MEASURING THE EFFECTS OF COMPUTERS IN EDUCATION: METHODS AND RESULTS
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In this section, I offer some personal reflections at a global level as a personal view of how the three studies reported in this book harmonize and support each other. This personal view is focused on two main points of reflection: reflection on the methodologies of the studies, and what these studies offer in terms of strategies for future research projects, and on key findings from the three studies, focusing particularly on culture.

How Can We Measure the Impact of Computer Use in Education on a Cross-Cultural Basis?

CompEd, ITEC, and YCCI shared many concerns and many interests. As researchers, the members of the three projects shared a common concern for finding an effective methodology to validly and objectively capture cross-cultural differences relating to various aspects of children and computer use. Appropriate to their research questions and their backgrounds, the studies used different approaches and instrumentation. CompEd and YCCI were similar in that they relied on fixed-response instruments administered to large samples. ITEC differed, in that it used a large range of observational data as well as a battery of instruments, and a case study approach where, by definition, the interpretation of the local researcher was interwoven in the data and its interpretation. But in all three studies, the methodology was agreed upon by researchers with long and proven experience in dealing with methodological issues, instrument development, sampling, and data analysis.
Two general questions present themselves when looking at the methodology of the three studies: Can we, based on our experience from the three studies, make a recommendation for methodology for subsequent studies? Were culture and cross-cultural differences handled adequately in the studies?

Choice of Methodology. It is well known that the choice of methodology for a research study must reflect the research questions of the study. The three studies in this book, although dealing with the same overall domain, had very different research questions and each chose a methodology that fit its focus. It does not seem debatable to say that if one wants an overview of broadscale patterns of usage, one should choose a survey technique and if one wants to study the dynamics of a classroom then one should choose a mixture of observational techniques.

Yet it is also well known that whatever technique is chosen, something is lost. The broader the view, the less feeling of life; the closer the immersion in life, the less the ability to generalize and summarize. Clearly, what this book shows is that a variety of methods, taken in combination, is what is best: overview data, systematically gathered, complimented by qualitative and observational data, also systematically gathered. Together these two can bring frame and interpretation closer into synchrony. A consideration of the videotapes of classroom and school culture collected by ITEC shows clearly the difficulties in capturing the richness of computer-use situations, certainly in broadscale inventory-type surveys but also in naturalistic case studies. The three studies in this book suggest the strength of a single study combining both approaches.

Such a single study is probably not likely to occur. The costs and difficulties of mounting such a study make it unlikely; the extent to which IT is now integrated into schools and society further confounds the difficulties of motivating a study to measure its effects. Of the three studies in this book, the only one with a stable funding basis was CompEd. ITEC depended heavily on the impact of UNESCO in many of its participating countries. Ironically, with the change in governments in the East European countries that occurred during the ITEC period, the UNESCO organizations in those countries lost much of their established framework for stimulating research activities making it now very difficult to find a nongovernmental organization with influence to support a research project on a worldwide level.

The cost-effectiveness of a methodology must also be considered. The ITEC study involved nine international meetings, at a considerable cost, both in time and finances. Even so, this was not enough to fully extract and interpret indicators and messages in the data. The survey-type approaches such as in CompEd and YCCI are more manageable and efficient, but each also involved considerable organization and expense, particularly so with CompEd, where the responsibility of summarizing countries requires considerable national support and conviction that the national research team can in fact represent the country in its sampling. As with any research, the costs of the activity must be considered against its payoff. Payoff is related to validity and generalizability, but also insight and relevance to decision making.
Taken together, the three studies in this book do bring many insights that can be extremely helpful to decision makers. In terms of recommendations for the methodology for any future multinational study about IT and education, it seems important to blend the range of perspectives in these three studies: system, classroom, and individual learner, and the range of methodologies: survey and systematic observation. The question of feasibility remains. What agency will support the cost and complexity of such an integrated approach?

