By Invitation

The Impact of Technology on Skill Development

Santanu Paul

Technology is the defining buzzword of the 21st century. Our smartphones and tablets have made quantum leaps in usability and transformed our lives. One major domino effect of technology is being felt in the education and training sector. With its multiplier effect, technology can become a mighty social leveller, creating access and success for all. Melding new technology with existing infrastructure to create click-and-mortar platforms can empower the current generation with job-ready skills. Technology deployment for skill development can lead to lower costs, higher quality, and greater reach, while reducing the burden on physical infrastructure. Social innovations are blooming in a world that has become a global village due to the collapse of geographical and temporal boundaries. Learning by doing is the new mantra for vocational education and skill development.

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Introduction

Have you heard the myth of the silver bullet? A prized weapon with magical powers that can slay demons? We believe that technology can be the closest thing to a silver bullet that can combat the intractable demons of un-employability and joblessness. It can overcome the digital divide and bridge the income disparities in our midst.

Anytime-Anywhere Learning

14-year-old Sudhir Chowdhary smartly manoeuvres his mouse with the fluidity of a seasoned pro. He has just finished a presentation on nuclear energy as an alternate source of clean fuel for the next generation spacecraft and submits it to a NASA student program online. The student and his assessor are separated by a distance of several thousand miles, yet everything gets accomplished in a jiffy and Sudhir makes the grade, ready to fly to the NASA headquarters in Florida in July 2014.

We are living in exciting times, where technology is the biggest enabler and social leveller. Opportunities fly equally and democratically to the most deserving;

resources are more equitably distributed and power flows from bottom-up, not top down!

Video conferencing and satellite uplinking have made it possible for students in Pakistan to swap information with their peers in Kazakhstan, and their instructor could be sitting somewhere in South Korea. Thanks to the rapid technological leaps made in recent years, the pedagogy, delivery, the approach to instruction, everything has changed for the better.

With the development of multi-platform delivery capabilities, such as Windows, Mac, UNIX, PDA, wireless devices, easy updating of content, quicker turnaround of finished product, billing options, increased control over access, date and time of access or the option to link to other training systems, even vocational learning or skill development can become more interactive and exciting than conventional classroom learning.

The strongest argument in favour of technology-assisted learning programs is their cost-effectiveness. Tech-enabled learning models are front-loaded, i.e., there is a lot of investment upfront to develop the technology and tools, but once that hump is crossed, there is very little requirement in actual deployment.

In contrast, classroom-based learning is back loaded. Another way to establish the cost-saving aspect of distance learning programmes is to quickly compile the average or cumulative time spent to complete an online program —a very easy task for a central computer—and compare this with the time away from work to complete an equivalent classroom course. In the latter case, a lot of productive time gets wasted in commuting to and fro.

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Not surprisingly, a distance learning programme often costs just one-third of an on-campus programme. With bandwidth expansion and satellite unlinking, delivery and student engagement are also getting better with time. Because programmes delivered over the web require very little physical infrastructure (in term of schools and libraries) it holds tremendous potential for adult literacy drives and vocational skill development in the developing part of the world.

Following is a lowdown on some of these changes that we must instrument and orchestrate over the coming years to promise more benefits of technology to the largest population, especially the disempowered.

Adopting Click & Mortar Learning

Chalk-and-talk classrooms are in their death throes and the reasons for this are not difficult to guess. The availability of high quality instructors is at an all-time low. Second, trainees that have grown up in the era of TV shows, interactive computer games and SMS texting genuinely lack the 60-minute attention

span required for a classroom lecture in which they are expected to play an ultra-passive and non-interactive role. Third, with low trainer-to-trainee leverage, it is impossible to reach speed, scale, cost, and quality across hundreds of millions of trainees that are needed.

