The Emergence of a New Digital Divide:

A Critical Look at Integrated Learning Systems

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What is an Integrated Learning System?

The title integrated learning system (ILS) inspires many people to immediately conjure up an image of an ideal classroom where learning is not divided into subject areas or grade levels. With more thought, this ILS classroom is very systematic, a word that, to many, lacks a human touch. ILS use has recently come under fire for its claims of integrated learning and its systematic approach. Furthermore, use of ILS's is creating a new digital divide for students in the United States; one based on use of technology rather than access to it.

At first glance, an ILS seems to be a progressive approach to computer use in the classroom, but actually these programs are "misnamed integrated learning systems . . . True integration respects the interrelationships of the disciplines – language, mathematics, science – as natural and necessary to achieving the goal of becoming educated about a particular topic" (Davis & Shade, 1994). Instead of true integration, these systems offer basic facts and skills based on a

> neo-behaviourist model of learning which uses automatic task selection, guided practice and feedback to deliver core curriculum content and skills through individualised tutoring and practice. Although reminiscent of programmed learning, this family of systems has been brought up to date through the use of the new multi-media technologies and, more importantly, through the availability of faster, more powerful hardware to support the large data sets and many computations needed to monitor individualised work for students. (Wood, Underwood & Avis, 1999, p. 92)

The bottom line for ILS use in the classroom is that it has become an "increasingly popular approach to teaching basic skills in heterogeneous elementary and lower secondary classrooms" (Hativa & Becker, 1994, p. 113).

One serious criticism for the ILS's is an absence of any social interaction. "Stand alone teaching technology offers one means of separating the learning process from the irrationalities, vicissitudes and distractions of the social environment" (Skinner, 1968, as cited in Wood, Underwood, & Avis, 1999, p. 95). For some educators, this means a more effective way of educating students in basic skills. For others, it means the loss of the valuable social arena for learning.

> Although we doubt whether this radical separation of effective learning from the social context lies behind the design of all contemporary ILS, the basic conception of learning as a solitary process, best supported through individualised instruction is, we argue, consistent with their design. (Skinner, 1968, as cited in Wood, Underwood & Avis, 1999, p. 95)

Factors Considered in Pedagogical Choices Regarding Computers

Larry Cuban (personal communication, November 18, 1998) points out that successful educational reforms are those that work within the powerful traditions of education. For example, one tradition is that knowledge consisting of concrete subject matter can be broken down into discrete facts and given to students. He further cautions that advocates of technology in schools must look beyond the technology and must consider the broader school context. The ILS's that have been accepted into schools successfully fit into the traditional

instructional model although some computer advocates like to see them as successful tools in the larger school reform effort.

The reality of the very traditional ILS use in the classroom is lacking when focusing on student outcomes.

> Research suggests that when computers are used to reinforce traditional teaching practices, the result is only modest improvement in easily measured areas of student achievement. Moreover, the gains measured seem to dissipate with time, suggesting that novelty, rather than some more enduring quality, may be the decisive variable. (Benton, 1996)

What must be kept in mind is that even though the ILS runs on a computer in the classroom, that "educational media alone do not influence the achievement of students . . . Media permit the delivery and storage of instructional messages but do not determine learning" (Thompson, Simonson & Hargrave, as cited in Benton, 1996).

Because this distinction between what technology can actually offer instruction and what it is often reported to offer is oftentimes blurred, advocates of technology use in schools must be especially careful. "Sometimes computer use enhances learning for all students and sometimes it simply confers a new technological sheen on the low-level programs that have long been a staple of education in the United States" (Burnett, 1994). To avoid being dazzled by that technological sheen, educators and decision-makers must look closer and realize that "evaluations of educational technology are really evaluations of instruction

enabled by technology, and the outcomes are highly dependent on the implementation of the instructional design" (Coley, Cradler, & Engel, 1999, p. 5). The focus is slowly turning away from the capabilities of computer systems in schools and turning toward the effectiveness of instruction with and without computers.