A further comment about validity and reliability is suggested by the three studies. Each was carried out, as carefully as was possible, in a way sensitive to the need to support the validity and reliability of its methods. It would seem that the CompEd and YCCI studies have more reliable methods than the ITEC study, if reliability is given its textbook definition of reproducibility and objectivity.

Yet, such a conclusion should not be taken too quickly. Every step in a research study is saturated by its researchers, if they are physically present in the data-collection process as they were in ITEC, or far distant, as they were in CompEd and YCCI. As an example, the relationship of gender and computer use stands out. CompEd and YCCI researchers asked questions about gender, analyzed their data according to gender, and found conclusions about gender. ITEC researchers did not ask particular questions about gender, did not see gender emerge as a differentiating aspect of computer use in its classrooms, and thus did not come to any conclusion about gender. Which approach is more objective? Neither is to be criticized. The example is only to show that researchers always determine the lens and filter through which conclusions are drawn.

Again, the recommendation seems to be to combine a number of lenses, as is occurring in this book, and then see what comes through this variety of lenses most consistently.

Culture. A major common aspect of each of the three studies in this book is their cross-cultural basis. Each wishes in its own ways to examine the impact of culture on the phenomenon of computer use in schools and its impact on learners. ITEC in particular began with considerable discussion of what is meant by culture, and which aspects of culture should be taken as a frame for the subsequent research. Family? Socioeconomic class? Ethnic group? Race? Religion? Political aspects? All of these are well-known determiners of culture.

Despite the frustrations of some of its original researchers, ITEC came to the conclusion that it was not possible to carry out analysis based on these aspects of culture. Some of the reasons were methodological and procedural; others related to the eventual complexity of handling the interpretation of the data. Thus, ITEC chose to define "culture" by "country." This has been generally the approach in the other two studies, although CompEd prefers to speak of educational systems instead of countries as units of analysis, thus reflecting at least some of the major cultural differences in countries such as Canada and Belgium. YCCI has done the most insightful work with the culture variable, by studying bilingual Hispanic students living in the United States. Thus most of the conclusions that can be made about culture in the three studies in this book assume that culture is equivalent to national
affiliation. This simplification was practical and justifiable for all three studies, given their research questions and their backgrounds. The YCCI work with Hispanic students in the United States, and the ITBC observations of common elements in classroom cultures when computers are in use, across national boundaries, suggest that further cross-cultural studies need both national definitions of culture but also something more meaningful to the actual experience of the learner.

**The Studies In Combination: What Messages Come Through From All of Them?**

The three studies in this book, with their three different perspectives and their different methodologies, give us an important opportunity for triangulation of their results. This cannot be taken too far, however, because of the differences in their research questions and thus in the questions they asked in their procedures. It seems clear from the studies that:

- Computer use in schools is increasingly established in schools around the world (a result well supported by many other indicators).
- At the system level, predictable issues and problems arise.
- At the classroom level, teachers are choosing from a variety of ways to make use of IT, including not to make use of it at all.
- From the learner level (at least for younger children), children are motivated by using the technology, are not negatively affected by it, and seem to be benefiting from it.

Although these conclusions seem simple, they are in fact profound, given the intense speculation about the impact of computers in education that occurred in the late 1970s and early 1980s.

These conclusions seem to be relatively clear after reviewing the three studies. As an individual I also have personal conclusions about the impact of computer use on children that I see emerging from the three studies in this book, and from my more general experience. I close my portion of this reflection chapter with my own list of key results:

1. Regardless of systemwide approach, major results seem the same.

During the 1980s, at the system level, intense efforts went on in many countries to find optimal ways at the system level of introducing and supporting IT in schools. What the three studies in this book, taken together, show is that despite all the variations in strategy at the system level that have occurred, similar problems and issues are still present, a wide range of classroom and teacher responses to IT is still occurring, and there is no consistent evidence that children, looked at from a system (i.e., country) level, are responding differently because of national policies. This, if it is a justified conclusion from the three studies taken in combination, is a result
that is quite amazing. Perhaps it is too bold to claim. But at least in the ITEC study, the impact of national policy and strategy did not seem to have any reflection in the classrooms that were observed. Regardless of great differences in national strategy and policy among the 17 studies whose classrooms were observed for the full term of ITEC, the ITEC researchers saw great commonalities in what was going on, in terms of happy and engaged children and dedicated and innovative teachers.