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Click-and-Mortar learning, we firmly believe, is the model of the future. The big advantage with high-touch instruction is that it can create intimacy and bonding between instructors and trainees, which is critical for inspiration and motivation. At the same time, the advantage with high-tech instruction is that it is infinitely scalable. Going forward, integrating high-touch with high-tech will guarantee speed, scale, cost, and quality.

Rewriting Pedagogical Rules of the Game

The first and the most basic competency, as per Bloom's Taxonomy is the ability to remember and recall concepts, terms, descriptions, and definitions related to a domain. The next is to understand the actual meaning of the concepts and in turn be able to explain them in lucid and practical terms. The third competency is to apply to performances and practical tasks. Next comes the competency to analyse (compare, contrast, make tradeoffs, organize, classify, and inter-relate); the ability to evaluate and critique work that has been performed (by self or others) in terms of quality, correctness, defects, and desired improvements and finally, the ability to create or design innovations and inventions; essentially new systems, solutions, processes, and tools.

Unlike the classical pedagogy that caters to children or young learners engaged in primary, secondary, or intermediate education, skill development is more about adult learners who must be armed with vocational skills to earn their livelihood. To that extent, skill development is more in the realm of andragogy (methods of adult learning). Concepts such as Bloom's Taxonomy, David Kolb's Experiential Learning, and Reginald Revans' Action Learning are critical to this kind of learning-by-doing, and indeed to all adult learning.

Learning on the Go

In recent years, technology has emerged as the biggest leveller in bringing about sweeping socio-economic change in our midst. It has unlocked several combinations of space and time. A relatively easy shift is to the quadrant of SAME TIME + DIFFERENT SPACE. If master trainers are in studios offering live and interactive classes over a technology platform that provides easy access at a low cost, trainees are liberated from the tyranny of travelling to the physical training centre and can learn from anywhere they choose, as long as they have access to the live and interactive technology platform. This is the realm of remote, virtual classrooms; where master trainers are live-on-screen, rather

than live-on-stage, supplemented by two-way audio and online communication technology that allows trainees to dialog with their instructors and their peers.

Going a step further, if the master trainer video classrooms are recorded, professionally edited, and archived as video lessons, and access provided to trainees through a technology platform for self-paced learning based on unlimited repetitions of each video lesson including start-stop-playback features, we are in the quadrant of DIFFERENT TIME + DIFFERENT SPACE. Of all quadrants, this is the one that provides the maximum benefit in terms of speed, scale, quality and cost. By breaking the tyranny of the classroom altogether and its attendant co-location challenges including scheduling, travel and logistics, and by enabling the instructors and trainees to operate from anywhere and at any time, it offers the least expensive and most scalable of all solutions that can be replicated rapidly across a large population of trainees without loss of quality.

A modest variant of the solution above is DIFFERENT TIME + SAME SPACE, which is very effective in situations where trainees do not have access to technology from their own locations for reasons of insufficient computing resources, connectivity or bandwidth. In such situations, the master videos can be accessed from a laboratory setting within physical training centres where computers, laptops, or tablets are available to trainees for self-paced learning.

The falling prices of tablets and smartphones also provide opportunities for mobile learning and the possibility of slicing instruction vocational modules into multiple, short learning objects of a few minutes each – with sharp and crisp learning outcomes per object that can be immediately tested on the portable device itself. This kind of fine-grain, micro-learning on tablets and phones aligns well with the falling attention span of young, modern learners, and increases absorption and understanding in adult learners. It also allows for leveraging serious games as a tool for enhancing learning outcomes.

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Technology as an Enabler

Technology is a very important component of problem-based learning (PBL). Why PBL models work so well in medical science is not difficult to understand. PBL attempts to situate learning in real-life environments that are similar to what physicians face in their everyday practice. Problems in medicine tend to be ill-defined, making them difficult-to-grasp. The facilitator acts as a critical link in establishing tutorial groups' process. He or she models the hypothesis-driven reasoning process by encouraging students to tie their hypotheses to the information that they already have.