Under this new scrutiny, the ILS's may align with some goals of education today, but they fall short of many others. As Coley, Cradler, and Engel (1999) put it, "Effective courseware needs to reflect the research on how students learn, be matched to national, state, or district educational standards, and be integrated into the teaching and learning activities of the classroom" (p. 5). This statement assumes that how students learn must be "matched" to educational standards, implying that the standards are driving education. Though this is true to a great extent, many would argue that the current educational system is not the best method for educating all students. Although computers are sometimes heralded as a reforming effort for education, the prevalence of ILS's in schools shows the easy success of a traditional instructional model. Where teachers get caught is between the school-provided ILS's and the expectations that they teach in a constructivist way using technology. "Any impact of [a specific ILS] on pupils' learning will not be understood without attention to the way in which the technology is assimilated into teaching and learning practices" (Wood, Underwood & Avis, 1999, p.91) and the best way to pay attention to the assimilation is to focus on the role of the teacher in the classroom.

The Role of the Teacher

Teachers are influenced by their own personal and professional beliefs, both of which have a direct effect on their teaching practice. For many teachers, innovation in teaching is not a part of their beliefs and practices, and they must "learn to re-think their craft, their basic pedagogical teaching approach, and their goals for students" (Becker & Ravitz, 1998, p. 3). Roy Pea (as cited in Benton, 1996) brings together teacher innovation and classroom use of technology when he states, "We know that technology may have important contributory effects to learning, but that they are crucially mediated by social practices in the classroom by teachers and students."

As teachers naturally innovate or learn to do so, they are very confined by certain factors of the greater educational system. The most prominent constraint is standardized testing. These traditional tests are looked upon as the assessment of the effectiveness of a teacher's teaching, but they "generally gauge mastery of discrete skills and factual knowledge, not whether students can solve complex problems, engage in sustained intellectual inquiry, work collaboratively, and analyze information from diverse sources" (Benton, 1996). In most cases, standardized testing mitigates teacher beliefs and affects teacher practices.

> Standardized tests exert a considerable conservative influence on teachers. To the extent that the current push for increased accountability on the part of schools and teachers leads to more emphasis on standardized test results, teachers may be inclined to use computers for drill-and-practice

> exercises to eke out whatever marginal gains in scores they can achieve, rather than in imaginative ways for which results may be more difficult to measure. (Benton, 1996)

Theories of Learning and ILS's

Since ILS's are designed based on a behaviorist theory of learning, these systems miss out on valuable parts of both constructivism and situated learning: collaboration, problem solving, use of multiple representations, and working in authentic contexts. "ILS designers appear not to have set out with such [learning] goals in mind" (Wood, Underwood & Avis, 1999, p. 103). Instead, Papert (1994 cited in Wood, Underwood & Avis, 1999, p. 102) claims that ILS designers create "not 'learning' in the sense of something the learner does but 'instruction', in the sense of something the instructor does to the learner." So as teachers are being told that they should reconsider themselves as guides on the side in order to increase student learning, they are handed ILS's that are the sages on the stage.

As the guide on the side, teachers are helping their students to solve problems for themselves. As the sage on the stage, ILS's use

> computer-generated speech, pictures and other graphics to help create problem scenarios and illustrations are simply not designed to help the learner to develop any knowledge and skills in the choice and use of the kinds of systems of signs and representations which they need to master in order to construct their own conceptual understanding. (Wood, Underwood & Avis, 1999, p. 103)

Many ILS's are billed as helping students to problem solve, but "if it is true that experience of ILS fosters or reinforces in the learner the idea that problem solving is about finding the one single, correct answer as quickly as possible, then they perpetuate a view of learning, and of good performance, which is, at best, a potentially dangerous half truth . . . Where time is spent in processes such as conjecture, planning, reflecting and evaluating there is some good evidence for positive effects on performance. Since feedback is a source of goals, any undue stress on being right and quick . . . risks distorting the learner's sense of what being a good learner is all about" (Wood, Underwood & Avis, 1999, p. 102).

The result of this model of learning is not an absence of learning; it is learning of a lower quality. Students should not look at problem solving as an accumulation of facts and skills, but rather as something requiring higher order thinking skills (Pea, 1993, as cited in Wood, Underwood & Avis, 1999). In addition to losing out on the opportunity to gain higher order thinking skills, students might also be losing out on valuable computer skills.

