Evaluation of the Computer’s Efficacy in Education

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Summary

Does the computer as an educational tool help or hinder the educational effort? We know that the answer really depends on the substantive question being asked – and evaluation of efficacy in any domain depends on how we define efficacy. In this survey, the focus is on how the evaluation of this at once too costly and too necessary educational technology has been shaped over the almost fifty years of effort in the field, and what we have learned as evaluators and from the evaluations. Starting with the early efforts in the 1960’s where the bar was set at a fairly low self fulfilling level to the most recent efforts to tease out the always subtle but real effects, the discussion will follow threads in the affective and effective domains while glancing often at the parallel state of other technologies used in education.

Introduction

“There are no answers; only better and better questions.”

The significance of this survey for evaluation and for the theme of this conference – learning via evaluation – is in how it reaffirms the role each component has in making the evaluation profitable for the target of the evaluation, for the stakeholders and for the evaluator.

We have an opportunity to take a fairly Longview (50+ years) of an effort to imbue education with digital/computer technology as we have watched that technology morph over that time from the cumbersome large rooms full of equipment to the miraculous PDA/Cell phone of today which has seen the transformation from little to infinite power and from massive to infinitesimal gravitas.

The current state of the effort to provide computers for instruction everywhere in education is to raise questions that have been on the agenda for 50 years. With the 2004 revisit of data collected in 2000, Fuchs and Woessmann reopened the argument that has dogged computer use in education (particularly K-12 instruction) since its flashy beginnings in the 1960’s – do computers add, detract or have no discernable effect?

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In this discussion we will look at the long history of the effort to evaluate the effectiveness of computers in instruction starting by looking at the current state of the art/enterprise, continuing with tracing evaluation efforts along the almost 50 years of progress and end the discussion by revisiting some of the fundamental issues in evaluation that suggest how we should view that which will be a continuing controversy until, like teaching reading as a response to the technology of the printing press, it disappears in the universal need to do such.

Along the path we will look at the efforts of the 1960’s where the argument for computers in education was the same as in evaluating the Dancing Bear – not that he dances well but that he dances at all. Then in the 1970 we will look at such seminal efforts as Robert Hess and Maurice Fisher’s study of young students treating the computer (a primitive teletype machine at the time) as possessing almost human qualities. The 1980’s see evaluation expanding and often focusing on external criteria such as test scores. In the 1990’s, while the struggle to demonstrate a positive effect on instruction from the use of computers and expanding range of uses and a concern over the “digital divide” turns the evaluation light on access and produces “NetDay.” The 21st century has started by hosting many concerns and evaluations focused on those concerns ranging from appropriateness of access to the same fundamental questions from the dawn if this technology – does it improve achievement/test scores.

Computers make you dumb(er)

The conclusion of those (Fuchs and Woessmann) who brought us here:

Our results on computer availability and use at school corroborate previous work on school computers such as Angrist and Lavy (2002) and Rouse and Krueger (2004), who also find disappointing results in terms of effects on students’ educational performance. Our results on computer availability and use at home extends this evidence, illustrating that there is also a negative relationship between home computer availability and student achievement, but a positive relationship between home computer use for internet communication and educational software. Similarly, our results on internet use at school complement the previous evidence on computer use at school.¹

This conclusion has been quite a hit among those who seek to find solutions in the debris of careful efforts to improve educational efforts in a rapidly changing world. However, a long look at the efforts to weave computers and computing into education over the past fifty some years has always been a problem of how to phase the research question so that the obvious, desired conclusions (“computers are good”) could be reached with scientific precision. In the next few pages, we will look at what the criteria were for that effort.

The Halcyon Early Days

In the 1960’s, when multi-user computers made it feasible to think about direct instruction of students via computer, questions as to how this might be accomplished were to be answered by the rolling technology juggernaut that was to put us on the moon by the end of the decade and give us marvels only dreamed of in science fantasy - the seminal visions of the time – 2001 a Space Odyssey (1968), for example - showed us what to expect from the technology by the end of the millennium.

¹ Fuchs, Thomas & Wößmann, Ludger Computers and Student Learning: Bivariate and Multivariate Evidence on the Availability and Use of Computers at Home and at School Ifo Institute for Economic Research at the University of Munich, October 2004
By the middle of the decade, major research efforts to bring the power of this mind tool to the classroom – at Stanford and University of Illinois and various commercial places where the computer age was being invented, education was an eagerly pursued enterprise.

