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Editorial

Alternative Paradigms

Donald G. Perrin

In good times we continue to build onto paradigms that made us successful. Changes in the world around us can invalidate those paradigms. Drucker gives some amazing examples in his *Theory of the Business* (1992). Joel Barker (1992) talks about *Paradigm Paralysis* where we continue in the old way with blind disregard, and *Paradigm Pliancy* where we question our paradigms and consider possible alternatives. In times of stress, people and organizations are more open to experiment and try paradigms that show promising results. We are approaching this point in education. We are not ready to abandon the old paradigm, but it is exceedingly painful to find resources to keep it going. The option of preparing smaller numbers of students because of the bad economy is counter-productive to our future needs, so what are we going to do?

The first paradigm I would challenge is that everything has to be learned as part of a *course* or *program*. New industries have developed that enable people with limited skills to buy complex systems they assemble for themselves – like desks, book cases, and office chairs, or install by themselves like computers, software, and networks. Step-by-step instructions, diagrams, and a checklist make instruction of the traditional kind unnecessary. The backup phone or internet connection is rarely needed. The result is substantial cost savings for the manufacturer, who can grow a bigger and more profitable business, and for the customer who gets affordable goods and services. Once I was at a faculty retreat where several hundred people had to be fed breakfast. The dining room had one person to set up and prepare food and one person to clear tables. The high point of the breakfast was individually made waffles with fresh strawberries. A simple sign told you how to use the waffle maker and prepare your own. The waffle maker became a social center like the water cooler. Everybody helped each other to prepare a delicious breakfast.

The second paradigm I would challenge is learning in the classroom. This solves management problems when working with young children, but for all of our attempts to make classrooms attractive and data rich, they are an intellectual desert compared to the world outside. In industrialized countries, homes have superior communication options to most classrooms with one or more audio record/play devices, radio, television, computers, internet, and multimedia cell-phones that encompass all of the previous options for adults and children.

The third paradigm I would challenge is traditional teaching - a lecture or instructor-led discussion. This tends to be one-way communication dominated by the instructor. Voice is one of the slowest means of communication, typically about 250 words per minute (wpm). The bandwidth for 30 or more people in the learning space is limited to one 250 wpm channel of communication at a time. Print is faster, audiovisual is richer, and interactive learning is more motivating. You can increase the amount of productive communication and learning that takes place by breaking into smaller groups or having learners work one-to-one with each other or with interactive technologies. We have tools that can double or triple individual learning yet 98% of instruction that takes place in schools and higher education is lecture-demonstration-discussion.

The fourth paradigm I challenge is the curriculum. Its roots are in the past, it rarely encompasses the present, and it is ignorant of the future. Our mission is to prepare learners for an emerging world and society. Do we really give them the knowledge, skills, attitudes, and higher levels of learning that will make them successful in this ever changing world? Can our graduates anticipate paradigm changes, recognize them when they occur, and change successfully in ways that will make them healthy and productive citizens? Do we need to change our paradigms for teaching and learning, curriculum and instructional design, and management of the educational enterprise?

Editor's Note: We immediately categorize almost everyone we come in contact with, including our immediate family. However, distinction between "artistic" and "analytical" have been documented since Plato and Aristotle and bear a close resemblance to the classical description of dissimilar minds and learning propensities. The editors are intrigued and cautious about the conclusions and inferences.

Digital Natives vs. Digital Immigrants: Myth or Reality?

Ravi Rikhye, Sean Cook, Zane L. Berge
USA

Abstract

Marc Prensky (1998; 2001a; 200b) argues that students today, *digital natives* as he calls them, having grown up in the Digital Age, learn differently from their predecessors, or *digital immigrants* as he terms them. As such, the pedagogical tools we use to educate the Natives are outdated. Intuitively it seems that Prensky is correct: few people who teach digital natives fail to note their students seem to think and learn differently. Attractive as this thesis is, there is little evidence to support the proposition. That does not mean Prensky is wrong. He is onto something, perhaps something seminal, regarding today's pedagogies and the need to change them. But further research is required before we can conclude with any certainty that digital natives learn differently.