> Only when computers are integrated into the curriculum as a vital element for instruction and are applied to real problems for a real purpose, will children gain the most valuable computer skill – the ability to use computers as natural tools for learning. (Shade & Watson, 1990, as cited in Davis & Shade, 1994)

Also at issue is the inclusion of social interactions to increase and support learning. Becker (1992, as cited in Wood, Underwood & Avis, 1999, p. 100) argues

that “without the social interactions of meaningful interaction with the material required for personal knowledge construction opportunities for genuine learning are reduced” and that ILS’s are failing in this area.

ILS’s also appear to fail in helping students use the strategies that seem the most natural to them by expecting all students to follow the same path through instruction.

> Setting all children the task of learning one (or even a number) of externally set strategies of problem solving runs the risk of asking them to use methods which may be at variance with what comes to them more naturally . . . The importance of multiple representations and multiple strategies in conceptual understanding, explore the case that exposing learners to potentially new or alien strategies is not, in and of itself, a ‘bad thing.’ (Wood, Underwood & Avis, 1999, p. 101)

The designers of ILS’s are caught in a disconnect between a learning theory that values various ways of doing the same task and a computer design principle that demands they “use constraints so that the user feels as if there is only one possible thing to do – the right thing, of course” (Norman, 1988, p. 199). Since the designers have little knowledge of learning theory, they must apply what they know, which has a huge affect on students in the classroom.

ILS Effectiveness

Many studies offer statistics that show an increase in student achievement as a result of the use of ILS’s. Estep, McInerney, Vockell & Kosmoski (1999) claim

that these studies are generally biased, being completed by vendors or school districts with high financial attachment to a certain ILS. They further claim that such research is perhaps not scientifically sound and offer up their own study that involved the use of pairs of schools matched up by similar socio-economic status (SES) and cognitive skills index.

> These scores show no patterns of results that would suggest a causal impact; that is, the scores do not suddenly improve for the experimental group but not the control group when the ILS is introduced . . . Had this study used only the data from ILS schools the results would have 'shown' that the ILS was 'effective.' However, when the results from the control (non-ILS) schools were considered, these 'advantages' of the ILS vanished. (Estep, McInerney, Vockell & Kosmoski, 1999, p. 9)

The Role of the Teacher in ILS Implementation

Davis and Shade (1994) go so far as to call the teachers' role in computer implementation in their schools critical. Although they were looking at implementation in general, the same may be said for ILS implementation. Mevarech (1991, as cited in Hativa & Becker, 1994, p. 115) tweaked the vendor recommendations and implemented an ILS in schools using pairs of students working on a single computer. This study found that "ILS paired learning led to better outcomes in basic skills as well as in cognitive processes." These results suggest the strength of student collaboration while using an ILS, thus supporting

the idea that a teacher's ILS implementation might make up for the elements which are lacking in the system.

> Osin et al. found that high and low achievers progressed faster than the medium-achievers in their ILS work. This result is explained by the suggestion that most regular classroom instruction addresses the class average, and the better and less talented students do not get instruction that fits their needs. (Hativa & Becker, 1994, p. 116)

Again, research has shown that the teacher has a decisive role in how computer technology will be used in the classroom and thus how effective it will be. Hativa and Becker (1994) confirm this and emphasize their point: "The level of integration of the ILS work in to classroom instruction was identified as crucial for attaining beneficial learning outcomes . . . [as] necessary for a mindful use of the ILS." (p. 114)

Individually-Centered Learning Environments

In addition to not being mindful of learning theories, ILS's do not account for learning differences among multicultural students. Hativa and Becker (1994) find that "human participation -- teachers, adult aides, older students, etc. -- is essential for helping students with limited reading-comprehension and limited self-learning strategies and motivations to progress in their ILS work and to learn with understanding" (p. 115). They point out that teacher intervention is the only way to make an ILS an appropriate and effective learning tool for all students.

