Part One
International Workshop on Mobile Learning for Expanding Educational Opportunities
I. INTRODUCTION

A. Partners

The International Workshop on Mobile Learning for Expanding Educational Opportunities was organized by the Asian Development Bank Institute (ADBI) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) with the support of the Asian Development Bank (ADB); Paradise Patent Services; Pacific Resources for Education and Learning (PREL); Asia-Pacific Satellite Communications Council; Hewlett-Packard Asia Pacific Pte Ltd; Microsoft Corporation; and International Business Machines (IBM) in response to the many activities to introduce e- and m-learning services that are currently being sponsored by governments in the Asia-Pacific region.

B. Objectives

The objectives of the workshop were to highlight the benefits of m-learning and to provide specific recommendations about how to develop strategies for the implementation and sustainability of m-learning.

Benefits:

M-learning has the potential to improve efficiency in the education sector and expand educational opportunities to underserved communities in remote areas. However, there are a multitude of challenges faced when introducing and implementing m-learning. For example, infrastructure is often underdeveloped, and poor and rural communities lack access to ICT and knowledge of its usage.

Prerequisites:

Before m-learning programmes can be implemented, infrastructure must be established, ICT services expanded, innovative policies administered, curriculum and content developed, school administrations reorganized and teacher training conducted.
While the benefits of m-learning are growing, there remains a need for better understanding of the impact and role of ICT-enabled education. It is necessary to build awareness among national and local government policymakers and rural communities in order to comprehend the benefits that m-learning can provide and, most importantly, address the inequality in access to education and to ICT.

In support of that goal, the specific objectives of the workshop were as follows:

a) To review recent trends of mobile and wireless learning programmes
b) To examine issues in introducing mobile learning programmes in rural and remote areas
c) To identify policies and strategies conducive for mobile learning
d) To draft action plans/project proposals to introduce mobile learning

As well as increasing awareness about the benefits of m-learning, the workshop encouraged sharing of knowledge and experience on the subject. Given the extent of resources required in implementing m-learning, sharing of knowledge and experience could help developing countries in the region to reduce costs and time required to develop suitable m-learning programmes, devices, and content.

C. Opening Remarks

The workshop was opened on 16 May 2005 at the Asian Development Bank Institute (ADBI) in Tokyo. Representatives from ADBI and UNESCO made opening remarks, as summarized in the boxes below.

Making ICT Relevant to Developing Country Needs

ADBI is a think tank that aims to promote development and tackle poverty across the region. ADBI conducts research, workshops, capacity-building, and outreach, all of which are funded by the Government of Japan.

Current technological changes and the rapid progress in ICT are largely beneficial and have a positive impact on many lives. However, many aspects of this technology are developed in rich countries and are not particularly suited to the needs of developing countries. Therefore, it is necessary to think about the way this technology can be used in developing countries to promote development. ICT needs to become more client-oriented and less supply-driven in order to respond to the needs of people in developing regions. Extending ICT and ensuring access to ICT is an extremely challenging task. In this context, the participants of the workshop have a critical role to play as the voices of the developing countries, and must tell suppliers of technology and development organizations whether the needs of the people are being met adequately.

Mr. Peter McCawley, Dean, ADBI
Workshop Objectives and Outputs

The four main objectives of the workshop can be summarized as follows:
• to review recent trends of mobile and wireless learning programmes,
• to examine issues in introducing mobile learning programmes in rural areas,
• to identify policies and strategies conducive for mobile learning,
• to draft project proposals to introduce mobile learning programmes in participating countries.

The following schedule will enable us to accomplish these objectives:
Day 1: Share country experiences
Day 2: Examine issues
Day 3: Case studies with demonstrations
Day 4: Policies and strategies
Day 5: Presentation of project proposals

The five expected outputs of the workshop are:
• Project proposals to introduce mobile learning
• Proceedings CD-ROM
• Workshop report
• Lecture CD-ROMS
• Networking

Mr. Jeoung-Keun Lee, Senior Capacity-building Specialist, ADBI

Examining M-learning as an Educational Tool for Development

Thanks go to Mr. Lee, Senior Capacity-building Specialist, ADBI, for taking action after the 2004 workshop on e-learning and turning the idea of an m-learning workshop into a reality. Such workshops facilitate exploration of the potential of m-learning and enhance understanding of the opportunities/risks associated with using such technologies in education.

When examining m-learning, several important questions should be considered:
• What kind of technological tools are we talking about?
• What kind of learning can take place with these devices?
• Can m-learning bring cost-effective, relevant learning opportunities to the poor and to those in rural areas?
• Who can use which tools and for which educational purposes?

In discussing e-learning and m-learning, it is important to remember that while technologies remain a tool in education and can supplement the teaching-learning process, they are not a replacement for teachers.

Mr. Cédric Wachholz, Chief, ICT in Education Unit, UNESCO Bangkok
D. Participants

Participants from 12 countries in the Asia-Pacific region attended the workshop. Resource persons from the workshop included experts from academic institutions, development agencies, government ministries, non-profit companies, and multinational corporations such as Hewlett-Packard Asia Pacific Pte Ltd, Microsoft, and IBM.

E. Elected Officers

The workshop elected the following officers:
Chairperson: Mr. Ashok Kumar Singh (India)
Vice-Chairperson: Dr. Tayyaba Siddiqui (Pakistan)
II. WORKSHOP PROCEEDINGS

A. Opportunities and Issues of M-learning in Asia-Pacific Development

*Mr. George Darby, President, Paradise Patent Services*

This paper will address the topic of technology infrastructure, and focus on the opportunities and policy issues encountered in “mobile learning” (m-learning). While various types of mobile devices can be used in m-learning, this presentation refers specifically to Pocket PCs.

M-learning depends upon the broader phenomenon of Internet Protocol (IP) convergence, when data, voice and video all travel over a single channel. The devices sitting on the IP network, such as the internet, convert the packet that belongs to a voice or data exchange or video into the appropriate presentation. M-learning devices have now been developed so as to have the required screen resolution and auto-handling capability to use normal web content.

M-learning combines two new technologies: WiMax and Pocket PC. WiMax provides wireless local area network connection, has a range of up to 30 kilometres and can carry up to 54 megabytes of data per second (Mbps). WiMax provides IP multimedia services and will accelerate IP convergence because it brings these high data rate services to a relatively inexpensive portable computer device (the Pocket PC). IP multimedia services include web content, streaming video, voice over IP (VOIP), and wireless links to video projectors. The Pocket PC central processing unit (CPU) can accommodate up to 634 megahertz (MHz) and enable simultaneous audio and video. Pocket PCs can use satellite or wire line connectivity, or simply a DVD to deliver content. Advantageous features of Pocket PCs are: XML micro browsers; touch sensitive screen; excellent audio quality; integral WiMax and Bluetooth; software-compatibility; e-books; and integral voice-over internet protocol (VOIP).

Use of WiMax Pocket PCs for m-learning can enable teachers and learners to overcome the resource constraints faced in remote and developing communities. Problems with some e-learning formats and distribution architecture that are encountered in the Asia-Pacific region include: distance; the high cost of desktop computers, wire line, and broadband connection; and the expense of installation, maintenance, storage and repair. The WiMax bandwidth (54 mbps) can reach rural areas, even in areas of difficult terrain. Satellite technology enables data to be accessible in remote areas in which teachers do not have access to libraries and an extensive array of teaching material. The Pocket PC devices themselves and the WiMax hotspots are affordable, and the cost of maintenance, storage and repair is low. An additional limitation of traditional e-learning equipment is that desktop computers require a high level of IT literacy and training. M-learning is a revolutionary alternative because it involves sophisticated technological devices (based on a wireless network) that can be used by untrained persons.

For content authoring, it is important to consider and know the skills of the user. If the device has multiple audiences or users then decisions in content authoring must also take into account the varying learning styles of each learner.
M-learning offers numerous opportunities but also poses related policy issues. Decisions must be made as to whether m-learning is a supplement to traditional classroom education or an alternative approach to mainstream education. Alternatively, m-learning could be utilized solely for special education for students with learning disabilities, or only in ICT courses. In educational administration, m-learning can assist in designing curricula, supporting school administration, and training teachers. Once m-learning and its broadband network is set up, the network backbone can be utilized for other services such as e-government and dialogue between government and citizens, and can enable the development of e-communities. The Pocket PC can additionally be used for preventive medicine and emergency communications.

Four key operational issues need to be addressed in the development of m-learning programmes and provision of m-learning devices:

1) How to pay for infrastructure and curriculum
2) Do content and VOIP servers (telephone service) connect to the Internet
3) Electricity
4) Inventory control (anti-theft)

Possible sources of revenue for the deployment and maintenance of m-learning programmes include:

- VOIP – people will pay for telephone service
- M-commerce – people will buy goods and services using Pocket PCs
- E-mail and web browsing – people will pay for Internet access
- Private network – businesses will pay for network services

The key policy issues in m-learning are:

- M-learning as the agent of change in education
- VOIP services within a nation’s telecom policy and regulations
- MSP services and existing ISPs within telecom policy
- Private network services
- Process of determining priorities

While adapting to m-learning requires significant effort for those who have only a basic level of IT skills, and therefore there can be resistance to it in some countries, such resistance to change can be overcome by initially only using m-learning in special education courses or ICT courses, then gradually using them in mainstream education as they gain acceptance. In addition, because older teachers may be more resistant to adopting ICT and m-learning, ICT training is vital for all teachers. However, as a fellow workshop participant Mr. Deshpande, has indicated, m-learning does not require teachers to become ICT experts, they only need a limited level of ICT experience to be able to operate particular devices and use them as a tool to deliver educational content. It is clear that teachers will use the technology if they recognize that it enhances learning content and improves the quality of education. It is important to make teachers aware that m-learning is a natural extension of mainstream learning, and can meet student’s needs and bring benefits.
B. Developing Action Plans for Mobile Learning

Dr. Jeoung-Keun Lee, Senior Capacity Building Specialist, ADBI

This paper provides a brief overview of the functions and history of the Asian Development Bank (ADB) and gives recommendations for writing project proposals relating to m-learning.