Digital Natives vs. Digital Immigrants: Myth or Reality?

Teachers or trainers of today's students realize at some point that they do not understand how many young students learn, or at least how they prefer to learn. Most do not analyze and articulate this realization. Few resolve to understand the apparent communication gap, and fewer still attempt to bridge it. Prensky is a pioneer in attempting to define the gap. If he is right, someday he may be considered a revolutionary thinker who alerted us to these notions. Our entire educational system—primary, secondary, and tertiary—may utilize pedagogies very different from those developed for the Industrial Age model of education, which in many ways is still used today.

Unless the language gap between the natives and immigrants is closed, or at least narrowed, it is possible that the greater part of teaching efforts will be misdirected and ineffective. We are wasting the organization's resources, whether teaching in formal education or in the workplace (Barnes, Ferris, & Marateo, 2007; Bennett, Karvin, & Maton, 2008). It is likely that global expenditure on education overall is ~\$3-trillion.¹ Significant wastage of this money is hardly a trivial concern.

The difficulty with Prensky's propositions is the astonishing lack of research supporting them. Given the importance of the thesis, one would think that seven years later a respectable body of research would permit definitive expositions of the gap along with suggestions for further research and suggestions on closing the gap.

This paper reviews literature regarding the brain and learning, showing that digital natives probably learn differently from digital immigrants. A literature search on the thesis that digital natives learn differently reveals no significant empirical evidence to support it. Our first approach

¹ For brevity, we do not cite sources for the following figures. In the US K-12 sector alone, we are approaching an annual expenditure of \$550-billion, which equates to ~5% of the GDP. We do not yet have a good estimate for tertiary, corporate and government training/education, but if we assume as a very broad generalization that the world GDP is ~\$55-trillion¹, and assume that the percent of global GDP spent on all these forms of education is 6% (back of the envelope calculation), we are looking at total education spending of ~\$3-trillion/year.

to this subject was to examine both the pros and cons of Prensky's thesis. On attempting this, however, we found that persons on both sides of the argument use "common sense," meaning neither those supporting or denying Prensky's theory have empirical research to support their position.

The Environment Affects Brain Wiring

The environment affects our perception of the world, and in turn, our perceptions affect the way in which we shape our world. For decades the only way in which we could "see" into the brain was by the use of psychology and psychological experiments. The experiments were analyzed using statistical science. These were the tools employed by educational giants of the 19th and 20th centuries, (for example, Bandura, Dewey, James, Montessori, Paiget, Skinner, Vygotsky). In a sense, the psychology/physiology of learning was like astronomy. Astronomy is a science in which we must rely entirely on remote observation. Just as we cannot visit Alpha Centuri to determine its physical characteristics, scholars had no direct way of knowing how the brain worked.

With the development of brain scanning tools in the past 30 years, and with the continuing emergence of increasingly powerful tools, we can finally prove the proposition that environment affects our brain wiring. A few examples suffice.

Neurons in Brains from Childhood to Maturity

Neurons connect our brain cells and are the wiring of our brains. In a newborn's brain, the connections between brain cells are sparse. As the individual grows to maturity, the connections multiply and thicken to become hugely complex networks akin to national highways, state highways, urban/rural roads, streets, and paths. The construction of the wiring depends on our experience.

Post-Traumatic Stress Disorder (PTSD)

Trauma can almost instantly and permanently change brain-wiring patterns. If exposed to traumatic stress and left untreated, the brain's wiring patterns can be changed for a lifetime (National Institutes of Mental Health, 2008, *para* 1).