The facilitator also models critical thinking by polling the group to see if all

the students have a similar understanding of the problem. Students are continually asked to justify their thinking. Initially, the facilitator scaffolds this by encouraging the students to answer the "why" component of a problem. Later, the facilitator may ask them to justify their thinking. In addition, the facilitator orchestrates the students' ranking and evaluates their hypotheses with respect to the scientific causes and the availability, in order to help them generate more coherent explanations and learn to use hypothesis-driven reasoning.

In any learning situation, learners bring their own theories-in-use or 'stances' to bear or what are often referred to as 'final vocabularies' or 'learning binds.' The core of the PBL model has the following characteristics:

- Learning is student centred
- Learning occurs in small groups
- Teachers are facilitators or guides
- Problems form the organizing focus and stimulus for learning
- Problems are a vehicle for the development of problem-solving skills; and
- New information is acquired through self-directed learning

Good problems engage students and facilitate connections between theory and application. Good problems are complex and inspire students to work together and rely on each other to solve them. Listing or mapping all possibilities is important, because although the process is student-directed, the instructor needs to anticipate certain paths students may take in order to steer them in useful directions that support higher order thinking and problem-solving skills.

Vocational practices, in particular PBL models, hold out the promise of breaking the stranglehold of a selective and elitist higher education. It challenges the notion that knowledge is situated only within an institutional context and through a subject-based curriculum. PBL or experiential learning thus becomes the key to broadening access to higher education and to 'democratizing' the curriculum.

Earlier, adaptation and application had no room for experimentation, open-endedness or unforeseen outcomes. In those days, learners were manipulated pedagogically to access already existing forms of knowledge either in the form of disciplines or, more usually, in the form of sets of behavioural objectives. Learner experience was valued but its use was instrumental, selective and at best illustrative. It was accorded significance only if it contributed to the learning of the pre-defined knowledge or skills. Experience had no inherent value in traditional forms of learning.

In contrast, under the PBL framework, a learner is not a 'technician.' His/her knowledge is not downgraded and learning outcomes can no longer be predicted or controlled, so there is always a possibility of discovering new knowledge.

The collaborative discussion in PBL serves two purposes: It makes the

student's thinking visible and helps to activate their prior knowledge. By making the students' thinking visible, it is available for reflection and critique. The students learn that more coherent explanations are more likely to survive challenges. They share knowledge and engage in reflective thinking. By abstracting from the specific context, they are able to cross apply their knowledge to a variety of fields.

Virtual Laboratories, Simulators & Haptics

Virtual laboratories are online systems that allow learners to practice and perform in front of a computer screen. An example of this may be a data operator who is learning to work with a particular database format on a remote mainframe system. For reasons of cost and scarcity, it may be impossible for the learner (or for that matter the training institute) to get direct access to a real system. A virtual laboratory would be a perfect solution to this kind of a problem. A simple, low-cost application can be created on a PC or a web browser to mimic the complex back-end system, and the learner would work with this virtual system to imbibe the actual end-user experience.

Simulators are more complex versions of virtual laboratories that combine proprietary hardware and software. There exist car simulation platforms today that combine hardware and software in interesting ways so that the aspiring cab driver can develop a significant part of her driving skill simply by learning to operate the car simulator without hitting the road.

The third and final technology that is gaining importance is haptics, which is the science and technology of touch and physical manipulation. Consider situations where we wish to teach complex motor skills such as welding, plumbing, or electric repair to trainees. Much of the learning here is tactile and can only be fully experienced when the trainee gets the real feel-and-feedback of manipulating objects with the appropriate toolsets. Haptics toolkits offer low-cost, straight-out-of-the-box solutions that are a combination of smart hardware and software based tools and objects that can be used to learn these skills in a literally hands-on manner.