According to Chisholm (1995), consideration must be also given to students' cultures since "teaching that supports students' cultural preferences improves academic achievement." For example, "the literature on learning preferences of African-American and Mexican American children suggests that they tend to prefer working with others and generally value cooperation and social interrelationships. They also seem to prefer holistic learning" (Chisholm, 1995). These important aspects of learning for these groups of children are completely ignored by ILS's. In fact, Chisholm (1995) further notes

> the computer culture and the native culture of many students in our classrooms are sometimes at variance . . . Because children differ in their needs, equitable access to educational computing means access to the same *type* and *quality* of software, hardware, and activities.

Looking at ILS's through a lens of multicultural learning environments quickly shows them lacking in providing equitable types of learning for all students.

Influences on Computer Use Outside the Classroom

The teacher may have some measure of control over the implementation of an ILS in the classroom, but other factors play a role in getting the proper ILS implementation to all students. One of these factors is community beliefs.

> Across socioeconomic classes, schools and teachers may operate under very different assumptions as expected skills and future workplace expectations vary . . . 'Progressive' or constructivist educational reform may also be primarily advocated in upper-middle class communities

> rather than in more 'practically-minded' working-class communities. (Becker & Ravitz, 1998, p. 8)

For this reason, students in some communities may not be exposed to effective ILS usage due to community norms and resulting pressure on teachers.

Along with community mores, certain norms of the educational system influence to which type of implementation these different groups of students get exposed. One such norm suggests that the better teachers teach the better students. This alignment can happen when teachers choose districts:

> Teachers who are prone to reflect intellectually upon their job themselves may have been disproportionately recruited to teach in more educated communities and assigned to teach classes of more highly performing students. Thus, the unrepresentative sample of classes engaging in new forms of teaching and learning may itself increase differential accomplishments among students, merely as a result of the atypical location of the innovating teachers within the social structure of American schools and school systems. (Becker & Ravitz, 1998, p. 3)

A similar alignment occurs within schools, again offering the norm that the better, or more innovative, teachers teach the higher-level students.

> The teachers who teach successful students may be predisposed to experimentation and innovation, while those who are accustomed to working with lower performing students may, for whatever reason (their own bias or external pressures), be inclined to pursue traditional methods,

> including those geared toward increasing test scores. (Becker & Ravitz, 1998, p. 5)

Because of this discrepancy, steps must be taken to establish effective ILS implementation practices with all students. "[Teachers put more trust and give more responsibility to high achievers] Thus, without substantial effort to target younger students, lower-track classes, or non-college-prep courses, opportunities may be directed much more towards more successful students and their classes" (Becker & Ravitz, 1998, p. 3).

The New Digital Divide

This difference in implementation of ILS's in schools is resulting in a new digital divide – one not based on access to technology, but access to effective learning with technology. "[The Tomas Rivera Policy Institute's] analysis found that the true gap is not in the quantity of computers used by students; rather it is the quality of technology access that has the greatest impact" (Rivera Institute, 1997). As with any reform there are great differences in access to quality learning with computers among schools, but the concern grows even greater when looking within classrooms. "In terms of pupil achievement levels, the within-class differences due to variance in pupil capabilities are much higher then the interschool difference due to SES" (Osin, Nesher & Ram, 1994, p. 63). This new digital divide, based on access to good learning, is dividing students based on ability, culture, and SES.

Many assumptions on the part of communities, decision-makers, and teachers are contributing greatly to this new divide. The Northwest Educational Technology Consortium (2000) offers the following assumptions, which contribute to patterns of computer use that promote inequality:

- Children with special needs require drill on the basics before they are capable of moving on to higher-order thinking or problem solving (programming) activities.
- Integrated learning or computer-managed instructional systems are the best way to use computers with lower-achieving students.
- The primary benefit of computers for low-achieving students is mastery of basic skills. (NETC, 2000)

They also point to stereotyping that seems to exist among educators.

> Often unconscious stereotyping on the part of educators keeps them from challenging ethnic minority, lower-income, differently abled [sic], and female students academically. Within schools, research shows that different groups of students use the computer in different ways. This indicates that school staff my play a role in perpetuating inequities. (NETC, 2000)

These assumptions lead to inequitable use of computers within each classroom. "The lower-ability and middle-ability classes used computers primarily for drill-and-practice and tutorial computer-assisted instruction, while the upper 10% of

classes used computers for a more diverse array of learning activities including computer programming" (Becker & Ravitz, 1998, p. 3).

