E-LEARNING AS PART OF DISASTER RECOVERY PLANNING

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ABSTRACT

The world has recently witnessed large natural disasters with the Asian tsunami, the Pakistan earthquake, etc, which has resulted in loss of life measured in hundreds of thousands. One or two years later surveys of reconstruction work have revealed less than 25% of schools have been re-established, implicating long term economic and social consequences. Disaster Recovery planning could include rapid deployment of E-learning systems adapted to disaster zones, even with an apparent lack of broadband telecommunications infrastructure. This paper proposes technically innovative solutions to the rapid re-starting of education in disaster-struck communities by introducing the concept of a mobile E-school. Planning for Disaster Recovery could include the solution/s proposed herein, as it is also possible to imagine in this Globalization World that budgets of wealthier nations encompassing these concepts.

Keywords: Disaster Recovery, Education, Applied E-learning, Technically Innovative, E-school.

Experience: a Spate of Natural Disasters

While much of the world has embraced new computer and communications technology – literally based on the speed of light – time has almost stood still in disaster zones at a number of recent massive natural disasters (viz-a-viz the Asian Tsunami and the Pakistan earthquake.) While the global community responded with alacrity and magnamanity to the survivors with physical aid it appears that education facilities remain unaddressed.

The scale of the disasters galvanized donor nations into sympathetic action, at the same time providing scholars of many disciplines the opportunity to measure and record a wide range of geophysical and human consequences, both of the calamities and the physical post-disaster consequences. Subsequent studies reveal 18-24 months after re-construction started only 25% of schools were re-built. (1) **Figure 1** (next page). Official Indonesian government figures show that post the tsunami disaster of early 2004, a total of 2937 schools were damaged or destroyed – and only 721 had been rebuilt – 18 months after reconstruction began.

The long-term economic implications for the communities are almost as horrendous as the natural disasters themselves. Deprived of basic education, or with education interrupted by at least two years, the economic cost to the community is onerous (2).

Whereas some physical recovery of the destroyed communities occurs based on the aid provided, the communities become aid-dependent, or at best – slow to recover their previous economic independence. A wide range of studies provides evidence of the consequences of a lack of education (2-3).
E-learning offers a whole new vista of applied education, from a distance, even if it appears that infrastructure is lacking.

Arguments may be offered by the aid-providers that there are greater priorities than the re-establishment of education, with urgent need for housing and medical facilities, not to mention the basic necessities of running water and power. But with the passage of 18-24 months and the education problems remaining largely unaddressed it would appear as if the economic implications of the education problem have not been fully recognized, or (worse) - ignored.

Arguments may be proffered that the wholesale destruction of communities also included the loss of teachers and academic staff, no doubt an accurate observation.

It is the contention of this paper that all of the reasons for the non-implementation of replacement education opportunities for the survivors are likely to be related to traditional-thinking about the delivery of education. Delivery of education via E-learning has probably been rapidly discounted because of the obvious need for electricity and broadband telecommunications carriers and/or infrastructures – patently lacking in disaster zones. Nevertheless, while these calamity stricken communities are scrambling to survive, technology continues to evolve … literally at the speed of light.

Figure 1. Indonesian statistics of schools damaged, destroyed, re-built (or not) in the recent major tsunami. (The first "dark section" of each bar of the graph = damaged schools.)

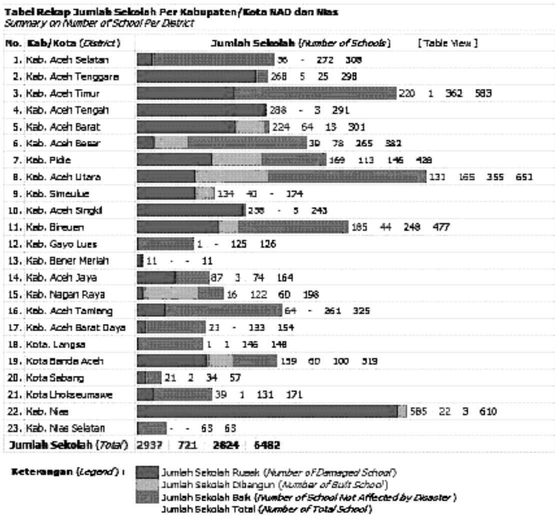
The technological advances in computing and communications have been exceptional within the past few years to the point that industry leaders refer to this epoch of computer technology as the “time of the agile innovator”. (4) Additionally making claims like “businesses will be able to break away from the confines of the office” (4) which, by extrapolation, education can also breakaway from the confines of a physical school building or classroom.