Plasticity of the Brain

Early, critical periods exist during which the brain is wired/rewired on a large scale. As an animal matures, there are certain critical periods early in development during which brain plasticity is highly active. By the time the animal reaches adulthood, plasticity is greatly reduced (Howard Hughes Medical Center, 2002, *para* 16). Also, brain wiring changes every day: up to 20% of synapses disappear, to be replaced by new ones, leaving the overall synaptic density the same. Thus, the brain's size and wiring is an ever-changing landscape. Not just the wiring, but also the physical brain itself keeps changing from birth to death (Sowell et. al., 2001).

Contrary Ideas Regarding Brain Wiring

"Experience-wires-the-brain" is not universally accepted. Some argue that brain wiring is inborn, "with experience acting merely to preserve and enhance existing connections" (Duke University, 2000). Currently, however, the mainstream theory is that experiences matter regarding writing/rewiring the brain.

The problem the brain wiring research creates for analysis of Prensky's idea is: how do we get from here to there? Brain wiring is affected by environment; so digital natives have different brain wiring from digital immigrants. How does this translate into Prensky's thesis that natives learn differently than immigrants? The difference must be addressed.

The Literature on Natives vs. Immigrants

Tapscott (1998), the author of the influential book *Growing Up Digital*, is a pioneer in the idea that digital natives learn differently from digital immigrants. He spoke of Broadcast vs. Interactive Learning. In many ways, some suggest that Tapscott initiated the idea, while Prensky gave it a catchy name.

Table 1
Broadcast Learning vs. Interactive Learning

Broadcast Learning	Interactive Learning
○ Linear, Sequential/Serial	○ Hypermedia learning
○ Instruction	○ Construction/discovery
○ One size fits all	○ Customized
○ Absorbing materials	○ Learning how to learn
○ School	○ Lifelong
○ Teacher-centered	○ Learner centered
○ School as torture	○ School as fun
○ Teacher as transmitter	○ Teacher as facilitator

(Adapted from Tapscott, 1998, Figure 1)

Even a cursory examination of Tapscott's thesis shows he is conflating interactive learning with digital natives. Educators such as Montessori, who developed her methods 100 years ago, would have approved of Tapscott's interactive learning; she followed the same principles.² Indeed, it's hard to think of educational leaders in the second half of the 20th century who supported the broadcast learning model. Broadcast learning was the industrial Age model of teaching. By the 1880s the Industrial Age had grown to maturity and educators were already questioning the efficacy of the model (Berge, 1999).

Today "multimedia" means digital technology. In the pre-computer age of teaching/learning, good teachers routinely used a variety of media – print, pictures, movies, slides, audio etc. in their classrooms and training. Winteringham (1943) was a military analyst who made the point that weapons change tactics, and tactical needs change weapons. But at no point did he claim weapons *are* tactics or tactics *are* weapons! Tapscott mistakes interactive learning for digital learning whereas one is pedagogy and the other is a set of tools. Knocking down broadcast learning for any reason is knocking down a straw person. Except for the all-important consideration of efficiency for mass education, no educator believes broadcast learning is the way to go.

In a summary of his ideas, Tapscott (1998) cites just one UCLA research study on web-based learning versus traditional learning, and claims, "initial research strongly supports this view." The study, with 33 subjects in two groups, however, shows only that a course using web media produced 20% better scores compared to the course using voice and print. It tells us nothing about how, when, why, where – if at all, digital natives learn differently from digital immigrants. If the traditional class was taught using broadcast learning and the web class using interactive learning, this shows only that interactive learning is superior; as we've indicated; interactive learning is possible without digital technology.

² In particular, see a current examination of Montessori's methods of teaching geometry (Feez: 2007, p. 241-311).

Tapscott (2008) has updated his thesis in a new book *Grown Up Digital*. Unfortunately, this book has not yet been released. From an interview with Tapscott, we learn the new book has the results of a \$4.5-million study that “draws upon more than 11,000 interviews conducted as part of a research project, as well as scientific studies and input from academic, business and government leaders” (Hoffman, 2008). Hopefully the book will provide quantitative research to support the thesis digital natives learn differently. Until then however, attractive as it may be, we must consider Tapscott’s thesis unproven.

