Technological Applications of Leapfrog

John W. Moravec, Ph.D.
Director, Leapfrog Institutes
College of Education and Human Development
University of Minnesota

330 Wulling Hall
86 Pleasant Street, S.E.
Minneapolis, MN 55455
tel +1 612-625-3517
moravec@umn.edu

Abstract

Relating recent social developments in mobile learning (*m*-learning) technologies in China, this article explores technological manifestations of Leapfrog as it relates to educational transformation. The author asks readers to consider a break in didactic educational settings where students "download" knowledge from their teachers to a new paradigm where *m*-learning devices replace the teacher for banking-style pedagogy and free classrooms from rote memorization exercises. New technologies therefore must be *purposively* employed to support the construction of new ideas and support the co-construction of new pedagogies. This purposive refocusing allows for the application of innovative modes of knowledge production and distribution that identify, create and utilize new and future-oriented formats for sharing knowledge in schools. In this reframing to support knowledge-based learning for an innovation society, Leapfrog schools must design and build institutional flexibility to rapidly adopt/incorporate/evolve these technologies into transformative practices rather than using them to support old practices.

Key words

Mobile learning; human capital development; China; innovation society; educational transformation

Introduction

It all started with a failure. In January of 2007, I failed to renegotiate favorable terms on my cable television bill, which had elevated to a cost beyond what I was willing to pay. As a result, I canceled my service, and looked to the Internet to provide for my television needs. I found a program called TVUPlayer, created by TVU Networks[1], that utilizes BitTorrent technologies to stream near-real-time

[1] See http://www.tvunetworks.com/

television broadcasts over Internet Protocol. This allowed me to view several popular U.S.-based television networks, and many others around the globe.

While watching a Chinese movie channel, I encountered a lengthy advertisement for a handheld, *m*-learning (mobile learning) device, a "Q," manufactured by Ozing in Shanghai. While I do not understand Mandarin, the advertisement relayed the following series of events clearly:

1. A student who does not perform well in school exams is chastised by fellow classmates.
2. The student's father expresses shame in his son's academic performance.
3. The father gives the student an *m*-learning device and walks away.
4. The student is shown learning from the device.
5. The student is shown using the device in the classroom … to help him do his class work.
6. The student is shown being congratulated by his classmates for improving his exam grades.
7. The father giggles with happiness over his son's academic improvement.

The most interesting element of the advertisement, however, was not the device itself, but rather that the pitchman for the product was a smartly-dressed Caucasian Canadian (Dashan, AKA Mark Rowswell). In other words, the marketers are conveying a message that the West is adopting these technologies in our homes and in our classrooms. Furthermore, we're using these devices to help students augment their knowledge, and perhaps to help them take tests. Are we?

What are the possibilities for Leapfrog education?

In the United States and elsewhere in the West, *m*-learning devices are routinely confiscated at the classroom door. In didactic educational settings where students "download" knowledge from their teachers, such devices are often viewed as providing a means for cheating, distracting students from the educational environment, or providing a means to access prohibited content.

Consider what might happen if *m*-learning devices were allowed in the classroom and embraced by teachers:

1. Content may be delivered "anywhere, anytime," eliminating the need for teachers to download information and knowledge into students' minds.
2. Students are able to look-up information and facts rather than committing them to memory by rote memorization.
3. Students are able to make better grades by passing tests with the assistance of handheld devices.
4. Students are prompted to use readily available information to stimulate the construction of new knowledge.
5. Students are helped to use new knowledge to support innovations, or actual changes in the way learning and other activities are accomplished.

This also prompts several questions:

1. If content could be delivered anywhere and at anytime, what are the new roles of teachers?

2. If students were freed from the rote memorization of facts, what new activities should they do in the classroom?

In an earlier publication, Arthur Harkins wrote

> Many school boards and administrators will face the prospect of realigning educational services to meet the needs of a knowledge-based Continuous Innovation Society. Fortunately, the U.S. workforce is already pioneering the use of distributed software and handheld devices to support the growing percentage of Knowledge Workers. As the role of software grows, the focus on just-in-time performance evolves with it. Performance competence stimulates innovation by taking advantage of cost-effective improvements supplied by software such as job automation, skill downgrading, and the freeing of worker time for innovation of next- generation jobs.
>
> Accordingly, preK-12 and higher education should emulate the worker software movement by bringing it into the common experience of students. My arguments are premised on the assumption that software-based preparation of students for success in a Continuous Innovation Society will be driven by performance-based learning, where the skills of (a) software and device management, and (b) developing and working within fast cultures will become the new CTE basics. The separation of technical-vocational education from liberal or general education will greatly diminish, and that career education will shift to career creation and career cycling. I delineate the potential for significant social and employment sector leadership in helping schools and colleges understand the requirement for technical and software support in all forms of education, employment and daily life.
>
> I also argue that no one should be permitted to fail in the development of software-supported performance and innovation. If Johnny cannot read, the software will do it for him. If Johnny cannot do calculus, the software will do it for him. If Johnny can operate the software, Johnny, in theory, can do anything the software knows. Johnny will get 'A's' in everything that he alone, or his software alone, or both together can accomplish. For example:
>
> > *It is 2005. You are S.E.L., a second grader (S.E.L.'s initials are the same as the acronym Software Enabled Learner). You are being asked to learn a new math process, multiplication. It is the first day that multiplication has been presented to you. You are having a terrible time getting the right answer all by yourself, so you move to another problem. You are marking time. The teacher seems to make no sense. Some other kids understand her but some, like you, do not.*
> >
> > *On the second day of multiplication class the teacher gives you a wireless device to clip into your shirt pocket. If you pull the small pen out of the device and scan it over your multiplication problem, the pocket device talks to you and tells you how to get the right answer. After a while you are making 'A's' in your multiplication class.*
> >
> > *Unfortunately, you get stuck after a few weeks' success with multiplication. The problems have become more difficult and you are unable to do them any more. But it doesn't matter. Your teacher makes some adjustments to your pocket device. Afterward, when the teacher calls on you for results, your pocket device tells you the answer and provides explanations of how the answer was framed and arrived at. You are still making*