2. Regardless of many variables at the classroom level and software level, the teacher is the critical influence.

And what about the classroom level? An enormous amount of research has gone on with respect to teacher training, to approaches for the instructional integration of computers in the classroom, to software characteristics, and to issues relating to innovation in the classroom. Something quite important does seem to emerge from the combination of the three studies in this book in this respect. In the CompEd study, with its broad sampling, the definite tendency toward the use of “easy” applications of computers was supported; easy in the sense of easy to integrate into existing classroom practice, easy to fit to existing curricula and methods, easy for learners to use in a self-supporting way. Game playing and drill and practice are the major uses of the computers that have made their way into elementary schools. Because these activities are by definition time-intensive and computer-intensive relative to their use (e.g., a child must sit, by him or herself, for a certain period of time in a computer if drill is to be effective), the most predictable, and reasonable, response from a system level is “We need more computers.”

But the ITEC study shows a very different situation. When one examines not the “average” classroom, but the “special” situation where a combination of circumstances, largely influenced by the characteristics of the individual teacher, has led to substantial use of computers in the learning practice, what we saw was very different than the CompEd picture. In ITEC we saw almost no game playing. We saw almost no drill and practice. We heard almost no complaints that more hardware was needed. Instead we saw teachers making the successful effort to integrate computer use in the whole lesson experience, not as a supplementary drill or diversion, but as a learning media with which the whole class was engaged. This does not have to occur through sitting each child in front of a computer at the same time, although it can, but can also occur through use of a single computer as an important resource during a lesson, which learners use as a reference tool or a production tool or a data-accumulating tool. Such approaches do not necessarily require more computers; they do necessarily require a teacher willing to change his or her instructional method to incorporate the strengths of the technology.

That this does not yet often occur at the system level is borne out by the CompEd study. That this can occur in the classroom level, with rich consequences, is borne out by the ITEC study. The studies do not contradict each other; each is necessary to see the whole picture.
3. Regardless of different experiences and cultures, children are benefiting from and enjoying their use of computers.

With regard to the individual, all the studies concur. Children are learning with and about computers, regardless of what happens at the system and even classroom level. Children find computers interesting and not threatening, despite our earlier fears. Children can handle computers in a way parallel to the evolution of computer use in their larger societies. Children are not being negatively affected by technology in their schools, at least in any way we can capture in these data. These are very good things to report; thousands of words of concern have been expressed about these issues over the last 15 years; considerable effort has gone into the development of a range of different programs and curricula for introducing children to computers in schools. Perhaps we can say, it doesn't seem to matter; perhaps we can say it has all contributed to a positive evolution. What does matter is that for the child, the use of computers in schools is generally a positive experience, both subjectively and in some unmeasurable way, intellectually. This is very good news.

4. Regardless of methodological approach, there is no simple answer about how to best use computers in education.

More specifically, the studies taken in combination bring both good news and frustrating news to decision makers. Frustrating news, in that no "simple" answers emerge with regard to actual steps and decisions. No one type of educational software can be clearly shown to be "most effective." No one approach to teacher training can be shown to be most useful. No clear indication about how many computers of what type should be present in a school can be claimed. No clear evidence of learning effect, relative to classic indicators such as systemwide improvement in normalized test scores or job market indicators, can yet be substantiated on a broadscale basis among countries with respect to computer use in schools. No particular evidence favors one strategy for national policy to another. No particular classroom procedure is to be consistently recommended as "the best way" to make use of computers.

5. Despite what we don't know, we can believe that good things are happening.

But the frustration of these results is also their strength. Technology is moving into schools, (some) teachers are making use of the technology, children are benefiting. We can and we must continue, with a positive and confident feeling.

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