Oblinger

Diana Oblinger is a name hard to miss in any web-search on education and the digital generation. Recently she co-edited *Educating the Net Generation* (Oblinger & Oblinger, 2005), an Educause publication. In reviewing the 15 chapters in this publication, it became clear that digital natives conduct their learning differently from the immigrants. But none of the authors had any hard research in the proposition that digital natives learn differently from immigrants. All that can be concluded is that *natives use different tools and that they have different learning preferences*.

As an example, look at the questions below that Oblinger uses for self-identification as a digital native versus digital immigrant. Oblinger does not use the term “Digital Native,” but Prensky’s term clearly applies.

- Are you more comfortable composing documents online than longhand?
- Have you turned your "remembering" (phone numbers, meetings, and so on) over to a technology device?
- Do you go to meetings with your laptop or PDA?
- Are you constantly connected? Is the Internet always on whether you are at home or work? Is your cell phone always with you?
- How many different activities can you effectively engage in at one time?
- Do you play video or computer games?

Now, pretend that it is fifty years ago in the 1960s, before digital technology became available to everywoman and everyman. Let’s reword the survey.

- Are you more comfortable composing documents using your IBM Selectric than longhand?
- Have you turned your "remembering" (phone numbers, meetings, and so on) over to a technology device such as voice recorder?
- Do you go to meetings with your voice recorder?
- Are you constantly connected? Is your radio and/or TV always on? Do you have a telephone constantly available?
- How many different activities can you effectively engage in at one time? (For example, listening to radio, talking on the phone, and doing homework simultaneously.)
- Do you play sports, participate in crafts and hobbies, read, play cards, do crosswords and number puzzles etc.?

Did the availability of technology tools such as typewriters, telephones, radio, TV, tape-recorders etc. in the 1960s mean ipso facto that kids who grew up with these technologies learned differently from kids who did not? Perhaps. But wouldn’t a scholar of the 1960s making that assertion be required to support it with empirical evidence?

Lane and Yamashiro

Lane and Yamashiro (2008) conducted two surveys at the University of Washington of the sort that is typical of the research on digital natives:

In this climate of constant change, understanding how the university community becomes aware of and employs new technologies is critical. While personal anecdotes and the perspectives of early adopters are readily available, it is much more difficult to understand the general technology climate. A well-planned technology survey can provide evidence that extends beyond anecdote, allowing technology units, administrators, and other interested parties to make informed decisions that better meet the needs of the community. (Lane & Yamashiro, 2008, p.1)

Three important conclusions were:

- 1.5x Students bring laptops to class vs. Instructors
- 2.5x Students thought course websites should be required vs. Instructors
- 4x Students use Instant Messaging vs. Instructors for educational purpose

Fair enough. So we have a quantitative assessment of how natives use digital technology, and the unsurprising conclusion is that their instructors, who are on average, older and as such immigrants, use digital technology much less frequently. But what information do we gain on learning styles? Again, nothing.

Brown

Brown (2000), chief scientist at Xerox, discusses learning characteristics of the net generation. He researched how adolescent digital learners function. He concludes³:

- Multiprocessing: The digital learner can do several things at once despite what parents think. One can listen to music, talk on the phone and answer email. (See critique below.)
- Multimedia literacy: The digital learner's literacy is beyond text and includes images and screen literacy. Discovery-based learning. Comment: 100-year old stuff.
- Bricolage: The digital learner's form of reasoning is not deductive or abstract but more similar to Claude Levi-Strauss' concept of Bricolage, the science of concrete. Comment: we are unsure if Brown is aware that in K-12 education, for at least the last 30 years, the stress has been on Bricolage. This way of learning has nothing to do with Digital Natives.
- Bias toward action: The digital learner focuses on learning in situations. Learning is as much social as it is cognitive and becomes situated in action. Comment: figuring what this means requires smarter people than ourselves. If Brown is talking of informal learning outside the classroom, he need not worry. Students of all ages have always learned outside the classroom.