> *'A's' in your math work, and you always will, because even if you cannot do the work, sooner or later the software will.*
>
> In this scenario, multiplication tasks have been supported by a wireless pocket device that makes S.E.L. capable of performing at a novice level within a few minutes. Over time, with the assistance of a wireless pocket device, S.E.L.'s performance levels will move from novice to competent to skilled to excellent to master. The speed of S.E.L.'s progress will depend upon how s/he and the Distributed Competence software of the wireless pocket device work together. (Harkins, 2002)

The technological applications of Leapfrog are not centered on *which* technologies are used, but rather, *how* technologies are employed. Perhaps the ideal future is one in which age, incapacity, educational level or ignorance are no longer factors in solving problems and capitalizing on opportunities. Distributed Competence software and its supporting technologies make possible the cascading of formerly esoteric and difficult skill sets into contexts of technologically amplified human performance. Several scenarios that illustrate this point are:

> *Five year-old Yolanda brushes her teeth in the bathroom of her family's small apartment on Chicago's South Side. As she moves the smart brush up and down, its tinny voice coaches her, "Move up onto your gums. That's it! Not so hard, now…. OK, let's do the bottom teeth." After Yolanda finishes she rinses the brush and places it in its holder. Within seconds, a data stream carrying gingivitis, plaque, and bacteria types and levels, has been sent to an analytical program in a dental hygiene office.*
>
> *While Yolanda brushes her teeth and prepares to leave for school, two late-model automobiles are tested on a snowy slope in upper Michigan. The cars are positioned at the top of a winding, ice and snow-covered road descending steeply into a valley about one mile away. Both are driven by certified test drivers. The first car move down the hill, and within a thousand feet slides into a ditch. The second car follows. Employing smart steering software it negotiates the winding road perfectly, arriving in the valley without control problems.*
>
> *At about the same moment as the car arrives safely in the valley, flight control software refuses to permit a tired pilot's command to pitch up the nose of his airliner while descending into Chicago air traffic. "Your speed is too low for that maneuver, Captain," says the voice in his headphones. "Entered in the flight log," the voice concludes.* (Harkins, 2002)

These scenarios illustrate the real world functionality of distributed competence (DC) software embodying information base skills. DC enables Yolanda and the driver of the second car to accomplish tasks beyond their current experiential, skill and information resources. In effect, Yolanda's smart toothbrush embeds some of the dental hygienist's capabilities, while the driver has benefited from partnering with driver-enhancement software. The airline pilot may face further simulator time and even a proficiency check ride, but his passengers arrive safely in Chicago.

The lesson learned is that if we want to create graduates who will perform well in an ICT-oriented society, then we should provide them with technological tools. If we want them to develop creative and innovative uses to succeed in knowledge and innovation-based societies that demand the use of ICT, then we must embrace these tools. And, when we do so, we cannot use them to teach the same old content (usually rote, "download"-style learning). Pedagogies that embrace ICT must leapfrog conventional paradigms and support students' pervasive drive for creativity, knowledge production, invention, and innovation.

New technologies must be *purposively* employed to support the construction of new ideas and support the co-construction of new pedagogies. This purposive refocusing allows for the application of innovative modes of knowledge production and distribution that identify, create and utilize new and future-oriented formats for sharing knowledge in schools. In this reframing to support knowledge-based learning for an innovation society, Leapfrog schools must design and build institutional flexibility to rapidly adopt/incorporate/evolve these technologies into transformative practices rather than using them to support old practices.

Heuristics for purposive applications of technology

Table 1, adapted from Harkins (2002), provides a heuristic framework for the purposive applications of technologies in industrial through innovation societies. The chart presents the history, present, and emerging future of technologically-augmented educational paradigms. Schools in both China and the US have a long way to go if they choose to apply technologies that can properly utilize these paradigmatic functionalities.

