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# Taxonomies of Educational Technology Uses:

Dewey, Chip & me

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## Abstract

In the early 1990's, Chip created a taxonomy of education technology uses, which I helped to expand and evaluate. This taxonomy is based on John Dewey's "four impulses of the child": inquiry, construction, communication, and expression. This taxonomy has helped people interested in the uses of technologies for education to better understand the range of uses and it has also helped spur the development of new uses.

Most of my joint publications with Chip have been centered around a taxonomy of educational technology uses that Chip created and that we jointly elaborated and tested (see <http://www.isrl.illinois.edu/~chip/pubs/taxonomy/index.html> ). This chapter will tell the story of the development and use of that taxonomy over the past 20 years. This story will illustrate something about Chip, about me, and even a bit about John Dewey.

I arrived at the University of Illinois, Urbana-Champaign in January 1986, which was quite a climate shock since we moved from San Diego, California. A hefty investment in winter clothing at our local sporting goods store allowed us to survive our first winter in East Central Illinois, while I adapted to the intellectual climate at UIUC. Given that my expertise was in new technologies for learning and teaching, that meant learning about PLATO and CERL (the Computer-based Education Research Lab), which was in its prime when I arrived in Illinois. PLATO was a computer-based education system developed by Engineering professor Donald Bitzer at UIUC in the early sixties, which grew to be a dominant force in computer-based education research and development through during the 1960's, the 1970's, and early 1980's. PLATO was a self-contained time-sharing system, with a central main-frame computer and special purpose Plato terminals. This was in the days before there was an Internet, hard as that is to believe these days. For example, when I arrived in Illinois in 1986 and wanted a new business card for my new position, I had to use the back of the card to list my multiple email addresses, since at that point, there was email, but you could only send email to those people using the same system. Figure 1 is a scan of the front and back of my first UIUC business card.



Figure 1: the front and back of my first business card at UIUC.

Note that one of the seven email addresses listed on the back of my business card was a PLATO email address – one of the lasting impacts today of PLATO is the variety of communication media developed to allow people using PLATO to communicate with each other.

The development of personal computers was underway in 1986, and my work at UIUC (and my previous work at UC San Diego) had explored ways to improve education with personal computers (Apple II computers, IBM computers, TRS computers, etc.) and with long-distance networks created by interconnecting these personal (or micro) computers with dial-up modem communication.

Chip arrived at UIUC in 1990, coming from BBN, a private research firm in Cambridge MA. Before he arrived, Donald Bitzer had retired, and the future of the CERL lab that created PLATO and which conducted research and development on its uses to improve education was being considered by the campus. Chip was appointed to the review committee. Now Chip had also done research into the uses of personal computers (and networks of personal computers) for education, as part of Project Quill at BBN. In fact, we had worked jointly on aspects of Quill. So Chip was well aware of the range of educational activities that even in 1990 could be done with personal computers, including the uses of word processors, spreadsheets, and data bases, for educational activities, and the development of distributed educational activities. The review committee talked with the people remaining at CERL, and there was a discussion about the future uses of technologies in learning and teaching. At that time, there were tens of thousands of hours of courseware developed for PLATO, but much of it was of the drill-and-practice variety and simulation games. In the course of discussing the variety of uses of technology for learning and teaching, Chip remembered a distinction that John Dewey had made about the "impulses of the child" for learning: inquiry, communication, construction, and expression (Dewey, 1956). Chip started to list the kinds of uses of technologies in education that fit within these four "impulses" and developed sub-categories with the four categories. But I suspect that the CERL folks were **not** convinced by his presentation of this first version of the taxonomy because in this first version, there was no place for the direct instruction uses that were so central to PLATO at that time.

Chip shared this initial taxonomy with me, which I found interesting, but I pointed out the lack of a place in the taxonomy for most of what PLATO consisted of. I suggested that teaching could be seen as a specialized kind of communication between the teacher and the student(s). We discussed various ways to think about the categories, then settled on the term "media" for the different categories in the taxonomy.

I was co-Principal Investigator of a grant from the National Science Foundation's Applications of Advanced Technologies program at that time, and had been to a PI meeting at which many of the PIs presented their work, so it occurred to me that a good initial "test" of the taxonomy would be to see where each of the technologies developed by the NSF-funded projects fell in our taxonomy. The majority of the uses fell into the "inquiry" category (43) with a substantial number in the "communication" category (27). Only a few uses fell into the "construction" category (3), and none into the "expression" category (Bruce & Levin, 1997).

We thought that distribution was interesting, but I was concerned about the scarcity of instances of two of the categories among these NSF-funded projects. I had been puzzled myself about what exactly was meant by "expression", but I reflected back on a workshop that I attended earlier at Asilomar (that Chip was invited to, but suggested I be invited instead) at which I described the micro-computer based network educational activities that I had been researching at UC San Diego. Also at that workshop was Donald Graves, an expert in writing instruction, and in several conversations about our respective work, I was puzzled by the way that our conversations seemed to be at cross-purposes. Graves kept referring to the importance of a student's voice in writing, while I kept emphasizing the importance of authentic audiences for a student's writing. In thinking about the taxonomy after this first paper, I came to realize that Graves' focus was on writing as expression, while my focus was on writing as communication.

Chip was asked in 2002 to revise a chapter he had published in 1991 called "Roles for computers in teaching the English language arts" for the *Handbook of research on teaching the English language arts* (Bruce, 1991). He wanted to revise that chapter using the taxonomy, so he invited me to join him in that effort. We came up with the plan to examine all the language arts software that appeared in the catalog of Sunburst, a top educational software publisher at that time, as a further test of the taxonomy. We found quite a different distribution of the language arts software uses across the four categories of the taxonomy. We found 17 software packages with a "communication" focus, 10 with an "expression" focus, and only 2 with an "inquiry" focus and 1 with a "construction" focus. Table 1, which appeared as Table 2 in that *Handbook* chapter (Bruce & Levin, 2003), compares the distribution of the language arts software uses to our earlier distribution of NSF-funded educational technology uses.

Taxonomy category	Language Arts Software in the Sunburst Catalog	NSF Science Education Projects
Inquiry	2	43
Communication	17	27
Construction	1	3
Expression	10	0

Table 1: Examples of educational software in each taxonomy category.

In thinking about the different distributions between the two different kinds of educational uses of technologies, we wondered whether we couldn't use the taxonomy to "predict" uses that didn't currently exist, sort of like the way that Periodic Table of Elements was used to predict new elements. Were there inquiry uses or construction uses of technologies for the language arts? Were there construction uses or expression uses of technologies for the sciences or mathematics? In the revised *Handbook* chapter (Bruce & Levin,

2003), Chip and I came up with a few ideas, but that remains a largely unrealized possibility.

About the time that chapter was published, I moved from UIUC back to UC San Diego. Chip had already embarked on his "Inquiry Page" efforts that have continued to this day. He has kept me informed of his progress, and I jokingly suggested that when he finished his work on the Inquiry Page, he could then move on to develop a "Communication Page" website, a "Construction Page" website, and an "Expression Page" website. In following his work at a distance of 2000 miles, I see that especially his recent work on Community Inquiry Labs (iLabs) is sort of a combination of Inquiry and Communication. So I fully expect that, given all his free time in retirement, we'll see more work from Chip on the other parts of the taxonomy of education technology uses, in ways that bring John Dewey's 20<sup>th</sup> century insights to bear on the world of the 21<sup>st</sup>.1 century.

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