Unfortunately, the only data point presented in the article is:

People my age tend to think that kids who are multiprocessing can't be concentrating. That may not be true. Indeed, one of the things we noticed is that the attention span of the teens at PARC—often between 30 seconds and five minutes—parallels that of top managers, who operate in a world of fast context-switching. So the short attention spans of today's kids may turn out to be far from dysfunctional for future work worlds. (Brown, 2000)

While we appreciate Brown's enthusiasm and sympathy for the digital natives, does he suggest the best way to learn Multivariate Calculus is in attention bursts of 30-300 seconds? Are all digital natives going to become managers? Every different way of thinking has its place. Fast

³ This is an edited version of the schemata from Skiba (n.d) as Brown uses drawings we were unable to interpret. The references used date from 2002.

context-switching is an absolute requirement for military officers, for example. But we may doubt Brown will risk surgery with a doctor/nursing staff with 30-300 second attention spans.

Most important: has anyone done research on multi-taskers in the context of how well they perform each task? Further, does this suggest that educators/instructors can now throw multiple tasks at their students, all to be simultaneously performed? If Brown wants expert multi-taskers who may never have seen a digital device, he should research mothers/housewives.

As with other sources, we are left with the same problem: there are a lot of perceptive insights into how digital natives behave differently from digital immigrants. But is their behavior different because they have access to so many more tools than immigrants had or are they learning differently? We still don't know.

Dosaj and Jukes

Dosaj and Jukes (2006) are a perfect example of creating a framework of thinking and then looking for data that supports the framework. For example:

Digital natives learn differently

Digital natives on the other hand, pick up new devices and start experimenting with them right away. They assume the inherent design of the devices will teach them how to use a new gadget intuitively. This is because the digital native has adopted a mindset of rapid-fire trial and error learning. They're not afraid of making mistakes because they learn more quickly that way. They use devices experientially, and have no problems getting help online. . .

Digital Immigrants do not understand this

. . . But many digital immigrants just can't conceive how anyone can learn like this. So by the time a digital immigrant has read the table of contents of a manual, the digital native has already figured out 15 things that will work and 15 things that won't. While the digital immigrant is afraid they'll break the device, the digital native knows they can just hit the reset button and do it all over again. In fact, for many digital natives, they see the world as one great big reset button. (2006, p.15)

How many people do Dosaj and Jukes know that actually read a manual before using a gadget? Yes, there are people who read the manual, usually engineers, but they are in a distinct minority. People learn to use computers the way they learn to ride a bicycle or a car or cooking or sewing, by watching someone else and then doing it themselves. A big reason immigrants might be nervous about breaking digital devices is because they are expensive - they do not know in advance how robust digital devices can be, and they've heard horror stories about people hitting the wrong button and losing all their work or harming the machine. Natives, i.e., children, usually do not have to pay for the devices, so they can afford to bang away.

Furthermore, digital natives start with digital devices when they are toddlers. So what manuals are they reading? In the days we played with blocks and erector sets instead of digital devices, did we read manuals before starting? Trial and error is the standard way of learning, digital device or not.

Conclusions

As yet no significant empirical evidence exists to support Prensky's Conjecture. Before suggesting the need for empirical research, perhaps we should take into account:

- Since brain wiring is ever changing, digital immigrants may not start with advantages possessed by digital natives, but possibly the gap between native students and immigrant instructors is not as wide today as it was ten years ago.

- If we count those born after 1980 as natives, the first cohort is now approaching age 30. Natives are then likely to already form some significant percentage of schoolteachers, and some percentage of college instructors and corporate trainers. Their numbers can only increase each year.
- Given that several years of research is needed, and then several years more will elapse as research is translated into policy and then on to the classroom floor, it is possible by the time immigrants learn to teach natives, the divide – if it exists – will become irrelevant.

Nonetheless, Prensky's ideas are fascinating and useful because they cause immigrant teachers to rethink their assumptions regarding their native students. This may cause better teaching regardless of their students' technological learning preferences.

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