The main functions of ADB are to: provide technical assistance, offer advice, provide training, and furnish loans. There are four types of loans: project loan, sector loan, programme loan, and private sector loan. The types of technical assistance (TA) provided are: project preparation technical assistance (PPTA), regional technical assistance (RETA), advisory technical assistance (ADTA), and small-scale technical assistance. Since the inception of the Bank, priorities have been set as follows:

<table>
<thead>
<tr>
<th>Time Period</th>
<th>ADB Priority</th>
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<tr>
<td>1960’s</td>
<td>Feeding people</td>
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<tr>
<td>1970’s</td>
<td>Providing energy</td>
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<td>1980’s</td>
<td>Protecting the environment</td>
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<td>1990’s</td>
<td>Focusing on people</td>
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<td>2000’s</td>
<td>Fighting poverty</td>
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ADB has invested a total of US$5.3 billion in education sector development since 1970. The priorities for the education sector are: reducing poverty; enhancing the status of women; and providing the knowledge, attitudes, and skills essential to pro-poor sustainable economic growth.

The ADB policy on e-development focuses on creating an enabling environment by fostering development of innovative sector policies; strengthening public institutions; and developing ICT facilities, infrastructure and networks. The e-development policy focuses efforts on building human resources to improve knowledge and skills, and promoting ICT literacy and lifelong learning through e-learning and awareness programmes.

The cycle of an ADB project consists of six stages, which are:

1. Identification
2. Preparation
3. Appraisal
4. Loan negotiation and board approval
5. Implementation
6. Evaluation

The time from the identification stage to evaluation can take a maximum of 10 years. The preparation and completion of a project with ADB follows specific bureaucratic procedures.
The creation and implementation of a project in the education sector consists of the following steps:

**Step 1:** Assess performance in education sector  
**Step 2:** Identify constraints and issues in education sector  
**Step 3:** Analyze cause-effect relationships to identify factors of low performance  
**Step 4:** Search for opportunities and solutions  
**Step 5:** Establish an objective for the project  
**Step 6:** Design project by tackling causal factors (use the project framework)

In cases where much time, say five years, is needed to approve an ICT-related project, then it is possible that the particular technology in question could be obsolete by the time the project is ready to be implemented. It is important, therefore, to consider the time required for approval when submitting any project proposal. Although hardware and infrastructure expenditure can be deployed rapidly, components such as teacher training and content development often take longer. The time required is reduced when a policy and plan coordinates all these different inputs effectively. One way to accelerate the implementation of a project in the education sector is to use standardized procedures or curricula. Another means is to repair existing facilities (laboratories, schools, etc.) instead of building new ones.

It is recommended that project implementation follow a phased approach, including pilot testing. Such an approach is recommended because while a project or experience may work successfully in one part of a country, it might not be feasible or appropriate in a different region of that country or internationally.

The rate of failure of projects undertaken by ADB is relatively low because ADB conducts advisory technical assistance, or pilot testing, which builds capacity and holds consultations and discussions with stakeholders. ADB provides technical assistance in order to build the capacity of local governments, thereby enabling them to have the ability to select appropriate measures and equipment for ICT projects.

The project framework is a tool to summarize the project proposal. The project framework should include the following:

- **Impact or goals.** Long-term development vision in education sector. Other projects and interventions in addition to this project may contribute to the impact.
- **Outcomes or objectives.** Improved status after project and focus of project design. The result that must be delivered by the end of the implementation.
- **Output.** Describes the physical or tangible deliverables to be achieved such as buildings constructed, policies formulated, schools operated etc.
- **Activities.** Tasks that must be undertaken to produce each output such as: establishing regulatory framework, putting in place mobile learning units, developing courseware, improving information network, mobilizing equipment and software, conducting teacher training.
- **Performance targets/indicators.** Define sector performance objectives to be attained. Success, quality, quantity, time, and location.
• **Inputs.** Consultants, equipment, training, staff, resources, private sector contributions, funding, operation and maintenance costs.

• **Assumptions and risks.** Assumptions are positive factors essential to the project’s success, but outside of the project’s control. Risks are what are most likely to go wrong.

In conclusion, listed below are a number of recommendations for writing a persuasive project proposal:

• Know your donors and your potential funding sources.

• Select the right topics to match the priorities of the funding agency’s agenda.

• Share information with partners, stakeholders, and donors.

• Explain clearly why the project is important and why the funding agency should finance it.

### C. Key Questions on M-learning

*Mr. Cédric Wachholz, Chief, ICT in Education Unit, UNESCO Asia and Pacific Regional Office for Education*

The first step in developing a m-learning project in a country is to map the national vision with a clear understanding of the country’s goals, plans, and educational context, as well as an analysis of the dynamics of change in administration. The second step is the identification and analysis of areas for ICT intervention in education. It is critical to establish and define the educational objectives.

When analysing areas for ICT intervention in education it is important to think about how m-learning could be used to facilitate the goals in each of the following categories:

• Expanding educational opportunities

• Increasing efficiency

• Enhancing quality of learning

• Enhancing quality of teaching

• Sustaining lifelong learning

• Facilitating skill formation

• Advancing community development

• Improving policy planning and management

Depending on the context, m-learning can be useful in all of the above areas. For example, it can support the expansion of educational opportunities (access to education) because it can be used to deliver educational opportunities to a range of types of people, including women who face social barriers to education; populations living in remote rural areas; and working adults whose time is limited. Likewise, if the goal is sustaining lifelong learning, m-learning is useful as it can provide convenient, user-centred learning.
Successful project implementation must also take into account the following key parameters:

- Infrastructure (hardware, maintenance)
- Content (curriculum, software, assessment)
- Personnel (need to be committed and trained)
- Financial resources, sustainability
- Piloting and evaluation

In a workshop activity, participants analysed m-learning and developed questions and issues relating to each of the categories of educational goals and key parameters presented above. The participants generated the following list:

**Expanding educational opportunities (access)**

**Challenge:** to reach individuals and groups that are historically underserved such as girls and women, rural populations, adult workers, and persons who cannot go to learning centres (due to distance, expense, and other obstacles).

**Increasing efficiency**

**Issues:** dual shift school-systems, multi-grade schools, small urban or rural schools, flexibility in learning schedule.

**Enhancing the quality of teaching**

**Issues:** difficult profession, no one-shot training, continuum including initial training, lifelong upgrading, and connecting.

**Enhancing the quality of learning**

**Challenge:** to motivate and engage learners, bring life to concepts and processes, foster inquiry, provide flexibility, allow application of information, bring the world into the classroom, offer collaborative opportunities and communication, offer individualized learning.

**Sustaining lifelong learning**

**Issues:** modern society demands constant updating, the “educated” can become obsolete, the lifecycle pattern is changing.

**Improving policy planning and management**

**Issues:** management of institutions and systems, management of policymaking including storage and analysis of data, construction and assessment of policy scenarios, and tracer studies or tracking systems.

**Financial resources, sustainability**

**Issues:** Acquisition of hardware and software, installation and configuration, connectivity, maintenance, supplies, utilities, retrofitting of physical facilities, replacement costs, acquisition and creation of content materials, training of staff, testing, evaluation, and adjustments.
D. Mobile-Campus Solutions

Mr. Yasunori Akenaga, Senior Manager, Wireless Broadband and Sensing Solutions, IBM Japan

This presentation begins with a brief historical overview of information technology (IT) revolutions and developments in ICT, then discusses the impact of recent ICT developments on educational institutions and provides a summary of the challenges these institutions face and recommendations for addressing those challenges.

Historical Overview

The mainframe was the first information technology revolution, enabling organizations to process data quickly and efficiently. This was followed by the advent of Personal Computers (PCs), which enabled rapid personal data manipulation and further raised efficiency and effectiveness in information processing. The internet revolution led to momentous developments in communication and exchange of information. In addition, during the internet revolution the concept of e-business was introduced. E-business has improved intra-organizational productivity; streamlined business processes between organizations, and introduced new business models such as supply chain management. More recently, pervasive wireless technology is enabling the launch of the on-demand era. The on-demand era means that IT technology is expected to enable the following activities:

• Real-time sense and response to core applications.
• Access to mission-critical data from any location.
• Connect people, data and processes on demand.
• Decision-making and communication without human intervention (autonomic computing).

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<tr>
<th>Information Technology Revolutions</th>
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<tr>
<td><strong>Time period</strong></td>
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<td>1960’s</td>
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Impact of Recent ICT Developments on Educational Institutions

Modern ICT has had a significant impact on university campus systems. In the past, the face-to-face campus culture was the norm. Universities had a mixture of voice and data communication networks including wired, wireless, LANs, and hotspots that were unconnected and uncoordinated. The population on campus was a captive audience meaning that it functioned in a relatively closed environment. Today, however, in many university campuses, wired and wireless technology is creating a community of connected constituents. An increasing majority of students are using wireless devices such as notebook PCs and PDAs. Today’s students are more technology savvy than the university staff and officials, and they expect their needs to be met anywhere, anytime and with any device.
Challenges

There are a number of challenges involved in meeting the needs of today’s students:

1. Mobility Challenges
   - Connectivity
   - Authentication and authorization
   - Security
   - Voice/data access
   - Device management
   - Scalability
   - Services including messaging services, location awareness, intelligent notification

2. Device Challenges
   - Unique device capabilities
   - Varying programming models
   - No dominant standard
   - Wide range of target environments

3. Application Challenges
   - Content aggregation
   - Customization and personalization
   - Application reuse
   - Multi-device capability

Opportunities

In order to meet these challenges, the following opportunities should be pursued by educational institutions:

- Developing new business models that will increase revenue for the institution
- Future-proofing the campus network infrastructure
- Focusing on the integration of essential public safety solutions
- Selecting the best vendor partners and alliances to ensure multi-device (internet, phone, PDA, etc.) application access
- Differentiating the college/university to ensure competitiveness in the marketplace
- Improving the “braking distance” necessary to lower IT costs and quickly align IT with changes in funding and budgeting
- Increasing the value of the relationship between the institution and the surrounding community
Wireless Solution Roadmap

The diagram below depicts a campus wireless solution roadmap (Figure 1). The right side of the model, from stage A to stage D, displays the services provided by the IT service-company to support the development of each phase on the left side of the chart. The phases can be combined to increase speed to market. This solution roadmap defines an iterative approach to solution development that provides business value checkpoints that ensure the sustained business viability of the solution. In addition to the phased-approach roadmap, campus services can be enhanced by instituting adequate infrastructure. The campus infrastructure needs to support and impart application delivery and messaging, commerce, personal safety and security, and digital media.