Cost-effective, Multi-dimensional Feedback Loops

Instead of using offline assessment and feedback systems, conceptual knowledge of adult learners can easily be evaluated through well-designed online tests that can provide real-time feedback to trainees. Practical knowledge can similarly be evaluated through well-designed exercises on online simulators or in virtual labs.

Both these systems are inexpensive and safe when compared to real production quality equipment. They are hard to damage and can be accessed remotely as well. Moreover, every performance of every trainee automatically gets recorded by the system, so that peer-group benchmarking and performance analysis

is free and automatic, as is the ability to determine how a single trainee is progressing over time. Taken together, such a system can be a rich source of extremely valuable information for industry-wide skill reporting and workforce planning.

The New Instructor

The new instructor is a counsellor-on-call, providing mentorship and networking skills in a non- obtrusive, need-based, flexible and responsible manner. He doesn't hand-hold or spoon feed, until it is absolutely essential.

Technology Create Jobs only for Tech-savvy

A recent newspaper report mentioned that in 2013, 1.75 million engineers got freshly minted in India, along with 0.35 million MBAs. The article did not carry exact statistics of science, commerce, and arts graduates, but a conservative estimate would suggest an addition of another three million jobseekers! This stacks up the class of 2013 to at least five million!

Is this the sum of our demographic dividend coming home to roost? Do we have enough jobs to go around? How equipped are we to handle this unprecedented explosion and the weight of their collective aspirations? That could be anyone's guess.

By the present yardstick, only 15% of the 30 million of our annual crop of graduates are job-ready. This raises the challenge - how can this pool of 85% job seekers be made more employable? Should employers be tasked with remediating and repairing the large skill gaps left wide open by our dysfunctional feeder academic systems?

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Real world skill development and competency mapping can make them employable but this would call for practical, conceptual learning accompanied by a regimen of well-designed, expertly-delivered hands-on experiential activities in a tech-facilitated environment - that is both cost-effective and stimulating. Trainees can be inspired to learn their craft by doing rather than listening in. It also calls for continuous trainee engagement, mentoring and active information exchange. Finally, it calls for creative solutions to skill financing, and the institution of resourceful organizations that would cater to and create effective skill development models with an intelligent use of technology.

While the need is to scale up quickly in order to administer an unprecedented number of skill interventions, we have to remain mindful of cost implications and design efficacy, especially while aiming to deliver to a large demographic at a very low entry price, while keeping the quality of intervention high enough to sufficiently engage the learner.

Pedagogical Improvements

In any kind of vocational training, pedagogical content must be such that it implies active give and take (interactive) in an empathetic, listening environment, where the learner can engagingly interact with a subject. In this sense, any material of interest, from literature, newspapers or autobiography can be used as pedagogy. Rich media treatment (enabled by new technological tools) can be used to develop the smallest detail or a specific situation into building vivid images of human experience that can provide raw material for cognitive appreciation and affective response in the learner.

Use of Focus Groups

Focus groups are different from other groups that utilize multiple participants but do not allow interactive discussions. In vocational learning, purists assign a narrow, specific objective to focus groups – peer-to-peer exchange of ideas. Whatever be its eventual use, focus groups must meet a specified set of criteria and initiate structured discussions, even where the group composition is heterogeneous, as a widely spread out geographic group that meets in "virtual classrooms."

An Opportunity Waiting to be Tapped

Last year, India bypassed Japan to emerge as the world's third largest internet user after China and the United States, reported digital measurement and analytics firm comScore in a study. India now has nearly 74 million Internet users, a 31 per cent increase over March 2012. Three-fourths of India's online population is under 35 as against just over half worldwide, and it's our firm belief that taking the high road to technology could be the panacea to our problem of plenty. Essentially, the challenge before us is not 'if and why', but 'what and how'. It's not about 'will it work', but 'how will it work'.

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We believe that an intelligent use of technology can give us answers to these riddles and in the process, also bring about lasting socio-economic change that can ring in the next phase of growth in the knowledge-led era.

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