Computer’s New Epoch is Wireless Based

The buzz-word of the computer technology these days is Wi-Fi, a ubiquitous network of small radio antennae distributed across some of the major cities of the world, enabling the classic computer-geek to engage in another new buzz-word – M-commerce, or mobile commerce.

This is not a paper about current developments in computer technology, but nevertheless this very latest technology can also be deployed well beyond the boundaries of the world’s biggest cities by a little agile innovation, as this paper attempts to describe.

Wi-Fi infrastructure doesn’t come cheaply – as well as requiring mobile devices, phones, lap tops computers, or hand-held computers (palm-tops) which are fitted with 802.11n compliant radio signaling. Wi-Fi, an abbreviation for *wireless fidelity*, allows transmission speeds of about 256 Mbit per second (which is about 100 times faster than your plain ordinary telephone system).



Wi-Fi, with a typical antennae range of not more than 100 meters, is heavily dependent on connections to high-speed carriers, meaning a backbone of fiber-optic telecommunications cables running at light-speed between networks. Or, in simpler terms, it is the communications-backbone that enables a user’s connection to the (again) ubiquitous network of Internet Portals and the World Wide Web.

The other wildly popular buzz-word of this New Epoch is IP, Internet Portal, – enabling devices such as office telephones, digital cameras etc, to deliver digital content to anywhere another user is connected, via the Internet.

As proponents of E-learning we are all well aware of the possibilities of utilizing the Internet to deliver content, equally as importantly as much of the thinking around E-learning technology is focused on the need for broad-band access to carry the E-learning content.

Survivors in a disaster zone may dream of internet connections, but clearly all terrestrial infrastructures have been destroyed: everything, that is, except nature’s radio spectrum.

A Step Back to the Future: Wireless

One of the typical constraints of E-learning has been broadband access or width, with is the governing factor of speed in data communications. Broadband, in general, refers to telecommunication in which a wide band of frequencies is available to transmit information. A wide band of frequencies is available, information can be multiplexed and sent on many different or channels within the band concurrently, allowing more information to be transmitted in a given amount of time. (5)

Broadband carriers have typically been based on fiber-optics – very prone to breakdown in the event of natural disasters and extremely difficult to repair.

With the rapid developments in the technology of mobile computing devices, phones, et al, and the relatively inexpensive infrastructure costs associated with wireless networking, wireless technology has exploded in recent year or 18 months.

Wireless carriers at broadband speed have now become a technological reality, with solutions commercially available off the shelf. “Wire-less” is exactly that: communication without wires or cables – a panacea to Disaster Recovery of telecommunications.

With appropriate planning, a pre-requisite of all Disaster Recover plans, a broadband wireless network can be established to provide high-speed wireless Internet services. Considering that the Internet *is* a major tool of E-learning, if not *the* major tool, high-speed wireless broadband enables very rapid deployment, as a very cost-effective alternative to cable broadband carriers. The delivery of E-learning content to disaster regions should, therefore, not be impeded.

Emphasis can be placed on cost-effectiveness: as this paper will describe, the implementation and deployment of such a system does not have to be expensive or time consuming.

Achieving such a state of preparedness, nevertheless, requires re-thinking about the mode and content of an education syllabus to be delivered on-line; plus some re-thinking about systems architecture suitable for wireless broadband. Non-technical explanations about the wireless technology are in the following sub-section.

Long Distance Wireless Broadband Explained

Popular knowledge of wireless broadband (Wi Fi) is concentrated on cordless access to the Internet at cafés and other Wi-Fi hotspots in big cities, but that is by no means the complete picture of the latest technology in wireless broadband systems. The recent mega-calamities in Asia have afflicted remote communities, or in the jargon of telecommunications – *very* remote communities, and *long reach* wireless broadband systems have recently become commercially available “off the shelf”.