Mobile technology and advanced ICT can extend self-service web applications into a multitude of student services and departments such as finance, registration, grades posting, and alumni events. It is important to deliver these capabilities in a low cost self-service mode while increasing community exposure and level of service. Local commerce should also be considered. On campus and off campus transactions through the university can generate revenue while building brand loyalty for the university.

![Wireless Broadband & Sensing Solutions](image)

Figure 1: Campus wireless solution roadmap
**Examples**

A number of examples can assist in demonstrating the benefits of harnessing wireless technology. At Wake Forest University, for example, cellular coverage was extended using third party neutral hosting which enabled the university to address the explosive use in cell phones while supporting a revenue-generating cellular business model. The university additionally supported a revenue-generating business model for low-cost broadband to the university and the community, and tied the multiple infrastructures together with a mobility-enabled framework that leveraged the existing networks. In another example, the University of Central Arkansas provided a new range of services to both students and faculty, including instant access to financial aid, grades, and registration by shifting its telecommunications business model to fully embrace wireless technology. Another example of utilizing wireless technology on campus is that of the Canyon Independent School District which took advantage of wireless technology to overcome the challenges posed by geographic distance and difficult terrain that had prevented residents of this region from accessing educational facilities and services.

**E. Why We Need to Cultivate E-learning Professionals**

*Mr. Kazuyuki Shinkai, Enterprise Solutions, Mizuho Information and Research Institute*

Judging from the country reports presented by workshop participants, there are three leading issues in expanding e-learning and m-learning:

- ICT infrastructure
- Financial resources
- Human resources

This presentation is related to the third issue: human resources.

There are numerous definitions of an “e-learning professional”. An e-learning professional can be any of the following positions:

- Learning manager
- Chief learning officer
- Instructional designer
- Contents developer
- System developer
- Tutor
- Course Mentor
- Instructor
- Consultant
The activities of an e-learning professional can be placed within certain categories, including:

- Analysis – defining the needs and constraints
- Design – specifying learning activities, assessment and choose methods and media
- Development – beginning production, formative evaluation, and revision
- Implementation – putting the plan into action
- Evaluation – evaluating the plan from all levels for next implementation

An examination of the e-readiness of e-learning professionals in the 13 Asian countries that are part of the Asia e-learning network shows that in Japan the concept of instructional design is widely recognized. However, it is not widely applied in Japan, especially in employee-training enterprises because e-learning is only implemented if it directly helps to cut costs. An additional reason for the lack of e-learning instructional design is that Japan is a densely populated country with numerous schools within a small area, and there is therefore little need for distance learning.

In Vietnam and countries of similar e-readiness, e-learning is not yet at a practical stage. E-learning professionals in Vietnam are classified as content developers, instructors, or IT specialists. In the Philippines e-learning professionals are: academic support staff, including instructional designers and teachers; administrative support staff; technical support staff; and management staff. In more ICT-advanced countries such as Singapore there are some differences. For example, the Nanyang Technological University (NTU) classifies e-learning professionals into three categories: front-end, including teachers mentors, tutors, teaching assistants; mid-end, including subject experts, instructional designers; and back-end, including system administrators and Learning Management System (LMS) administrators.

The role of e-learning professionals is to support learning. Implementation of e-learning is not the end goal. E-learning professionals are important because they guide, manage, and encourage students. E-learning professionals can gain skills through university courses, or through government and business training.

Analysis and evaluation are important factors when developing e-learning courses. There is a need to ensure that courses are appropriate to the needs and cultural conditions of each country. Ongoing analysis and evaluation of e-learning courses is required, so that they remain relevant and are continually improved. Any obstacles to such improvement should be identified and overcome. In many cases, for example, the lack of financial resources and budgetary planning are a major obstacle, because once the course contents are developed, the lack of financial resources impedes improvements to the course.
F. Exploring M-learning: Academic Initiatives in North America and Europe

Ms. Judy Brown, Director, Academic ADL Co-lab, University of Wisconsin System

There have been many changes and significant progress in mobile technology since I bought my first mobile device in 1979. Below I will give a brief overview of the history of mobile devices, then discuss their potential for use in the classroom and provide examples of projects that are underway to introduce m-learning devices in educational institutions.

History of Mobile Devices

Modern mobile devices began with the Apple Newton in 1993, followed by the Palm Pilot in 1996. Five years later the Pocket PC and the introduction of flash player were the next significant introduction, and have since been used for educational purposes. The next major development occurred when cell phones gained the capabilities of personal digital assistants (PDAs) and merged connectivity.

The different types of connectivity available through mobile devices are: wide area network (WAN), local area network (LAN), and personal area network (PAN). Within the field of education it was originally envisioned that handheld devices could serve as computer replacements in which full courses could be delivered. However, to date only individual applications and teacher training has been successful, as well as data collection, mainly in the scientific and medical fields.

Currently, there are a multitude of devices available for mobile learning, ranging from PDAs to video players to cell phones. Add-ons to mobile devices such as cameras, barcode readers, and Global Positioning Systems (GPS) are also popular.

Mobile Devices in the Classroom

While students are initially enthusiastic about new mobile devices when they are introduced in the classroom, students quickly realize their limitations and difficulties. However, mobile devices are readily accepted.

There is a wide selection of applications available, several of which are suitable for, and useful in, the classroom. For example, the University of North Carolina has developed a mobile device classroom-response system in which all students can answer the teacher’s questions, thus enabling a teacher to monitor the level of each student’s understanding. Mobile devices are also being used to improve communication and efficiency at the University of California, San Diego where location-based information is available on handheld devices, enabling staff and students on campus to locate each other immediately. At some universities, mobile devices are actively encouraged. Medical schools are especially active in utilizing handheld devices. At the University of South Dakota, for example, all freshmen and medical school students were given handhelds and the use of these devices has been successful in several subjects. Similarly, at Duke University all freshmen were given Apple iPods, which were used to store course content, music appreciation, poetry, and readings. Other possibilities for the use of mobile devices in education are e-books, GPS and audio devices.
M-learning Projects

There are a number of m-learning projects underway which aim to utilize mobile devices to improve learning. One such project is the “m-learning.org” project, sponsored by the European Union, which was initiated in 2001 and completed in 2004. This project targeted unemployed, underemployed, and homeless youths. These youths were provided with handheld devices that also functioned as phones. A variety of courses such as driving courses and language courses using SMS were administered. The findings of the project were that m-learning helps learners to improve literacy and numerical skills, remain focused, and to identify areas where they need support; raises learner confidence; encourages independent and collaborative learning; removes formality from the learning experience; and helps combat resistance to use of ICT.

Another significant European m-learning initiative was one which focused on developing a common core of content which would be shared among European countries, ensuring interoperability, open standards and quality measurement of materials.

There are also several ongoing projects that are exploring future possibilities of m-learning. These may not be applicable to early stages of development of m-learning, but are interesting to think about and learn from. Some projects currently being implemented explore augmented reality such as superimposed information diagrams and scientific role-play programmes.

References and Recommendations

A useful source of reference for information about m-learning is the www.mLearnpedia.com website. This site has a range of types of information, including about free and open-source software.

It is recommended that m-learning content be translated into various local languages so that teachers and learners can benefit from the new technology. Without translation into local languages, even those students fortunate to have access to the technology are restricted by language barriers.
G. Satellite-Based Distance-Learning Network

Mr. Eui K. Koh, President, The Asia-Pacific Communications Council

This paper examines the contribution that satellite technology can make to distance learning. There are several mechanisms, including fixed telephone systems and WiMax, that can deliver digital content. Satellite technology plays a complementary role to such delivery mechanisms because satellites enable wide coverage.

Satellites are a valuable means of enabling wide distribution of educational content. In addition, satellite technology is a viable and effective form of education technology for the Asia-Pacific region because satellites are easy to install, are scalable for growth, and provide affordable communication capacity. There are many opportunities for acquiring affordable satellite capacity in Asia as there are numerous competing satellite operators within the Asian region. In certain countries, however, some regulatory hurdles exist.

Satellite service applications in Asia include broadcasting and video services. Satellite also enables broadband services and direct to home players (DTH). In some countries, such as Japan, DTH subscription provides educational programmes for those studying for college entrance exams.

Broadband satellite applications have the potential to facilitate distance learning because they provide intranet, LAN, and WAN connectivity; provide access to the internet for remote and underserved areas; enable VOIP; and facilitate commercial services including enterprise video distribution. Satellite broadband services are currently used in distance medicine programmes. In addition, this technology enables digital media streaming and is utilized for monitoring and control of traffic and natural disasters. Direct to home (DTH) and broadband services are readily available in Asia.

Very small aperture terminals (VSATs) are satellite dishes that are sized between 1.2 and 2.4 metres wide. VSAT Internet Protocol (IP) applications enable rapid mobility. The application of such terminals is extremely useful for e-learning, e-government, and e-business. VSAT technology has progressed rapidly and currently the Digital Video Broadcast – Return Channel via Satellite (DVB-RCS) two-way service standard is utilized for interactive communication between students and teachers.

Satellite digital multimedia broadcasting (DMB) is a new concept in broadcasting services, characterized by three key differentiators: mobile; personal media; and interactive, including video, audio and data. Content is aggregated at the satellite DMB centre and then sent to the satellite on Ku-band, and downloaded to the terminal through an S-band link. User terminals for satellite technology are numerous and include: car navigation combo terminals, mobile phone combo terminals, mobile television terminal and portable digital assistants (PDAs). DMB via satellite is ideal for mobile learning.

From the points made above it can be concluded that satellite applications are a viable option to complement PDA or WiMax applications for m-learning in the Asia-Pacific region.
H. Introduction to Mobile-Learning Tools

Mr. William Horton, President, William Horton Consulting, Inc.

