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Developing the Digital Mind: Challenges and Solutions in  
Teaching and Learning

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Abstract

This paper explores the issues and challenges associated with the transformative nature of digital media and devices on teaching and learning. It proposes that current students may think and process information differently from their teachers and suggests that we adopt the term *digital mind* as a way to explain this phenomenon. It explores the relationship of societal changes to the learning styles of current students and suggests possible ways to develop classroom activities to accommodate the learning styles associated with digital minds.

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## Developing the Digital Mind: Challenges and Solutions in Teaching and Learning

### **Introduction: From Analog To Digital**

In his book *Being Digital*, Negroponte (1995), spoke of the fundamental shift in the way we deal with information as we move from an analog world to a digital world. We are no longer moving atoms (building blocks for physical matter) mechanically through ground or air transportation. Now we are moving bits (building blocks for digital content) through wired and wireless networks. As an example, consider how this paper is produced. Instead of us writing drafts by hand and typing this paper on single pages and taking the printed page (the atoms) and mailing it to the editors through mechanical transportation, we word process this document and send it to them in bits through electronic mail. This change in procedure can change the way we think about writing. On a practical level it gives us more time to write it because we don't have to plan in time for the postal service to process and deliver it. And on a conceptual level the way we think about writing has changed as well because our drafts are actually the same file as our final paper. Our students today do not understand this shift. In their world it has always been possible to word process and send a file electronically.

Some have called the children growing up today "The Millenials" (Yahoo, 2003; Strauss & Howe, 2000). They note that these children are different in many ways from preceding generations. "On a typical day, a young person selects from 200+ cable television networks, 5,500 consumer magazine titles, 10,500 radio stations, 30 million+ websites and 122,000 newly published books (Yahoo, 2003 p.1). The millenials live and thrive in a sea of information. They encounter as much information in a single year as their grandparents did in an entire lifetime (Cetron, 1988). They are accustomed to information becoming obsolete, to having to constantly update their knowledge, and to sharing their knowledge instantly and virtually.

For adults who grew up in a strictly mechanical, analog world, this is a change. It is one we can adapt to, surely. It is one we can learn, obviously. But for children today, the strictly analog world has never existed; a digital world has always existed. While we, as adults, may ultimately and with effort grow to understand this new digital world so well that it becomes commonplace to us, our children will not have to. And the reason they will not have to is because they will not have to shift their understanding. What we work to learn and understand they simply experience and use. Prensky (2001a) provides a useful articulation of this phenomenon. The adults are *digital immigrants* and our children are *digital natives*.

## Digital Immigrants and Digital Natives

Marc Prensky's (2001a) terms *digital native* and *digital immigrant* resonate with many people. It is a phrase that has meaning because it is an analogy we understand. Natives think in their birth language; immigrants must translate. Digital immigrants must translate their understanding of the digital world in analog terms. One clear example is that digital immigrants may think of word processors as being like a typewriter, but digital immigrants have no memory of a world where inserting a sentence or correcting a spelling error meant retyping a page or an entire document. Word processing is all that they know.

Digital natives neither translate, nor learn digital technology. They understand the digital world because it is their world period, and they don't have to learn it, they only have to experience it. Prensky (2001b) goes on to say that because of the way that they experience the world, the way that they think is fundamentally different than the way we think.

If this is true, that digital natives and immigrants process information differently (and we think that there may be some truth here) cognitive development could be different for digital natives than for digital immigrants. And if cognitive development and cognitive processing are different for digital natives and digital immigrants, then we may need to rethink the way we, as digital immigrants, teach digital natives. As educators we find ourselves working with people who definitely have different expectations about the world than we do, and who may actually process information differently than we do. It may be appropriate to say that we as educators are speaking one language while our students are speaking another. We must find a way to communicate with what we call the *digital mind*.

### *Digital Minds*

Digital minds may process information and learn concepts differently than we do because they see the world from a digital perspective. This digital perspective can manifest itself in the way we view timelines and due dates, when we expect grades and feedback, and in the ability of digital natives to multitask in a classroom environment. Norman (1993) speaks of the difference between reflective cognition (deep thinking and processing) and experiential cognition (reaction to stimulus). An example of reflective cognition is the classic writing of a paper such as this one. You read materials, assimilate what you have read and accommodate it to what you already know, and then present a, hopefully, cogent synthesis of this information. Policy analysts do this on a regular basis. An example of experiential cognition is driving a car. Stimulus comes at you quickly and you respond to it automatically. Your reaction here is not based on intuition, but rather on preparation. You know what you know so well that you can react to situations easily. In reflective cognition there is time to think through problems at relative leisure. In experiential cognition one typically reacts quickly based on experience through repeated trials. Everybody practices both types of cognition regularly, but the move from an analog world to a digital world could be preparing digital natives to favor experiential environments over reflective ones.