The Educational Testing Service (ETS) offers up their own data on the differences among students in using computers in the classroom.

- Black and Hispanic fourth graders were more likely than White and Asian students to report using computers almost daily.
- Fourth graders receiving Title 1 services and those attending rural/small town schools were more likely to report daily computer use than other students.
- Twelfth graders receiving Title 1 services and those attending rural/small town schools were more likely to report daily computer use than other students. (Coley, Cradler, & Engel, 1999, p. 3-4)

It appears from these statistics that computer use among these ethnic or low SES populations is high. When looking closely at the facts, a disconnect appears. "Students from minority groups were less likely to have courses or experiences in word processing and computer literacy, and less likely to use computers in English courses and to solve problems in mathematics and natural science" (Coley, Cradler, & Engel, 1999, p. 4). The question then becomes, how are these populations actually using the computers. The answer to that seems to lie in ILS's offering independent drill-and-practice exercises.

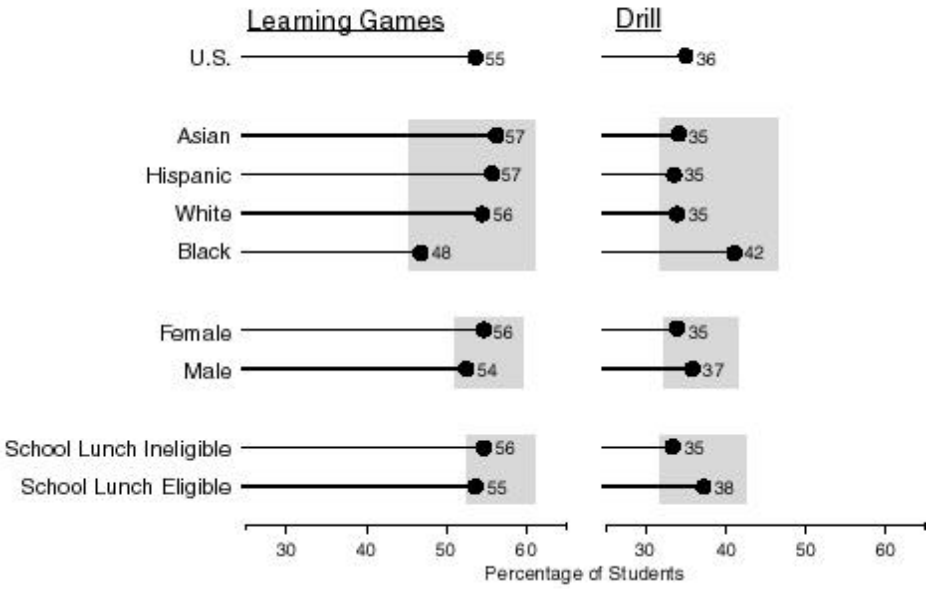

Figure 1. Percentage of fourth graders whose teachers report learning games and drill as primary computer uses (Wenglinsky, 1998)