This paper provides an overview of the tools needed to create, offer, and access mobile learning. Mobile learning or e-learning tools are the result of two converging technologies: computers and mobile phones. Numerous platforms are available, each with its own advantages, technical specifications, and cost (see Figure 2 below).

Typical Technical Specifications

<table>
<thead>
<tr>
<th>Wireless Laptop</th>
<th>Tablet</th>
<th>PDA</th>
<th>Smart Phone</th>
<th>Mobile Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>&lt;2 kg</td>
<td>1.8 kg</td>
<td>0.2 kg</td>
<td>0.1 kg</td>
</tr>
<tr>
<td>Processor</td>
<td>*****</td>
<td>****</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Memory</td>
<td>2 GB</td>
<td>1 GB</td>
<td>192 MB</td>
<td>64 MB</td>
</tr>
<tr>
<td>Storage</td>
<td>80 GB</td>
<td>60 GB</td>
<td>2 GB</td>
<td>-</td>
</tr>
<tr>
<td>Display</td>
<td>1400 x 1280</td>
<td>1024 x 768</td>
<td>640 x 480</td>
<td>220 x 176</td>
</tr>
<tr>
<td>Battery</td>
<td>3-5 hrs</td>
<td>3-5 hrs</td>
<td>6-8 hrs</td>
<td>8-12 hrs</td>
</tr>
<tr>
<td>Wireless</td>
<td>b, g, BT</td>
<td>b, g, BT</td>
<td>b, g, BT</td>
<td>phone, BT</td>
</tr>
<tr>
<td>Cost (USD)</td>
<td>$2000</td>
<td>$1500</td>
<td>$800</td>
<td>$400</td>
</tr>
</tbody>
</table>

Figure 2: Range of platforms

A wireless laptop computer offers the greatest capabilities, including maximum storage and a standard PC platform that enables conventional e-learning and web content. However, a wireless laptop is often not suitable for use by small children, and does not permit e-learning while moving.

A tablet computer has full computer capabilities without the keyboard and has been especially successful for teaching and learning of visual subjects. Its major drawback is that the screen scratches too easily.

A personal digital assistant (PDA) and Pocket PC are portable and can have many add-ons, but might not be compatible and incur high costs. The smart phone is a PDA with some mobile phone features or a mobile phone with PDA features. It is advantageous because it is a small device to carry, but the display size is limited. The mobile phone is the least expensive alternative, adequate for exchange of simple messages. In addition to these platforms are some unusual devices such as wearable computers, music players, in-vehicle computers, and I-pods that carry data.
Wireless networking is a feature that can be added or built into the system. Bluetooth wireless is a wireless connection to a local device. It exchanges and synchronizes data so can be utilized for interactions between students and teachers, and is useful for connecting to peripheral devices.

A Global Positioning System (GPS) is a hardware device that guides learners to locations and objects, records data, and teaches navigation skills. Another hardware device is a data probe, which hooks onto the device and is used for real-time data collection with sensors for temperature, air and light.

Radio frequency identification (RFID), another hardware device that can be used for m-learning, is a reader on the mobile device that will detect and retrieve data such as lesson plans from a designated object. Still and video cameras can also be used in m-learning as they offer multiple functions to capture data.

Web browsers and Macromedia flash are the most common type of software used in mobile devices. Additional programmes to consider are Acrobat PDF, readers for MS office, Power Point converters and media players.

When selecting hardware devices and software for m-learning, it is important to be cautious about the following issues:

• Battery life.
• Health concerns – eyestrain, repetitive strain, radio emissions.
• Intellectual property protection.
• Theft of devices.
• Theft of identity.
• Privacy – access to student records.
• Cheating.
• Cost of updating technology.

One cost effective method for updating technology is mixing and matching parts between different devices to build a functioning usable computer. In order to upgrade, hardware equipment must be modular so that units can be added together to make the system larger, improve the capabilities, or expand its size. In project planning it is important to consider the record of companies in supporting older products.

In conclusion, below is a list of guidelines for selecting the appropriate mobile technology for e-learning:

• Start with your educational goals: what sort of technology is required?
• Do not forget learners: what are their needs, how does the technology assist them?
• Pick a practical platform.
• Choose tools that have been proven to be useful.
• Budget for peripherals, software and maintenance.
I. IT for M-learning in Developing Countries

Mr. Vinay L. Deshpande, Chairman & CEO, Encore Software Ltd., Managing Trustee, The Simputer Trust

The designers of current mobile technologies do not necessarily consider the conditions in developing countries when designing, so their products are not always applicable in the developing world. However, there has been research into the technological needs of people in developing regions, and this paper will discuss some technologies and devices that are suitable for conditions in the developing world.

Today’s personal computer (PC) is a general-purpose machine which integrates computing, VCD/DVD functions, TV, and audio system. Because of this complexity this machine is not suitable for some developing regions. It is no longer useful for many simple day-to-day tasks. Most of the capacity and capabilities remain unused and the excessive complexity has made software “buggy” and unstable. Most importantly, the complexity makes the learning cycle too difficult and time-consuming for those living in developing regions. Other disadvantages of current PCs are the continuous threat of viruses due to security lapses, and the need for a continuous power supply, something which is often not possible in unstable and rural regions. In addition, there is the issue of cost. Most advertisements for PCs hide the real cost of ownership. PC owners must pay for hardware, software, power supply and maintenance costs. They also face the cost of internet connection, which can often be very high in rural areas. Furthermore, the primary interface is generally in English, not in local languages. For the reasons listed above, normal PCs are unsuitable for three quarters of the world’s population.

The developing world needs technology with the following characteristics:

- Simple, easy to use, affordable technology.
- Independent of mains power-supply.
- Rugged, dust resistant.
- Shareable.
- Fitted with multi-lingual capabilities.
- Useful – must make an impact on daily life for education, earning a living, and communication.

Given these special needs, the desirable features for a computer are:

- Affordable.
- Battery operated; rechargeable.
- No moving parts.
- LCD screen which requires less power.
- Touch screen with pictorial icons.
- Printer interface.
- Internet connectivity with built in modem.
- Intuitive user interface making a manual unnecessary.
- Built-in software including word processing, e-mail, browser, multilingual capability, local language text-to-speech, multimedia.
- Memory expansion capability—application software on USB flash memory stick.
With an understanding of the particular needs of people in developing regions, designers developed a simple mobile device, the Encore Simputer (see Figure 3).

It is a low-cost Linux-based local language computing device with multiple input and connectivity options, and has the following features:

- A smart card facilitates sharing while maintaining privacy of data.
- Icon graphics make it easy to use.
- Voice feedback in local languages does not require the user to be literate.
- Touch is the primary input, image and sound are the primary outputs.
- It runs on two AA batteries because these are commonly available in developing regions.
- A large and flexible memory of 64 MB DRAM, in 144MB flash means that user data is never lost even when batteries are empty.
- One of the most important attributes is that the applications can be platform independent, hardware is not needed.
- The Simputer can accept and export files to and from Windows as well as view PowerPoint.

Figure 3: The Encore Simputer

Another computer device similar to the Simputer, but larger in size is the Mobilis, a mobile desktop computer. The unique features of the Mobilis are:

- Portability and small size.
- Downloadability for upgrades and files transfers.
- Multi-language capability – can be easily adapted to other languages, has indigenous and multilingual text-to-speech engine.
- Optional GPS, GPRS built-in.
- Low power consumption – battery operation and enhanced operation using solar power.
Typical *Mobilis* applications in education are:

- Electronic book reader for educational content
- Access to digital libraries
- Storage for “Electronic Books”
- Streaming and animated content
- Personalized learning
- Text-to-speech for various applications

The cost of the *Simputer* is about US$225.00, and the *Mobilis* with all wireless capabilities is US$400.00.

### J. Designing Courseware for Mobile Devices

*Mr. William Horton, President, William Horton Consulting, Inc.*

This paper examines design factors and guidelines for m-learning projects.

Successful m-learning projects always start with clear goals that have worthwhile and achievable purposes. Some of these goals are outlined below.

<table>
<thead>
<tr>
<th>Goals of instituting m-learning</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>To learn from the world.</td>
<td>In m-learning, learners learn from a variety of sources including objects such as exhibits in museums; locations and environment; and experts including discussions with parents and teachers.</td>
</tr>
<tr>
<td>To maintain physical and mental health.</td>
<td>M-learning can reduce physical strain caused by school bags; provide exercise; change scene and environment; and provide a variety of learning experiences.</td>
</tr>
<tr>
<td>To enable learners to learn when and where they are, utilizing their time more efficiently.</td>
<td>M-learners can set their own time and pace of learning.</td>
</tr>
<tr>
<td>To reduce the costs of infrastructure.</td>
<td>Mobile learning does not require the facilities and physical materials that traditional classroom learning requires.</td>
</tr>
<tr>
<td>To enhance the delivery of outdoor subjects and foster the development of skills practiced outside the classroom and office.</td>
<td>M-learning can give hands-on experience in any setting.</td>
</tr>
<tr>
<td>To prepare people for future communications technology and computing.</td>
<td>The accessibility of m-learning can give people greater awareness of new communications technology and prepare them for change.</td>
</tr>
</tbody>
</table>
Once worthy goals are established, the next step is to ensure that m-learning software is designed for the learners rather than the devices.

First, it is important to evaluate learner needs by examining their technical skills, experience with computers, and task-performance ability.

Second, the m-learning programme should be designed for the specific conditions in which the learning is intended to occur. Conditions that must be taken into account are noise, vibration, brightness, dust, moisture, and temperature.

Third, it is important to give the learner alternatives so that they can choose how they consume information, for example a choice of pictures, audio and written content. Here it is important to design reading formats so that they are easy to read.

Finally, consider how the learner’s time will be used and try to ensure that they can learn efficiently and minimize non-learning time, including time spent moving between locations, equipment failures.

In pilot projects, it is recommended that learners be tested on how efficiently they utilize m-learning, remain interested, communicate freely, and smile.