Prensky (2001b) suggests that digital natives are better at experiential cognition, and that digital immigrants are better at reflective cognition. Specifically he feels that digital natives are better at experiential cognition because they grew up in a world with computers, instant access to information, and video games. Digital immigrants, on the other hand, grew up in a world of libraries, card catalogs, and long waits for communication. A key difference between digital immigrants and digital natives comes in our expectations on how the world works and how we react to it.

### *How Do Digital Minds Learn?*

One group of people who could be considered the first digital natives would be Generation X. This group of adults born roughly between 1961 and 1981 were one of the first groups to grow up with digital devices (Brown, 1997). While subsequent generations may have even greater reliance on the digital world, Generation X provides an early look at this phenomenon. In an early look at Generation X, Brown (1997) found that the gap between Generation X and earlier generations was more than age and technological differences and that these differences could impact learning.

Table 1

*Life experiences of digital natives and how it can impact teaching and learning. Adapted from Brown (1997).*

<i>Generation X/Digital Native Life Experiences</i>	<i>How It Impacts Ways Of Learning</i>
Having grown up with both parents working/furthering their education, Xers are used to getting things done on their own.	Xers tend to be independent problem solvers and self-starters. They want support and feedback, but they don't want to be controlled.
Because many of them grew up with computers, video games, microwaves and cordless devices, Generation Xers are technologically literate.	They are familiar with digital technology and rely on the immediate access of media when looking for information.
Conditioned to expect immediate gratification, Generation Xers seek immediate response. They also use technology to facilitate immediate response.	They crave stimulation and expect immediate answers and feedback via mobile phone, email, IM or other devices. They also expect instant feedback on assignments in class.
Skeptical of society and its institutions, Generation Xers are focused on specific problems that are relevant to them.	As learners, they don't want to waste time doing busy work or repetitive tasks to facilitate knowledge acquisition; they want their work to be meaningful to them. They want to know the relevance of an assignment before they do it.
Knowing that current economic conditions require them to be vocationally flexible, they must keep learning to be marketable. Generation Xers are lifelong learners.	They do not expect to grow old working for the same company, so they view their job environments as places to grow. They seek continuing education and training opportunities; if they don't get them, they seek new jobs where they can.
Generation Xers are ambitious and started many of the dot com companies of the 90's.	Generation Xers take chances on new ideas and are more likely to do trial and error as part of the activity.
As illustrated by their involvement in extreme sports such as bungee jumping and sky surfing, Generation Xers are fearless.	They are risk takers and self starters.
Generation Xers are used to juggling ideas and devices, such as talking on the phone while working on the computer or driving.	Generation Xers are able to multitask in the classroom. (This is often mislabeled as inattention to the task at hand, but it is really the ability to do parallel processing).

## Problems With Technology In The Classroom

Driscoll (2002) relates a story that is familiar. A 14 year old boy downloaded a program for a TV remote control to his Personal Digital Assistant (PDA) and took it to school. Being 14 year old boy, he proceeded to turn the TV in the corner of the classroom on and off. The teacher was annoyed and, being a teacher, eventually figured out who was doing this and what was going on and sent the young man to the principal's office. The principal of the school was under pressure from the teacher to "do something." But rather than use this as a teachable moment by having the student use his powers for good and not for evil, as it were, the principal took a different approach. He banned PDA's from the school. Driscoll is not intending to malign the principal but rather is pointing out a very real issue: technology integration issues are complex, and not just from the perspective of professional development or return on investment. The introduction of technologically advanced devices can pose problems for schools. Digital natives rely on these devices. Many students in k-12 and college classes are using PDA's to manage their day, to take notes, to manipulate data, and to do classroom and homework. They are also using them to beam messages to each other during class, play games and, at times, to cheat.

Consider the mobile phone. Because of issues of personal safety and busy lifestyles, many parents need for their children to have phones. They want them to have them for emergencies; they need to have them to call home after orchestra rehearsal or soccer practice. So schools have allowed phones. A CNN report (CNN, 2003) told the story of students who have memorized the keypads on their phones so well that they can text message by feel with the phone out of sight under the desk or table. Teachers and administrators in the schools are conflicted. The introduction of these devices into schools may have potential, but at the moment, in the current school environment, they can be a distraction for the student and cause issues of safety and security within the classroom environment.

Historically in schools if a student brings something to class that becomes a distraction, the item is taken away from the student. The item may be kept for a day, for the year, or until a parent comes to the school to pick it up. This technique may work if you are talking about a \$3.00 Yo-Yo, but if you are talking about an electronic device that costs over \$100 then it likely will not. Taking the device away, even if the student is using it inappropriately, is likely to raise the ire of somebody.

But if they can cause problems they can also provide solutions. PDA's and cell phones today are marvelous tools that can take pictures, access web sites, and provide desktop computing power in the palm of one's hand. Technology conferences (such as that held by the International Society for Technology in Education) provide entire strands on hand held computing. Software now exists to enable handhelds and cellular phones to support science probes and music editing software. These devices are becoming a common part of society, and ultimately they will become a common part of classrooms. Georgia State University provided classrooms of fourth and fifth graders with PDA's in an exploratory study (Harmon & Gropper, 2003). The results were quite encouraging. Students in both grades quickly become proficient at the technology and integrated it into their school life. At the study's end most of the student's found the PDA's so useful that they bought their own.