Table 1

Five learning approaches

Learning system attributes	**Earlier industrial training**	**Generalized mass education**	**Information/knowledge transition**	**Cybernetic supports: Person-focused electronic performance support systems**	**Performance/innovation-based learning for Continuous Innovation Society**
Primacy (learning is performance)	Performance (learning is secondary)	Learning (performance is secondary)	Performance (performance is focus)	Performance (learning is unnecessary)	Creativity, innovation & learning are synchronous
Purpose	Prepare individuals for specific task performace	Prepare individuals for general task performance	Provide explicit information to enhance performance	Guide performance	Advise, consult, guide, facilitate, perform-for, innovate-with
Approach	OJT preparation	Class	Inform	Coach	Partner, innovate-with

		preparation		(perform-with-for)	
Occurrence	Episodic instruction	On-going tutoring	On-demand information	On-demand performances	On-demand innovations
Learning sequence	Learning occurs prior to performance	Learning occurs prior to performance	Need-driven	Event-driven	Continuous (concurrent and post-performance)
Delivery platform	Human & machine-based	Human-based	Machine-based (electronic information base)	Agent-based for individuals-in-context	Agent- & human-based upgrades of distributed competence software
Learning initiative determinant	Trainer determines how individuals will learn	Teacher determines how individuals will learn	Need-driven	Event-driven	Learner-tool-task-context co-determine nature of innovation base learning
Context	Context dependent (partial)	Context independent	Context independent	Context dependent	Context creative
Delivery location	OJT/classroom	Classroom	Computer node	Software network nodes	Anywhere, anytime, anyplace (user, task, context-determined)
Delivery time	Unscheduled/scheduled	Scheduled	On-demand (anytime)	On-demand (anytime)	Continuous (anytime)
Workforce implications	High relevance, but usually lags behind needs	"Just-in-case" relevance; sometimes only chance of applicability	High situational relevance but very inefficient to store or access due to information mgmt. limitations	High situational relevance; essential for supporting PBL	Uploaded situational competence/innovations to points of need "just-in-time" or "just-ahead-of-time

A continuously innovative society is driven by continuous context creation, recreation, and ubiquitous access to innovative social and knowledge formats. Moving from a download education paradigm to a human capital development paradigm, a continuously improving workforce is able to upgrade their skills situationally to adapt to new, competitive socioeconomic. While *m*-learning is described as a potential change agent toward this new paradigm, it is at the "tip of the iceberg" of technological and social changes that are transforming human learning:

- Tiny terabyte disk drives; pocketable optical and quantum computers operating at room temperatures; circuitry woven into clothing or sprayed onto skin; early implants; large percentage of flat surfaces receive painted-on interactive displays; heads-up delivery of high-resolution images to the retina; automatic language and dialect translations; obsolescence of the keyboard; 'nano-marketing' to individual consumers worldwide; projections of the eclipse of homo sapiens by a wide range of intelligent technological and genomic varieties of humanity.
- Jobs whirl into and out of existence quickly, sometimes overnight.
- More and more, human work creates jobs that are carried out by automata. Traditional separations of living, learning and working have vanished, as the same technologies are used in all three domains. Learning is experiential, through simulations and direct, real-world involvement. Performance and innovation are paramount.
- Humans are expected to move forward, creating low-cost, highly efficient automated processes in their wake. Innovative knowledge workers make up perhaps 90% of the work force. Intelligent machines, capable of competing with innovative Knowledge Workers, are on the 20-year horizon. The individual resume replaces the transcript.

Looking toward the future

Leapfrog means not avoiding the future, but rather, taking the future head-on. Leapfrogging builds the future into today. Leapfrog education is not concerned about "future-proofing" in a world driven by accelerating change and accelerating uncertainty. For example:

- How do we future-proof our schools?
- How do we future-proof our libraries?
- How do we future-proof our wealth?
- How do we future-proof our careers?
- How do we future-proof our families?

The above questions reflects dichotomous thinking along the lines of, "*if the rest of the world is going to change, how can I (or my beloved institution) best survive by changing the least myself?"* Why should we not expect ourselves to change significantly as well? Leapfrog schools do not use old rules to define how they use new technologies. To leap beyond the contradictory thinking of "future-proofing," leapfrog educators ask themselves:

- Does the future need schools?
- Does the future need libraries?
- Does the future need wealth?
- Does the future need careers?
- Does the future need families?

More importantly, leaders in the Leapfrog Paradigm also ask *what*, *why*, and *how do we need to change today to help ensure positive outcomes for all learners given these futures*? By framing our actions based on these questions, the purposive uses of technologies becomes evident.

References

Harkins, A. M. (2002). The futures of career and technical cducation in a continuous innovation society. *Journal of Vocational Education Research, 27*(1).

Moravec, J. W. (2006). Chaordic knowledge production: A systems-based response to critical education. *Theory of Science, XV/XXVIII*(3), 149-162.

Moravec, J. W. (2008). Moving beyond Education 2.0. Retrieved March 18, 2008, from Education Futures Web site: http://www.educationfutures.com/2008/02/15/moving-beyond-education-20/