Designers of m-learning software must ensure that the courseware works on the device chosen for the delivery. Specific guidelines for device designing are:

- fit text within the screen
- ensure graphics display is clear
- use rich media appropriately
- enable downloading
- make interaction easy
- use space for meaningful content

In designing m-learning for teaching, the question is: are the learning activities likely to accomplish learning objectives? Materials that work in the classroom may not necessarily be effective when put into m-learning devices. The content for mobile learning might differ greatly from the content used in traditional classroom curriculum because mobile learning entails doing activities rather than just watching the simulation of processes such as chemical reactions or political relationships. M-learning enables participatory simulations in which learners enact rather than just watch the simulation of processes. M-learning can carry out an informational strategy in which learners are taught to find the information rather than just receive the information. Discovery learning is another possibility in which learners observe and collect data, analyze, then develop principles and concepts. Mobile learning can therefore enable new styles of learning such as collaborative learning in which learners share, compare, and refine ideas.

It is likely that the first deployments of mobile learning might be best for providing information to support the traditional curriculum, rather than replacing the traditional curriculum. And to ensure the acceptance of m-learning, it may be best to use m-learning in teacher education, then gradually expand the use of m-learning to classrooms and to community-learning centres.
The guidelines for the design of m-learning software can be summarized as follows:

- Design good content first
- Fit the learning to the learner and then to the device
- Keep learning efficient
- Make the learning experience reliable
- Accomplish worthy goals

K. Institutional Responses to Developments in M-learning

*Associate Professor Alan Smith, Director, Distance Learning and E-learning Centre, University of Southern Queensland*

This paper provides a perspective of m-learning based on the experience at the University of Southern Queensland (USQ), Australia, and recommends strategies for the implementation of m-learning, including how to build upon existing resources, and how to cope with uncontrollable factors.

Technology has the capacity to enable millions to gain access to higher education institutions. Technology changes rapidly and continuously, and these institutions are just beginning to cope with those changes.

The University of Southern Queensland is one such institution. It has three campuses situated 500 kilometres apart. With the advent of e-learning, the student population of 25,000 is spread across 100 countries with 75 per cent studying off campus. All students must therefore engage in e-campus activities.

Offering e-learning courses and supporting both on-campus and off-campus students through internet delivery systems poses significant issues. The first issue is accessibility. As a transnational educator, the University hopes to increase international access, become part of the global marketplace in education, enable learning at any time and any place, and increase flexibility in employment and study options. However, the University had to face difficulties relating to the indirect streaming of learners, and manage low bandwidth and high costs in many regions.

In response to the factors affecting accessibility the following strategies were undertaken:

- Re-examine institutional directions, priorities, and policies – no individual or faculty-based decisions.
- Plan the transition periods for the technology innovations.
- Review the number of courses and programmes, and avoid random acts of innovation.
- Incorporate new technologies progressively into traditional teaching and learning environments.

These strategies resulted in the foundation of a wireless network, interface, and portal that provide all students instant and easy access to the system within the university.
The second issue was the infrastructure and technical environment. Re-designing and rebuilding ICT infrastructure generated considerable improvements in portability, storage, capacity, speed, audiovisual quality, interoperability of components, and appeal. However, the university found that it was difficult to develop an infrastructure compatible with technological changes with existing financial funds. In addition, the system and infrastructure had increasing security threats such as spam and viruses, and due to difficult weather conditions in the area, the university had to ensure continuous power supply and back-up generators. The institutional responses to these infrastructure issues were to:

- Increase technical infrastructure spending.
- Coordinate purchasing of hardware and software.
- Forward planning of architecture – robust, reliable connections.
- Address variations between campuses and centres.
- Develop partnerships with technical providers and vendors.
- Introduce new positions such as Chief Information Officer (CIO) and Chief Knowledge Officer (CKO).

Transformation of the organizational structure of the university was critical to the successful establishment of the university as a transnational e-learning educator. The responsibility for supporting e-learning services had to be organized and clearly defined. Therefore, the university created the Global Learning Services Division. The Division integrated the functions of the Distance and e-learning Centre, Information Technology Services, and the Library. The Division also re-examined course materials and enabled automatic renditions, and developed ongoing relationships with various vendors.

The third issue is teaching and research. New technology can create new learning and teaching environments as well as mechanisms for accessing resources.

Negative impacts of new technology on the area of teaching and research include:

- Transfer of costs to students.
- Plagiarism and collusion.
- Time-consuming investment in staff training.
- The need to teach students how to evaluate quality of internet material.
- The need deal with recalcitrant lecturers and random innovators.

The institution responded to these particular challenges by:

- Increased staff development activities.
- Redesigned course materials.
- Revisiting traditional delivery methods.
- Reviewing semester lengths, assessment methods.
- Research into ICTs, learning styles, study patterns and habits.

The university has introduced a range of initiatives such as federated searching, new basis of teaching, content repositories, a digital thesis programme, and an e-prints repository for staff publications.
The fourth issue is support for technologies. The university has developed an upgraded customer relationship management system (CRM) to provide better services to students. Support for technologies also necessitates increased investment in engaging and training staff; more robust technologies; and recognizing that learning takes place 24 hours a day, 7 days a week, 365 days a year.

Challenges that have arisen include:
- high expectations of students for immediate solutions;
- inappropriate uses of technology;
- inconsistent levels of support;
- the need to establish mirror networks in several countries.

In order to resolve such challenges, the university undertook the following measures:
- Coordinated centralized approaches to ICT support and strategies;
- considered outsourcing options;
- developed new organizational structures, policies, planning, and procedures for technology support.

The fifth issue is quality of education. In recent years there has been a greater emphasis on quality within the Australian educational system, thus people expect high-quality learning resources and online resources. A quality system requires that the university deal with copyright and intellectual property issues, maintenance and upgrading of learning resources.

The plan towards implementing a higher quality system includes: guidelines, templates and processes; integration of interoperable systems and applications; quality systems; accreditation and endorsements from outside bodies; and a quality assurance framework.

At the University of Southern Queensland the cost of face-to-face courses, online courses, or traditional distance classes is the same because the quality of the learning experience is the same. The university has worked extensively to ensure that all educational materials and courses meet each faculty’s high quality standards.

The sixth issue is managing and setting technology expectations. The key is to establish a framework in which technology expectations can be met through a consistent approach. Managing technology expectations requires the institution to constantly revise policies and processes, and provide various orientation programmes in which to communicate expectations with students.

The lessons on m-learning that have been learned at the University of Southern Queensland can be summarized as follows:
- Develop a framework for m-learning appropriate for your own context
- Don’t be seduced or consumed by new developments in technology
Collaborate
- Learn from the successes and failures of others
- Use mentors and consultants as catalysts

E-learning and m-learning have changed, and will continue to change traditional approaches to teaching, learning, student support, and administration. Thus, it is critical to develop an institution wide approach which focuses on:

- Policies and systems.
- Regular review and upgrading of infrastructure.
- Centralized coordination of services.
- Establishing quality standards.
- Setting expectations and communicating them effectively.

It is important to remember that technology is only a means to an end. It must be used wisely to develop systems and approaches which promote quality education provision.

L. Case Study and Demonstration: NEARStar English as a Second Language

Mr. David C. Brauer, Director of Information Technology, PREL
Mr. Tony Tung, Director of NEARStar Programme, PREL

NEARStar is the Network for English Acquisition and Reading, Star Schools programme. It is an interactive, web-based multimedia programme designed for students who are in the beginning stages of English language development (oral and reading). This unique e-learning teaching method merges reading-skill instruction with early English language development, specifically linking what students can understand, to what they are presented with in print. English language learners (ELLs) learn featured vocabulary words and phonemic skills from engaging activities, animated chants and songs, and interactive online books that provide repeated exposure and focused practice. At the same time, real-time monitoring and assessment provides teachers with the data and resources they need to help students succeed.

NEARStar has received numerous awards due to the following factors:

- Emphasis on curriculum rather than technology.
- Research-based curriculum.
- Merged pedagogies of reading and English Language Development.

The NEARStar programme was developed by internationally recognized reading expert, Dr Elfrieda Heibert who discovered that reading skills are acquired more successfully when the rate of introduction to new words is lowered and the rate at which new words are repeated is increased. The NEARStar programme is also based on the finding that successful English language acquisition requires high-meaning words with images, phonetically regular words, and high frequency words; and that songs, chants, and poems greatly enhance phonetic awareness.
The programme designed for students who were falling behind academically in English involved five key design guidelines, as follows:

- Active engagement and immediate participation in a supportive environment accelerates learning.
- Content of proficient reading for ELLs consists of the same five domains as that of English speakers: phonemic awareness, word recognition, fluency, vocabulary, and comprehension.
- ELLs need repeated exposure to content, especially vocabulary, for steady language development.
- Books with the appropriate instructional level and with engaging pertinent content are a primary source for acquisition of English vocabulary, background knowledge and syntax.
- Technologies provide opportunities for ELLs to experience models of English and different concepts and gain various means of access.

The NEARStar programme incorporates the following principles of interactive learning:

- Situated learning including immediate environment.
- Practice and feedback.
- Learning by doing.
- Learning from mistakes.
- “Tell me, show me, let me do it”.

Research indicates that teachers in the traditional classroom setting did not have sufficient time to implement the numerous lesson requirements and were not trained or certified to teach students whose first language was not English. It was clear that technology could serve as a solution by providing an additional teacher. Furthermore, multimedia (audio and visual) technology would help students to become interested in the content. In addition, computer software would be useful in assisting students who struggle with reading difficulties by enabling them to be active, self-directed learners. Computer software could also be used to display animation, facilitate the collection of data, and create administrative and assessment tools such as a roster system, lesson plans, class assessment reports, and online libraries.