Technology in schools no longer means simply the computer, as defined as the big box sitting in the lab. But mobile, ubiquitous computing will be difficult to implement in existing classrooms, not only from a technical standpoint, but because the culture will need to change in order to support its implementation. Part of changing the culture of the classroom is to change the strategies that are used in the classroom. We would like to offer some suggestions on how to do this.

### **Strategies For Teaching The Digital Mind**

As mentioned earlier, one reason that the digital mind exists is because of a change in culture. As digital technology becomes more commonplace in our culture writ large, then the way we think about the world changes. The classroom could be considered a microcosm with which to deal with these issues.

As the world shifts and our attitudes shift, then how we think will shift. If all of this shifting is going on, how can we build environments to support learners? Shift happens.

Brown (1997) suggests that for effective instruction of people who think differently than we do we must be able to step outside of our personal experiences and into the world of the learner. We must be able to engage the learner to make a commitment to learn. To do this with digital minds we do not necessarily have to involve devices (though it helps). What we do have to do is to accept some of their life experiences. The following list of suggestions for doing this draws on ideas from Brown (1997) and Driscoll (2002):

1. *Focus on Outcomes Rather Than Techniques*  
Provide students with opportunities to put information to work. Allow them to do something and not just to know something. Reality based learning, learning in context, situated cognition, and problem-based learning are strategies that should resonate with digital minds.
2. *Provide Options for Learning*  
Universal Designs for Learning (O'Neill, 2001) suggests that students will excel with options in learning. Multiple options to express learning, multiple representations of content, and multiple ways to engage learners will help digital minds in the classroom.
3. *Respect Parallel Thinking and Multitasking*  
People who grew up with the World Wide Web, mobile phones, MTV and video games are used to dealing with many streams of information coming in at one time. And while we, as teachers and digital immigrants, may see it as disruptive, they really can do more than one thing at a time in class.
4. *Highlight Key Points*  
New learners are surfers and scanners. While we had limited sources for writing papers they essentially have every library in the world available to them. They make decisions quickly based on formatting elements such as side heads and highlighting. We must provide them with cues they recognize *and* help them to slow down and process when needed.
5. *Involve Learners in Setting Learning Goals*  
Provide them a role in establishing learning goals, building the learning

- community, setting up the rules for the class and in writing the rubrics that will be used to judge their performance.
6. *Provide Active Learning Environments*  
Allow learners to use whatever tools they may need in an assignment. Allow them to play to their strengths, be it media production or artistic expression in assignments and activities in appropriate ways.
  7. *Allow Learning to be Social*  
We have long recognized the importance of working in groups. It builds social skills and provides students with the ability to work in the type of environment they will be working in as adults. Working in groups means that people will need to talk, discuss and interact, activities that are typically discouraged in most classrooms.
  8. *Provide Opportunities for Reflection*  
Lest we think we must only allow people to do things that are fast moving and lack depth of processing, we must provide digital minds not only with the time to reflect, but the requirement to reflect.. We should provide opportunities for both experiential and reflective cognition.
  9. *Provide for Changing Realities.* Technology changes how we do things. Take writing, for example. While we may have been taught to write by doing multiple drafts, this may not make sense to today's learners. Because on a word processor everything can be a draft, the concept of doing multiple physical drafts of a document is not something they can see the need to do immediately. We still think they need to do drafts, but we may need to redefine what we mean by drafts.

### **Conclusions**

Many people have speculated that the influx of digital media and devices will change the way that people interact with the world (Prensky, 2001a; 2001b; 2002; Negroponte, 1995). Examples such as word processing (many people can't imagine writing without it), email (getting responses to questions in minutes, not weeks), and the Internet (instant access to information on just about everything) are but a few of the things that bear out this speculation. We recognize that our lives have changed. Extreme Luddites aside, most people would argue that these changes are beneficial. They help us to put more time into writing; they keep us in touch and provide us with current, up-to-the-minute information. We agree that this is true and are advocates for digital media. But it is possible that what is changing is not just convenience. As mentioned earlier, it is possible that the way we think is changing. It is possible that the way that children process information is different today than it was ten years ago. At this point this is supposition, or intuition, or possibly even a suspicion based on what we know about cognition and the way the world has changed. What we need to do is to confirm these suspicions. The authors are in the process of studying, through qualitative observations, the difference between how adults and children learn to use new devices and pieces of software.

Of course one of the great things about being an Educational Technologist and writing specifically about issues in digital technology and learning is the opportunity to speak about new and unique devices that exist and to speculate about what the future may

hold. We are perhaps at the beginning of the next great chapter in human learning and instruction. Let's make sure we are reading the right book before we turn the page.

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