Characteristics of such systems can be listed something like this (6 – GmH /Wimax):-

- A quality of service delivered reliably and robustly
- Handling many types of applications simultaneously / supporting different application classes at the same time
- High Bandwidth (= many users)
- Long geographic reach
- Enables portable/ mobile outdoor broadband access

Reducing the computer parlance, the above characteristics can be compressed into a laymen’s definition of “whatever you can do in a computer/ language lab, you can do over a wireless broadband communication.”

Unlike the computer or language lab that was destroyed in the disaster, the communication technology is highly mobile, meaning not only users are mobile - but the transmission equipment is (relatively) mobile – or *rapidly deployed*. In extreme situations deployment can be measured in hours rather than months required to lay cabled infrastructure.

Neither does this wireless broadband deployment interfere with military or civil radio frequencies. By global consensus the Wi-Fi frequencies have recently been predetermined at 2,5 GHz, 3,5 and 5,8 GHz, obviating licensing requirements. In other words, the bureaucratic nightmares that followed the tsunami disaster, as an example, will not be able to (readily) cause bureaucratic interference or delays in using the wireless broadband frequencies.

Facilitating the long geographic reach of these wireless networks is that Non-Line-of-Sight (NLOS) transmission between the base-station and local Wi-Fi antennae. In other words – almost irrespective of the terrain or the disaster, connection and transmission can be rapidly implemented.

From an educator’s point of view in delivering E-learning via the Internet, the ‘triple play’ of voice, data, and video (7) simultaneously to multiple points is satisfied with wireless broadband.

During the clean-up operations immediately post the recent mega-disasters in Asia the only means of communication from the Governor’s office to the outlying districts was via a from or broadband wireless connection using VSAT communications through a combination of wireless and satellites. However, for the continuous interaction required between student and teaching-base, those communications costs would become prohibitive. New wireless broadband technology eliminates the need for VSAT communications, and there is very, very cost effective.

On the Users’ Side –
Mobility and Logistics Solved

Having deployed a wireless broadband system for education in disaster zones, both teacher and student will require equipment to connect: again, Wi Fi technology is a rapid and obvious solution – because of the portability at the receiving end, and the mobility of the devices, such as laptops.

It is the proposal of this paper that mobile E-classrooms could be designed to fit into the volume of something like a 40’ shipping container, and loaded onto the back of any appropriately equipped truck for delivery to the disaster site. In that container there would be the following items:-

- Appropriate antennae and transceiver equipment according to the system requirements
- Computer server adapted to Wi Fi, for up to 100 users (for example)
- 110 portable computer devices (includes back-ups) such as laptops
- Power generation (either solar, or from the truck motor)
- Computer technician to maintain the server and communications
- 1-2 trained teachers, plus 2-3 teachers assistants drawn from the disaster site
- 100+ portable / collapsible chairs for students.

The container itself would serve as both office, and if necessary, rudimentary living quarters for the trained teacher + technician. From the roof of the container, or sides of the container, the canvas or similar fabric covering could be unfolded to provide roof covering or weather protection to the nominal class rooms. (A “low-tech” tent building design.)

In other words, each of these containers would be a “mini-school” that folded out, delivering course material via wireless broadband to the student of whatever level on the laptop – allowing the student to interact in real-time with a teaching base-station. Perhaps one could coin the phrase “E-school”.

The purpose of the teaching staff would to provide the ambience of an education centre, maintaining discipline and controlling records, but the course material to be delivered via E-learning, on-line. Wi-Fi would provide the cable-free access of the students to the teaching base-station, via the wireless broadband transceiver truck/container.

Technology to deliver such content exists today, albeit the technology has hitherto never been applied in the manner described in this paper. The closest example of such interaction between a very remote location and a base-station can be seen in telemedicine – when doctors in a major urban hospital help review real-time medical data and provide assistance with operations in small-town health facilities.

By extrapolation, these mobile teaching units could also serve in a similar telemedicine manner, but there are more complex issues of training and availability of medical personnel, and availability of medicines etc.