NEARStar is based on proven effective technology designed for English Language Learners (ELLs) from Kindergarten to third grade. It addresses reading and language development needs using a combination of interactive technology, online printable books, and traditional print materials. The curriculum is carefully crafted around the language and literacy needs of ELLs, including carefully sequenced lessons, ongoing assessment, and printable progress reports. NEARStar permits web-based delivery; macromedia flash XML for communication with database; flash for Pocket PCs which provide high quality visual effects; WiFi wireless communication, and WiMax in the very near future. The WiFi-enabled video projector used to provide demos of NEARStar, for example, does not require high-end or expensive hardware to deliver the content to a classroom.
Evaluation of the NEARStar programme

In recent years, the United States (US) government has placed increasing emphasis on empirical evaluation of educational programmes. Consequently, NEARStar designed a quasi-experimental evaluation of the effectiveness of the programme. Experimental sites were selected, based on specific criteria, to ensure that valid and reliable conclusions could be drawn. These included: the representation of key language groups; geographic representation across the US; and a range of urban, suburban, and rural schools. The assessment was conducted by a team of independent external evaluators and included teacher surveys and student progress monitoring. Multiple methods for data collection were used, including a series of individual and group standardized assessments of reading and language acquisition skills designed to assess the effects of NEARStar on student reading and language acquisition. At the end of three years, and after being pilot tested by over 7,500 students, the results of the evaluation were:

- ELLs using NEARStar increased their sight word recognition by more than twice the control group.
- Texts with good Critical Word Factors had a significant positive impact on reading speed, accuracy and comprehension.
- Content was found to be culturally relevant and age appropriate.
- Software interface was found to be effective when used independently by ELLs.
- Teachers and principals consistently identified NEARStar as a high-quality educational resource for ELLs.

Content changes as a result of the assessment included: shortened time span on some of the assessment games; reduction of number of questions or animations; and game changes based on students preferences or mousing abilities.

The demonstration of NEARStar in this m-learning workshop was the first time that NEARStar has been used as a mobile learning programme on Pocket PCs. Until now it has only been deployed as an e-learning programme. However, options for using it for m-learning are being explored.

M. HP in Education: Teaching Tomorrow’s Leaders

*Mr. Alvin Chan, Regional Marketing Manager,*  
*Public Sector, Health & Education, Asia Pacific & Japan*

The aim of this paper is to provide a holistic view of m-learning. The education scene has evolved significantly, especially in the learning process, with the emergence of new forms of ICT.

The purpose of e-learning and m-learning is to transform the student experience. Technology enables a student-centric learning experience and the ability to provide students with new and innovative learning solutions. However, student-centric learning requires an understanding of a child’s definition of a positive learning experience, specifically, what it means when a child says they had a great day at school.
ICT can provide innovative ways of addressing ongoing problems within education. In Spain for example, where truancy is a major problem, an estimated 35% of students skip at least one class a week. To address this issue, the Spanish education ministry provided over 2000 high-school teachers in Madrid with handheld computers (HP iPAQ Pocket PCs) to allow monitoring of attendance and performance of students. Parents were alerted via SMS or e-mail when a child skipped class without any valid reasons, enabling parents to be instantly informed and action to be taken.

An example of using ICT to enable better learning is a programme in New Zealand called “Children Have Ownership of Schooling” (CHaOS), at Brooklyn School in Wellington. The three-year project focuses on the use of new and emerging technologies to enhance students' ability to gain ownership and control over their pace of learning. One of the studies included in this programme includes the use of the Tablet PC to improve numeracy and literacy skills in junior schools.

In India and South Africa, areas in which access to education and resources is limited, Hewlett-Packard (HP) has initiated an I-community project by making ICTs available. This project requires ongoing engagement and communication between the government and NGOs. In Kuppam, India, HP is providing hardware, technical training, and teaching rural villagers to use ICTs and the internet to acquire agricultural information to improve crop yields, and also how to use digital photography. Equipped with new knowledge, the villagers are able start up new enterprises. In this project the villagers are the change agents.

Teaching and learning technology has evolved from having just one computer in the classroom to establishing a full school network, to a virtual school, and eventually to m-learning.

Another example is the “Classroom 2000” project in Northern Ireland. This project involved delivering wireless technology, infrastructure, connectivity, hardware, software, and applications for all schools and universities throughout Northern Ireland. The technology infrastructure had to meet the demands of 330,000 pupils and 20,000 teachers in 1,200 schools and universities. All individual school networks were linked into the online data centre through a single adaptive infrastructure. As a result, e-mail addresses and internet access was made available to all teachers, students and family, both at school and at home.

With new technology, new resources for learning and research are becoming available. New forms of learning, for example based on collaboration through e-mail and video conferencing, are more engaging and stimulating for students.

Learning institutes need the equipment and software to be able to provide students with new learning experiences. Companies such as HP are providing higher education institutes with infrastructure for e-learning and m-learning.

For example, at the National Institute of Education (NIE) in Singapore, HP enabled the transformation of the institute from a silo-centric department culture to a student-centric service organization. A student-teacher web portal platform was created to allow students to access their curriculum and project materials easily and allow teachers and students to interact online.
N. Future M-learning Opportunities

Ms. Judy Brown, Director, Academic ADL Co-Lab, University of Wisconsin System

This paper provides a brief description of the Academic Advanced Distributed Learning Co-Laboratory (ADL Co-Lab) and discusses the future of mobile learning technologies.

Academic ADL Co-lab

The Academic ADL Co-lab is an applied research organization that is looking into opportunities for education involving ICT. The vision of the Academic Co-Lab is to provide access to the highest quality education – including training and performance aiding – tailored to individual needs, delivered cost-effectively, anytime and anywhere.

As shown in Figure 4, the initiatives undertaken by the Academic ADL Co-Lab are based on firm standards to ensure inter-operability and reusability. The next step involves building compelling content, followed by the creation of repositories for this content. The next stage involves producing games and simulations which allow performance before competency. The final stage is anytime-anywhere mobile learning.

![Academic ADL Co-Lab Initiatives](image)

Figure 4: Academic ADL Co-Lab Initiatives

Current Trends in the Mobile Device Industry

It is possible that within 10 to 20 years there will be one global mobile campus. Devices are rapidly evolving, size is decreasing, capabilities are increasing, and cost is decreasing. However, battery life is still an issue for it needs to be extended. The imminent arrival of the Windows Mobile 5 will include hard drive support and a 30 per cent increase in battery life which will alleviate the problem of loss of information in Pocket PCs.
Other less-common devices being developed include wearable devices, watch computers, and handheld PCs for the visually-impaired and mid-range devices such as the OQO Ultra Personal Computer (ultrasmall portable PC). Examples of forthcoming devices that could truly impact learning and lives include: the talking pen-top computer which can draw a calculator and translate Spanish; pocket projectors that eliminate the need for a screen; and handheld game players which offer large video capabilities.

Also, research initiatives such as that by the MIT Media Lab to develop a US$100 laptop, are contributing to the potential for m-learning. This project is based on the belief that developing countries should be able to have access to the same technologies as other regions of the world. The $100 Laptop will be a Linux-based, full-colour, full-screen laptop, use innovative power sources (including wind-up), be WiFi- and cell phone-enabled, and have Universal Serial Bus (USB) ports.

Audio and video also offer future possibilities for m-learning. iPods, for example, are proving to be more than a means of playing music on the move. Podcasting is a relatively inexpensive means of storing audio files of information. This is an example of the opportunities that innovative devices and technological developments can provide for improving learning quality and education in the future.

Advantages of M-learning Devices

M-learning is:

- Continuous: where learning is not dependent on time and place.
- Relevant: where content, curriculum and tools are current and relevant.
- Adaptive: where instruction adapts to the needs of the individual student.

Mobile devices can useful in education for several reasons, including:

- Devices can be used when needed or when there is available time.
- Modular content.
- Wireless access.
- Automated delivery.
- Convenience.
- Performance.
- Information on-demand.
- Personal and responsive.

Recommendations

Below are a number of recommendations for harnessing the potential of mobile devices to enhance teaching and learning:

- Look for opportunities; follow the market and be ready to move.
- Focus on user context and needs.
- Build content in modular formats.
- Assess readiness and begin with pilot initiatives.
Dr. Hiko Tamashiro, Professor and Chair, Hokkaido University, Graduate School of Medicine

Although education is a key enabler of economic development and success, health is an equally important prerequisite for sustainable development. This paper provides a comprehensive overview of Supercourse, and a proposal for a Supercourse Asia Network.

The origins of Supercourse are with the Global Health Network in social medicine and public health at the University of Pittsburgh. Supercourse is a global library of lectures in which PowerPoint lectures and e-materials on social health, medicine, and statistics are available in multiple languages for free. Supercourse provides support for continuing education and teachers worldwide. It is a teaching support system, differing from a traditional distance education system, in that it aims to teach the teachers.

Approximately 1,500 lectures are provided by more than 1,000 authors from 134 countries. The quality of the contents and lectures is ensured by quality control measures based on continuous statistical analysis of customer feedback. Supercourse also delivers just-in-time lectures and information on public health issues worldwide. The fields covered by the Supercourses are: health, environment, sustainable development, epidemiology, pathology, rehabilitation, veterinary preventive medicine, and behavioral sciences.

The benefits of Supercourse are:
• It can provide lectures on a range of subjects.
• Fosters opportunities to work together.
• Mutual exchange of information among public health researchers, public health practitioners, physicians, teachers, and students.
• It is an efficient, fast, and inexpensive channel of information exchange.

Supercourse Asia is currently in the proposal stage. Supercourse Asia would be a regional library of lectures, relevant to the region in terms of languages and content. The proposal came about as a result of the third Japan and Pacific Islands Forum held in Okinawa.

Supercourse Asia would be managed through the establishment of a Supercourse Asia Network (SCAN). The objective would be to provide the Asia-Pacific region with equitable opportunities for education and for attaining better health. SCAN would involve a regional network of volunteers including students, academics, government, international and regional officers.

Potential members of the network are the member states of Asia, and of the Pacific Islands Forum; regional agencies such as UNESCO, UNDP, UNU, and ADB; regional universities; and local NGOs. The lectures would be provided voluntarily and could potentially provide access to previously unreachable
areas, fostering collaboration across the region. Supercourse Asia is based on the open source model, which allows free redistribution and allows modifications and derived works. The full contents of the Supercourse lectures will be provided for free, and will be accessible in developing countries with limited access to resources.

It is hoped that this project will lead to rapid, on-time, and efficient transmission of public-health and other information, and will help attain better health and quality of life for all through a global village of universal learning.

P. Technology for Teaching and Learning Today: M-learning (Tablet PC) Applications

Mr. Lim Soon Jinn, Deputy CEOI, Heuristix Lab, Singapore

This paper will share ideas on m-learning based on the “Tablet PC project” at Crescent Girls School in Singapore. The project established a learner-centred, interactive, experiential, and adaptive learning environment.

