the tailoring process should be complemented with measures that are common across projects.

Timing

There are various ways in which to time survey administrations. If one chooses to take a "snapshot" of technology use (and the relation with student learning and achievement), survey administration can be timed for the period of the year that is of interest (e.g., end of the spring semester). On the other hand, if one chooses to assess *change* in technology use (and the relation with student learning and achievement), taking a "pre-post" approach would be more appropriate than a "snapshot" approach. Pre-tests typically take place prior to implementation of the program (e.g., in spring of the prior year or the beginning of the first semester of implementation). Post-tests are typically timed in one of two ways: (a) after the program has run (or as close to the end of the spring semester as possible), which provides assessment of change from pre-test to the end of the program; or (b) at the end of the spring semester of each year that the program is implemented, which provides an ongoing record of change across the course of the program.

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