**PLATO**

Begun as an effort to bring the computer to bear on the task of education in the most technological sophisticated way, the system went through three revisions and extensions before, in 1967 the National Science Foundation granted the team steady funding, allowing Donald Bitzer (the “father” of PLATO) to set up the Computer-based Education Research Laboratory (CERL) at the University of Illinois. In 1972 a new system named PLATO IV was ready for operation. A site to record the history of this project is growing at [www.platopeople.com](http://www.platopeople.com) (“This site offers information regarding a book being researched and written about the PLATO system and the user culture that it spawned in the 1970s.”)

**IBM-IMSSS**

Starting at a few Palo Alto and East Palo Alto schools in the early 1960’s, the Institute for Mathematical Studies in the Social Sciences at Stanford University under Pat Suppes and Richard Atkinson began intensive research on using computer for instruction. The student terminal was a Model 33 Teletype, pictured at the left.

**TICCIT**

The Time-shared, Interactive, Computer-Controlled Information Television (TICCIT), first developed by the MITRE Corporation in 1968 as an interactive cable television (CATV) system.

From June, 1971 through July, 1972 MITRE demonstrated a number of potential social, commercial, governmental, and educational interactive services through the Reston, Virginia cable television system. In December, 1971, the National Science Foundation (NSF) Technological Innovations Group granted a contract to MITRE to further develop the TICCIT system as a Computer-Assisted Instruction (CAI) system for community colleges such as Phoenix Community College in Phoenix Arizona.

For these systems (PLATO, IMSSS, TICCIT) the improvement of education was guaranteed because very bright people would be in charge of the design and delivery of the material to the learner. In addition, the fact that the computer could tirelessly or errorlessly recorded all sort of information generation by the intersection between the students and the learned meant that we could get a huge amount of information on the learning

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1 Teletype ASR33, photographed in the HNF (Heinz-Nixdorf Computer Forum), one of the biggest computer museums world wide
process – we could see where learning took place and where performance began. The insight into this most useful of human capabilities would be limitlessly precise.

**1970’s - The positive outcome was guaranteed.**

The momentum built by the 1960’s tempered but pressed forward in the 1970’s. The “guns and butter” efforts which sustained both a trip to the moon and a large military effort in Southeast Asia strained the resources of the 1970s so that some large projects changed focus and direction while others were engendered to help with the issues raised by school desegregation and a conscious effort to improve efforts in the poorer schools.

The obsolescence of modern education is not only reflected in the exorbitant cost of it, the social strife it engenders, the failure of it to teach students what they need to know. It is also the inability to cope with modern industrial society. Courses designed from textbooks, usually five to 20 years behind the times, cannot cope with the actualities of any given subject, whether the subject is rock and roll or astrophysics. Technology sets its own pace; the textbook goes at a pace that is wholly different. It doesn't mean the textbook is condemned to death. It means that those fields in which change occurs daily must have daily change built into any instruction about them. This Plato can do.¹

As another note on the optimism of the 1970, Maurice Fisher and Robert Hess studied how the students in San José reacted to their teletype teacher and found that the students did a great job of anthropomorphizing the clunky mechanical devices. That was the level of research on computer in education – no limits to the potential & positive impact

**1980’s – Serious Microcomputing**

At this point the drift because serious – no longer was the main object of computer literacy to bend the computer to the users will but, rather, to help the student enlist the computer as a partner. Learning through the computer was changed to learning with the computer and the focus of the educational effort moved to learning about the uses of the computer in ordinary tasks – writing and arithmetic – word processors and spreadsheets replaced Fortran and Basic as the topic of classes about the computer.

**1990’s**

The effort begun in the late 1980’s accelerated in the 1990s as the Graphical User Interface replaced more usual forms of man-machine interaction. From the mid-1990’s and especially with Net Day in 1996 – a PR blessing and an infrastructure bane – Internet access has become the goal. Since Net Day, mostly as a milestone and not necessarily a cause, the internet and World Wide Web have become a principle vector for computer access and for new initiatives.

**Our Decade**

Here we are in the first decade of the 21st century with much to show – cell phones in our pockets withy more computer power than the ENIAC and far easier to use and little progress in our early goals.

If the purpose of our assessment if computers n education was to assay how well the devices have been used to improve instruction or give us insight into how we learn then we would be hard put to place a gleeful face on the results.

¹Darak, Arthur “Yes Computers can Revolutionize Education” Consumer Digest, Sept/Oct 1977
As the start it was suggested that what we would end with are better questions, not answers and I hope we are there. No one would say that the book has not contributed to education for as we can see the book became education. So too does technology not impact education so much as it is now a large part of the target of education. What we need to attend to is not whether the technology improves or damages our ability to read, write and do arithmetic but whether we are helping the next a future generations become careful, informed consumers of technology for it has a great potential for both good and evil and it is the former role we want it to play.