That the E-school is highly portable would also obviate bureaucratic delays regarding town-planning schema: the E-school could be rapidly deposited in one convenient location – and as equally rapidly moved to another location as town-planning schema required.

In the case of very (very) remote locations, such as the earthquake-prone Pakistani mountains, the E-school may never leave the back of the truck, but be driven from one village to another, on a pre-determined teaching cycle.

Under any circumstances the teacher-student ratio would be expanded exponentially – without unduly disadvantaging the student – because there would be even more teachers available on-line, thereby addressing the imbalances in live teacher-student contact. In this manner the unfortunate decimation of teaching personnel in the natural disaster could be rapidly redressed.

Like all Disaster Recovery, proactive understanding of the needs of community would require planning, preparation and investment. The long-term economic costs to a community “frozen” to the time of the natural disaster are very high, as equally as years of no education considerably diminish a community’s ability to regain economic self-sufficiency. Part of the Disaster Recovery logic is to invest Recovery-Planning and equipment for the reasons of getting a community “back on its feet” and economically productive as soon as possible. Aid money has two costs: is the most obvious cost is its contribution to a budget deficit, but the additional cost is the *lack of contribution* by that community to the Gross Domestic Product (GDP). Any economist will quickly point to the negative aspects of weakened growth in the GDP.

A Whole New Vista of Delivering Instruction

Assuming that a national government is able to invest in Disaster Recovery also for education, this proposal of deploying E-learning systems across the disaster zone then requires one additional ingredient (beyond the technology) – for the entire national curriculum to be encapsulated in an E-learning mode. At the same time as reducing the national curriculum to the E-learning mode, it is a fantastic opportunity to open a whole new vista on delivery instruction.

This paper is not suggesting that the national curriculum should be replaced by E-learning, but it should be so modified to fit the technology and the method of delivery.

Neither is it difficult to imagine the role of this type of educational technology implemented in the globalised-world, because disasters frequently affect more than one nation.

This paper suggests a Hub and Spoke topography of delivery, whereby the E-schools in the field, and those specially trained teachers, are the "spokes" connected to a "hub" or base-station of E-learning. At that base-station would be a host of specialized teachers that were competent with the E-learning/teaching medium, as well as being specialized in their fields of mathematics, science, language, humanities, et al. Those teachers would be available on-line to interact in *real-time* with the students attending an E-school

So as not to burden the budget for this Education Disaster Recovery (EDR) initially there would a limited number of teachers that form the core of the EDR unit. When disaster strikes a zone, then the existing EDR staff recruits and trains E-school teachers and base-station teachers for a limited period: only then would teachers to travel to the field.

During this training period the physical clean-up, as distinct from the re-establishment of, the communities would be undertaken. During the same training period a number of E-school containers/trucks would be fitted out according to both *numerical need* in the disaster zone, and according to models or examples already constructed.

In other words, the establishment of an EDR need not be a major undertaking or drain on a national budget. Only when a disaster emerged would the EDR be up-scaled to meet the demand. The up-scaling could reasonably take place over a period of months during the teacher-training and preparation of the sites.

The biggest requirement would be sufficiently pro-active planning and consensus on curriculum-content for an E-learning education mode, and some pre-planning and investment in a base-station.

CONCLUSION

While some people may think that broadband wireless networking can be cost prohibitive, the truth is that broadband wireless can usually provide very cost effective methods of reaching users.

The aim of this paper is to partly draw attention to the very serious time-lags in re-starting education in disaster zones, but also to offer realistic solutions to the rapid deployment of education centerscentres, or E-schools, based on recent technological developments. To the best knowledge of these writers the issues of the rapid re-starting of education have not been widely discussed, possibly because of cost fears and so on.

This paper aims to stimulate discussion on the matter, whilst offering realistic technical solutions. It is recognized that not everyone is a computer engineer, therefore this paper is nominally "thin" on technical details, but if any reader or listener is seeking more technical explanations it is possible to provide.

Principally, in this paper it is technically, possible to "take" your existing computer / language lab out of the class-room and into the field of a disaster zone very quickly – at not particularly high costs. Planning, preparation and investment is required to proactively prepare for the next natural disaster.

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