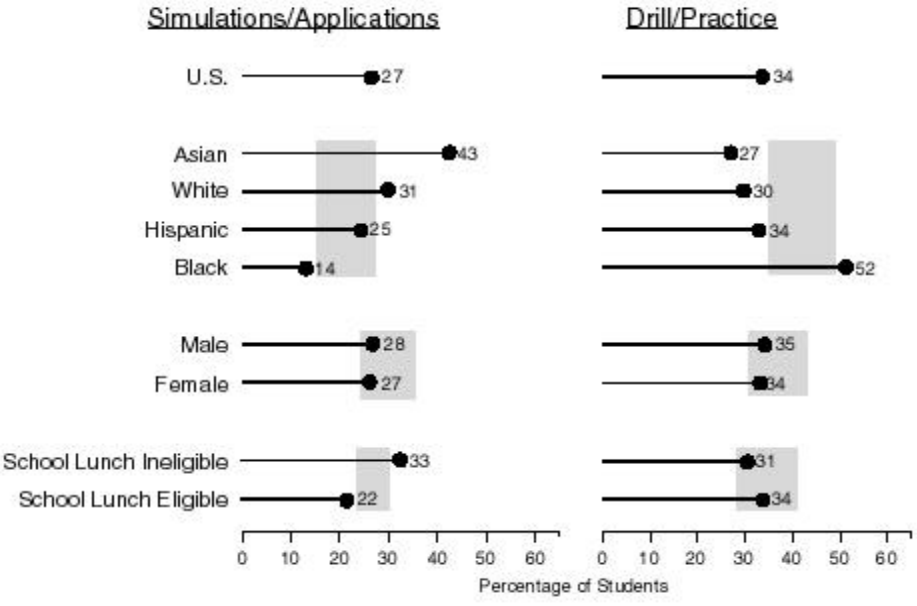

Figure 2. Percentage of eighth grades whose teachers report learning games and drill as primary computer uses (Wenglinsky, 1998

Where this Divide is Leading Students

> Early researchers saw this problem on the horizon and feared that economically disadvantaged students, who often use the computer for remediation and basic skills, learn to do what the computer tells them, while more affluent students, who use it to learn programming and tool applications, learn to tell the computer what to do. (Watt, 1982, as cited in Neuman, 1991)

More specifically,

> many students become familiar with information technologies in a general sense. But those who cannot claim computers as their own tool for exploring the world never grasp the power of technology. Such students become passive consumers of electronic information -- usually in front of the television. Once out of school, they are relegated to low-wage jobs where they may operate electronic cash registers or bar-code readers. They may catch on as data-entry clerks, typing page after page in deadly monotony. They are controlled by technology as adults -- just as drill-and-practice routines controlled them as students. (Piller, 1992, as cited in Benton, 1996)

What this means to educators, as well as the general public, is that perhaps the use of computers in schools merely to increase basic skills is not preparing students for the technologically advanced future ahead of them, although that is the message that echoes in schools across the country.

What Can and Should be Done

Everyone involved in education from the public to the classroom teachers must acknowledge that "despite the promise of emerging technology, it is important to remember that technology and equity are not inevitable partners" (Neuman, 1991). Specifically when considering the use of integrated learning systems in schools,

> either one concludes that such systems have no place in the classroom at all, or one accepts that they must be integrated alongside other teaching and learning practices if they are to make a significant contribution to learning with understanding. (Wood, Underwood & Avis, 1999, p. 103-104)

If schools agree to drop ILS's from their computer integration plans, they must still be aware of potential equity problems surrounding other uses of technology. Should schools decide to keep ILS's, they must insure that the integration of such systems is done in as equitable a manner as possible and in a manner that promotes the most effective learning for all students.

For decision-makers, the issue at hand should be the equitable use of computers for all students, specifically low ability students, minority students, and students from a low SES background. They should be sure to account for equitable use among districts and schools. They should also keep an eye on what is happening to these populations in individual classrooms because

> it is very clear that, after many years of considering disadvantaged schools as the main problem in the educational system, and investing resources accordingly, national policy should now grapple with the problem of individual difference which, as we saw, exist even in the 'best' school. (Osin, Nesher & Ram, 1994, p. 63)

For teachers the solution seems to lie in effective integration of any computer system into the classroom. "The use of any such ILS will need to be integrated with other teaching and learning practices that are designed to meet such ends" (Wood, Underwood & Avis, 1999, p. 103). Teachers can seek out or demand training to assist in this process. That training must focus on equitable and effective use of a variety of technologies in the classroom. Chisholm (1995) offers some suggestions to teachers about how to begin to close this new digital divide: "Assigned task rotation, student self-selection of activities, plus teacher-assigned activities ensures that all students have comparable experiences and opportunities to work at the computer."

For the designers of integrated learning systems, attention must be paid to how students learn best, as well as what is being taught in the classroom. "One reason why ILS is proving less effective than conventional teaching may result from poor alignment between what is learned on the system and what is demanded by the curriculum. If what pupils are learning is not assessed in examinations, then the negative impact would be a signal for changes in the content of ILS materials rather than a rejection of the technology altogether"

(Wood, Underwood & Avis, 1999, p. 99). There is hope that an ILS can be effective for student learning, but before any redesign processes begin, “We need to start reconceptualising the design of tools to support individual learning” (Wood, Underwood & Avis, 1999, p. 95).

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