The Book

Let us pause in looking at the computer for a moment and look at the book. The book has been around a long time. But the brining together of moveable type, mass produced paper, the press itself into a system for mass producing books was a favorable occurrence at a time when knowledge was being recovered. About 1450 Guttenberg brings it all together and gets credit for a significant event. Others (Caxton in England, as one notable example) also developed faster ways of reproducing books. Within 50 year of this assembly of parts, the printed book quickly becomes a regular object in the world. By 1501 there were 1000 printing shops in Europe, which had produced 35,000 titles and 20 million copies. Within the next 50 years Martin Luther and John Calvin break Rome’s monopoly on the church.

To quote from her very fine work on commerce and the Renaissance, Worldly Goods, Lisa Jardin writes

The printed book revolutionized the transmission of knowledge, and permanently changed the attitudes of thinking Europe. Print brought with it many of the features of a book-based culture which in our everyday lives we now take entirely for granted. … The comparative effortless production of multiple copies meant that printed books could disseminate knowledge much more rapidly, widely and accurately than their handwritten antecedents. The dramatically lower price of the printed book also made written material available for the first time to a large, less privileged readership.¹

The printed book also gave rise to all the difficulties surrounding and liberating technology – the immoral ones were banned and burned (immoral being a very subjective state). The rich had books with fancy bindings; the poor plain covers. But it was not suppressed and soon knowledge became to freely available and reading the recognized path to that knowledge that a digital divide arose between the literate and illiterate.

One might have made the case, and I’m sure it was made in many ways, that reading caused the work force to be lazy and distracted – not do well in their apprentice Sheppard training because of all the salacious and/or informative information they could spend their daylight hours on rather than work.

SQ3R

A STUDY/READING SYSTEM – Survey, Question, Read, Recite, Review. One doesn’t read textbooks in the same way that one reads a regular book. The SQ3R method of reading and studying was first introduced by Francis Pleasant Robinson in 1946 and has passed the test of time. Generations of student were taught (and are being taught) this way of approaching academic reading – and the books themselves are organized to support this method. This item is relevant here because the book is not blamed but, as a necessary object of instruction, is made more accessible by a method which will allow students to profit from their encounter with the book.

What Does a Computer Look Like?

Now that we are here in modern times, what is this computer that all the fuss is about

To some it is a dinosaur. From a recent Associated Press story comes a harbinger:

The PC’s role in Japanese homes is diminishing, as its once-awesome monopoly on processing power is encroached by gadgets such as smart phones that act like pocket-size computers, advanced Internet-connected game consoles, digital video recorders with terabytes of memory.¹

To others it is the savior of mankind. The MIT media lab project to build a $100 computer and make it available to children everywhere is one. To quote from the One Laptop Per Child web site (www.laptopgiving.org):

Our mission is to provide a means for learning, self-expression and exploration to the nearly two billion children of the developing world with little or no access to education. While children are by nature eager for knowledge, many countries have insufficient resources to devote to education—sometimes less than $20 a year per child. Imagine the potential that could be unlocked by giving every child in the world the tools they need to learn, no matter who they are, no matter where they live, no matter how little they may have.

And, of course, the opinion of those who brought us here In his article in the Christian Science Monitor reviewing the Fuchs & Woessmann work, MacDonald states:

With the rise of computers in classrooms, has come a glut of conflicting conclusions about the actual value computers bring to timeless tasks of teaching reading, writing, and arithmetic. For some in education, these results indicate how thoroughly this field of research has come to resemble that of the conventional wisdom about weight loss, which seems to shift with the tide. Yet others see hopeful signs of a maturing debate, where blind faith in the educational benefits of technology is giving way to greater appreciation for an understanding when computers are useful and when they’re not².

More like the book, me thinks.

The book in the end was the infrastructure upon which education, adventure, romance and the sciences of our time have been recorded and built. So we must look at the computer and its technological environment as infrastructure and not as foci of instruction or schooling beyond that concerned with basic literacy.

What this infrastructure is growing to be is a web enabled palm held devise for art, knowledge, communication and enjoyment. It is a vector for transmitting knowledge and culture to be facilitated in the educational system and not to be evaluated as the assessment of the paper, glue, binding or ink of books is left to the technicians and not to the educational evaluators.

¹ TABUCHI, HIROKO “PCs Losing Their Relevance in Japan” Associated Press 11.05.07
² MacDonald, G. J. “Contrarian Finding: Computers are a drag on learning.” Christian Science Monitor 12/6/04