A Tablet PC differs from a Personal Digital Assistant (PDA) in that it allows the user to write on the screen much like real writing.

The vision for the Tablet PC project, led by Heuristix Lab, was to enhance learning outcomes through the use of innovative technology. Initial explorations into the project began in December 2002. At this time seminars were conducted with teaching staff during which they explored the usage and function of the Tablet PCs. During these preparatory seminars the staff proposed a list of possible software applications for classroom curriculum that could be developed on the Tablet PCs. Many teachers taught themselves how to use the Tablet PC in a short time, while other teachers were trained in two lessons of approximately 1:30 hours each. The teachers’ initial involvement and consultations were critical for the successful implementation of the m-learning programme.

In this project, all students were given Tablet PCs to be used in the classroom. Students were able to conduct the following learning activities on their Tablet PCs:

- Take notes in class.
- Communicate using e-mail or instant messaging.
- Draw diagrams.
- Journal writing.
- Map reading.
- Online research for learning.
- Select research topics.
- Prepare student presentations.
- Collaborate with others on class-work.
The initial feedback from teachers and students on the use of Tablet PCs included the following comments:

- Useful in organizing thoughts.
- Felt more natural writing than typing.
- Useful for subjects that require spatial organization, languages, and construction.
- Makes schoolwork more interesting.
- Allows student to learn more independently.
- Enhances knowledge about Information Technology (IT).
- More motivated to do homework.
- Allows more interaction with classmates and friends.

A variety of innovative software applications enhanced the educational process on the Tablet PC. “Fun with Construction”, for example, is an application that functions as a mathematical tool, a map reading tool, and a flow-charting tool. “Fun with Virtual Classroom” is used for administrative purposes and classroom management. “Fun with Mind Book” is utilized as a scrap-book, organizer, and mind-mapping tool.

The cost of each Tablet PC is currently around US$1300, while the cost of software for all applications is around $US100. It is advisable for schools to employ a technical assistant to assist in maintaining hardware and trouble-shooting.

The key success factors of the Tablet PC project were as follows:

People
- Strong leadership.
- Well-structured professional development plan.
- Committed stakeholders.

Tools, Infrastructure and Policies
- Custom tools/applications.
- Infrastructure.
- Policies (Operations Flowchart; Values Education; Guidelines for Responsible Use; Anti-Theft precautions).

Future plans for the Tablet PC project are: to create more content applications and to develop a central database that will store the lesson plans.
Q. M-learning Issues and Strategies

Mr. Cédric Wachholz, Chief, ICT in Education Unit, UNESCO Asia and Pacific Regional Office for Education

The biggest challenge in educational planning is to set priorities. Priorities must be set because educational development is faced with an eternal dilemma: the need to increase access and improve quality, but at the same time decrease costs.

UNESCO has developed a toolkit to assist policy makers in every stage of educational planning. This paper provides a brief overview of the UNESCO policy makers’ Toolkit.

The toolkit provides a step-by-step guide to educational planning and policy-making, which is a complex process and requires a minimum of several weeks.

In brief, the first step is mapping of the present situation (situational analysis) including the national vision, goals and plans; educational context; existing ICT in education; and analysis of dynamics of change. This analysis of the educational context leads to an understanding of the situation and priorities. An analysis of the dynamics of change includes decision-making modalities, quality making process, preparedness of the ICT sector, and attitudes of decision makers.

The next steps are to: establish educational priority areas; identify areas for ICT intervention; and list the various objectives for each educational level, target population, and curriculum emphasis.

Based on the objectives one can generate possible scenarios. The implications of the scenarios are then assessed according to desirability, implementability, affordability, sustainability, usability.

For further information about the policy makers’ Toolkit, visit the UNESCO Bangkok ICT in Education website: www.unescobkk.org/education/ict/policy
R. M-learning in Practice

Mr. Christopher T. von Koschembahr, Worldwide Mobile Learning Executive, IBM Learning

This paper discusses how m-learning devices are contributing to achieving educational objectives and provides guidelines for the successful deployment of mobile devices in education.

How mobile devices can contribute to education

M-learning enables the extension of learning such that it weaves itself into a person’s work or personal activities, when and where they need it. People with time constraints need small portable learning objects that suit low bandwidth conditions, and these devices must suit a new generation of learners with different expectations. Mobile devices open the possibility for new types of learning activities and can help in be a means of doing quick lessons in free time while travelling. More specifically, mobile devices provide functionalities in three key areas outlined below.

The first area is the notification system, a function that instantly sends an SMS or e-mail. This system is a means of informing and reminding the learner, and communicates information about the next learning activity. For example, such a function was used in a project in South Africa. In this project mobile devices were used to complement postal-based distance learning. An SMS was the only means of informing an individual living in a remote area that the course materials were ready to be picked up at the post office. Thus, this simple notification system enabled individuals to keep up with distance-learning activities, proving to be useful and relevant for people living in remote rural areas.

Second, mobile capabilities can provide access to a learning management system. For example, some mobile phone devices can support a text-based portal through which a student can log-in and complete enrolment for a class or browse a course catalogue.

Third, mobile devices are increasingly providing interactive applications. For example, these devices can facilitate interactive lectures, application-simulations and online discussion boards.

New trends in mobile devices

Leading trends and changes are: device convergence; mobile phones connectivity with Personal Digital Assistants and cameras; connectivity convergence; increasing bandwidth. User interface and device constraints are rapidly changing and solutions are constantly being developed.

Integrating mobile devices in education

Discussions about mobile learning require organizing contents of learning and management of people involved in the learning delivery. The education services needed for successful deployment of mobile learning are as follows:
• Education planning, including training, and skills assessment
• Education content service, including customization, selection of content and delivery
• Define, build, or host e-learning/m-learning infrastructure requirements
• Deploy multiple delivery formats including classroom, e-learning, and m-learning via a blended model
• Training management services, including outsourcing and out-tasking

It is important to remember that m-learning should be part of a blended approach, which includes e-learning and classroom learning.

**Partnerships**

Successful m-learning deployment is best achieved through partnerships. There are numerous potential partners including: content providers, wireless telecommunication companies (telecos), and governance bodies. For content providers, intellectual property protection must be ensured. For wireless telecos, revenue and increased data traffic are incentives to support m-learning initiatives.

**S. The 1:1 Computing Paradigm: Lessons Learned, Wisdom Shared on the Learning Journey**

*Mr. Bruce Dixon, Chair, International Advisory, Partners in Learning*

This paper outlines the fundamentals of m-learning programmes and provide lessons-learned from experiences in m-learning.

It is important to first establish and define a context for m-learning. The focus of m-learning should not be on the technology, but on the content. M-learning enables the creation of a personal, relevant and authentic learning experience. Mobile technology expands educational opportunities, increases efficiency, and can enhance the quality of teaching and learning.

Mobile technology can enhance education by providing the ability to display or convey complex concepts such as physics-experiment simulations or the solar system, in rapid, inexpensive ways. A useful tool is digital portfolios, tools that allow educators to chart changes in a learner over time. For further information about the benefits mobile technology can bring to education consult sources such as the *Taking it Global* website and publications by George Bradsford.

While technology is useful in education we should be cautious and continuously evaluate whether the use of the technological devices is delivering a more powerful and effective learning experience than a lesson delivered in traditional classroom mode. The reasons for implanting the technology must be clearly established and students should be expected to produce higher quality results as a result of using this technology.
Fundamentals of an m-learning programme

An m-learning project begins with a clear vision and set of objectives. This vision includes a clear definition of digital literacy. Digital fluency entails knowledge on how to use the tools to construct significant products. Although excellent content is a priority, pedagogy is the critical support factor. The role of the teacher becomes indispensable for they assist in the design of more powerful learning experience for the students. One-on-one learning and teaching is about capturing the unique and different dimensions of each individual learner and personalizing learning in ways never previously possible. Teaching needs to change along three dimensions:

- Teachers must engage with the understanding that their students bring with them.
- Teachers must teach some subject matter in depth, providing many examples in which the same concept is at work and providing a firm foundation of factual knowledge.
- The teaching of meta-cognitive skills should be integrated into the curriculum in a variety of subject areas.

The fundamentals for a one-on-one m-learning programme can be summarized as follows:

- Establish a clear vision, set of objectives and commitment.
- Select an appropriate implementation model.
- Select the appropriate hardware.
- Make professional development the first priority.
- Ensure parent and community participation and liaison.
- Undertake careful infrastructure planning to ensure connectedness.
- Assess all software issues.
- Consider finance options and insurance.
- Ensure careful project management – develop policies and procedures.
- Obtain advice on security.
- Manage programme logistics.
- Build a comprehensive service and support programme.

T. Teacher Training for M-learning

Mr. William Loxley, Principal Education Specialist, ADB

This paper discusses teacher training, teaching and learning processes, and prospects for the use of technologies in education.

The number of students in preschool, secondary school, and tertiary school are increasing rapidly. In order to meet the needs of the growing student population, a large number of qualified teachers is needed. Therefore, it is important to ensure that sufficient numbers of teachers are trained and certified. Teacher training is also an important part of improving the quality of education. Training in technology can assist them to provide relevant information but can also enable teachers to find creative ways to strengthen their classroom processes.
The teaching profession in Asia has many untrained and uncertified teachers, particularly in rural areas. In the Asia and Pacific region, it is estimated that only approximately 25 per cent of teachers are capable of handling new technologies in education. These teachers are generally secondary school and university teachers in urban areas. Approximately 45 per cent of teachers are marginal in terms of certification in technology.

New ICT devices are improving access to information and flexible learning, software is proliferating and open source software is emerging. Teachers therefore require access to, and familiarity with, new devices. In addition new pedagogical approaches and adequate working conditions are required.

A teaching workforce profile provides a guide to monitoring the growth of the teacher work force and comparing it with the number of students. Critical factors that should be considered are: teacher retention rate, experience and absenteeism, as well as the physical health of the teachers themselves. An additional consideration is teaching conditions. For example, a lack of basic amenities in the classroom can affect the quality of teaching.

**Standards for Teachers**

The International Society for Technology in Education (ISTE) has identified six dimensions, or standards, that teachers should master (See Figure 5 below). These standards and guidelines should be incorporated into teacher training and evaluation programmes.

<table>
<thead>
<tr>
<th>(i) Technology Operations and Concepts: Teachers demonstrate a sound understanding of technology operations and concepts.</th>
<th>(ii) Planning and Designing Learning Environments and Experiences: Teachers plan and design effective learning environments and experiences supported by technology.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(iii) Teaching, Learning, and the Curriculum: Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning.</td>
<td>(iv) Assessment and Evaluation: Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies.</td>
</tr>
<tr>
<td>(v) Productivity and Professional Practice: Teachers use technology to enhance their productivity and professional practice.</td>
<td>(vi) Social, Ethical, Legal, and Human Issues: Teachers understand the social, ethical, legal, and human issues surrounding the use of technology in schools and apply that understanding in practice.</td>
</tr>
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</table>

**Figure 5: The ISTE National Education Technology Standards for Teachers**

In addition to ISTE teaching standards, the system requirements identified by UNESCO for ICT Teacher Education should be adopted in order to accomplish effective teacher training.
The system requirements are as follows:

- Shared vision.
- Access to technologies.
- Educators skilled in use of ICT.
- Continuous professional development.
- Technical assistance to maintain the system.
- Standards and resources.
- Student-centred teaching approaches.
- Continuous assessment.
- Community support.
- System support to institutions and individuals.

Examples of teacher training projects

The Intel Teach to the Future website is a worldwide effort to help both experienced and pre-service teachers integrate technology into teaching. Participating teachers receive instruction and resource tips to promote effective technology use in the classroom. Another example is the District Wide Applications (DWA) Learning Systems, an interactive form of learning software which enables high school students to use cell phones and messaging systems to access information. A further example is the Nepal Teacher Education Project aims to develop a network of education training institutes to facilitate pre-service and in-service teacher training.

U. Public-Private Partnerships for Developing M-learning Programmes

Mr. Vincent Quah, Manager, Regional Academic Programme, Microsoft Corporation
Mr. Samir Patel, Principal Consultant, Optara

This paper outlines the benefits of public-private partnerships for implementing m-learning programmes.

From a discussion with the workshop participants, the education needs in most countries can be listed as follows:

- Providing education to excluded groups.
- Infrastructure.
- Learning guarantee.
- Utilization of the knowledge gained.
- Sustainability.
- Educational content, software and genuine operating systems.

Feedback from workshops participants generated the following list of ICT-related educational goals:

- Basic infrastructure.
- M-learning for the entire country.
• Applying e-learning to multi-disciplinary subjects.
• Efficient use of ICT in education.
• Technology that does not become obsolete.
• Optimal use of existing resources.
• Engaged learning.
• Capacity to make decisions.

Currently, 130 million children never attend school and 872 million adults do not have the basic skills to break their way out of poverty. Educators and government officials have told us that current teaching and learning methods will not bridge the educational and digital divide, therefore new approaches to education need to be devised. Initiatives are required which empower educators and learners and provide a holistic approach to learning. Educational policies must address technical support, standards, innovative software, digital content, training, and access.

From a discussion with participants about their perspectives of public private partnerships, the following list was generated:

• Mobilize resources.
• Coordination.
• Involving the community.
• Social mobilization.
• Cost structuring.
• Integrated participation in technologies.
• Sharing of experiences and results.
• Supportive.
• Partnership between government and private enterprises.

Public-private partnerships involve the private sector, government, end users, NGOs, public organizations, and most importantly the community. Public-private partnerships are pursued for the following reasons:\footnote{Caldwell, Brian, and Keating Jack. 2004. *Adding Value to Public Education: An examination of the possibilities of PPP*. Discussion Paper for Australian Council of Deans Education. Victoria, Australia.}

• Failure of public authorities to meet expectations.
• In order to secure higher levels of funding.
• A “third way” of delivering services to the public.
• The building of social capital.
• Transformation of public sector services in a knowledge society.
**Requirements for successful public-private partnerships**

Win-win partnerships are those which account for differing expectations and conflicting objectives.

Successful public-private partnership entails:

- A stable transparent framework that guarantees equality.
- Political will.
- Economic viability.
- Social legitimacy.
- Clear roles and responsibilities.
- Communication.
- Clear expectations.
- Ownership.
- Leadership.
- Trust.
- Change optimization.

The following factors are important for successful public-private partnerships:

- Strong support from government to promote private sector.
- Strong private sector.
- Flexibility.
- Capacity building.
- NGO participation.
- Cultural relevance.
- Equity.
- Transparency.

**Example of a successful partnership**

An example of a successful public-private partnership in m-learning is the “School of the Future” (SOF) project in Taiwan. This project came about through efforts by the Government of Taipei to pursue m-learning and ICT-enabled education. The Government’s holistic and integrated vision involved incorporating the following factors in order to enhance student achievement:

- Public policy support and integration.
- Education policy.
- Curriculum and pedagogy.
- Learning space design.
- Teacher training.
- Innovative technology.
- Research.
The partners involved in the School of the Future project included: the Taipei City Government (in charge of public policy and planning); Taipei Bureau of Education; the Teacher Training Institute; Tamkang University; Zhong-Lun High School; and companies from the private sector including Microsoft and Infovision; as well as NGOs.

The key driver of the project was a policy imperative initiated by the mayor of Taipei to modernize infrastructure and stimulate economic growth. The city has recently embarked on an aggressive initiative to blanket the entire city with a wireless network involving 10,000 antennae across the city, with the goal of providing 100 per cent WiFi coverage by December 2005.

The new mobile teaching and learning programme involved the community and all educational institutions within the city. Each school formulated a proposal for an ICT-enabled curriculum and submitted it to the Taipei Bureau of Education. Zhong-Lun High School was chosen as the site for the pilot project.

An advisory committee consisting of private enterprises, and local academics developed a 20-week curriculum for teacher training. NGOs provided best-practice information, including information of past successes and failures. The university provided a research framework and pedagogy, and the Bureau of Education worked with the community to get feedback from parents and students. The private sector furnished the bulk of the financial resources for the rejuvenation of Zhong-Lun High School’s existing infrastructure. The hardware and software costs for the three-year project was approximately SG$400,000.

In all, the project was deemed a success because the following components were continuously maintained and integrated: strong policy support; strong leadership; state-of-the-art technology and software; strong teacher and administrative training; ongoing consultation and collaboration with stakeholders; ongoing research that serves as feedback; and willingness to develop new ideas and models.

V. Global Development Learning Network (GDLN)

Mr. Ashok Daswani, Senior Information Officer, Tokyo Development Learning Centre

The Global Development Learning Network (GDLN) consists of the World Bank Global Communications network which encompasses distance-learning centres (DLCs) across 119 countries. The communication network is comprised of three satellites (the World Bank buys transformer space on the satellites) and involves a mix of technologies including voice, data, video, fax and internet.

The network was originally based on permanently assigned multiple access (PAMA) providing independent links into each office, then moved to virtual demand assigned multiple channel (DAMA) link satellites, to achieve full IP convergence over asymmetrical single channel per carrier (SCPC).
The Quality of Service (QOS) differentiates the network from the normal internet because it provides bandwidth and jitter guarantees, and gives priority to video and audio, which are important for video conferencing.

Migration to IP has provided numerous benefits. These are:

- Improved quality of all services.
- Single communication pipe for voice, data and video.
- Low communications equipment complexity.
- Low operation and management costs.
- Easy integration with local area networks.
- Automated dynamic service interchange.
- Automated videoconference scheduling.
- Full compatibility with internet.
- Simple re-engineering for future growth.

The network currently covers 82 distance-learning centres worldwide. Africa has 11 distance-learning centres; East Asia has 14; Europe has 9; Eastern Europe and Central Asia have 14; Latin America has 19; Middle East and Northern Africa have 7; North America has 4; and South Asia has 4. There are various types of distance-learning centres, including:

- Separate Centres connected to the World Bank Network via VSAT, IPL, ISDN, or internet.
- Centres within World Bank Country Offices.
- Institutions which have joined the GDLN as affiliates.
- Partner-organizations such as the British Council.

The learning interactions that define the functionality of the Global Distance Learning Centre are:

- Interaction between student and teacher including two-way videoconferencing; two-way communications; two-way collaboration tools.
- Interaction between students through discussion forums, chat rooms, and bulletin boards.
- Interaction between student and study materials, including web-based access to course material and information resources, as well as internet access.

Future initiatives for the GDLN include the development of Internet Two (IPv6). Internet Two was designed for multimedia applications including voice, video and data. Internet Two has 128bit IP address while Internet One has 32bit IP addresses. Internet Two has built in security solution and built-in quality of service network. The Internet Two is gradually emerging with implementation in private corporate networks, some universities in Europe, some limited commercial offerings on dedicated routes in the US, and on the Global Network of the World Bank. The consortium Internet2, the foremost U.S. advanced networking consortium, led by 200 universities working in partnership with industry and government, set out two objectives: develop and deploy advanced network applications and technologies; and recreate the partnership among academia, industry and government.
The consortium led to the creation of the Abilene network. Currently, the Abilene network has 10Gbps network; uses both internet protocol version 4 and native IPv6, is based on OC-192c circuits; and equipment is collocated with Qwest points of presence. The World Bank will connect its headquarters in Washington D.C. to Internet2’s high performance Abilene network. The World Bank’s connection to Abilene will permit the existing GDLN video-conference network to interconnect with the Internet2 community in the U.S. and to institutions connected to its 50 partner national research and education networks (NRENs) around the world. Successful utilization of the Abilene network requires full usage of multi-priority QoS scheme on the run, but as QoS is currently not supported VC performance over the Abilene backbone is “enabled” on the best-effort-basis and uses the network’s excess capacity. In addition, the leased line providing connectivity between GDLN centre and Abilene network has to provide enough capacity to prevent an overload. Once QoS is implemented the leased line capacity can be reduced.

Common activities provided through the network include: lectures, meetings, conferences and seminars on development issues, or consultations such as between the Japanese Government and Thailand during the tsunami.