The rapidly changing demands of a knowledge-based economy (KBE) have introduced a new paradigm to the educational scene, where the effective creation and application of knowledge are becoming paramount. KBE has also blurred the divide between formal education and adult learning, so much so that continuing education and training has become key to the continued employability of a worker.

A crucial component in ensuring the success of Singapore's education system is the quality of the teachers. The National Institute of Education is the sole teacher training institution in Singapore responsible for producing teachers effective in preparing students for the KBE.

The NIE has also defined a basic e-learning platform that allows fast and user-friendly access for building online courses. This platform is professionally supported by a team of instructional designers and resource/content materials developers. In the building up of online courses, NIE has adopted a 'learn-together' philosophy, where academic staff members picked up basic online skills together with the support team. To ensure that the technical aspects of the course delivery are well taken care of, NIE has invested strongly in the technical infrastructure for the e-learning platform adopted. Recognising the need to be able to translate and integrate established ICT into teaching and learning, NIE has actively engaged in ICT in education R&D. The primarily aims are to explore the possible uses of the various emerging technologies, such as the use of WAP over GPRS for discussion purposes, and to define ICT-enriched teaching and learning environments of the future.

This paper will end by discussing the various possible future trends in the use of ICT for teaching and learning, particularly when applied to lifelong learning.

1. INTRODUCTION AND OVERVIEW

Singapore recognises that, as a resource-scarce country, her ability to maximally develop her human resource through education is central to the economic survival of the country. As such, education has always been among the top priority focuses of the Singapore government [TEO, 1998].

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Communication Technologies (ICT) into education. This is a five-year S$2b plan that aimed to set out a blueprint for the use of IT in schools, and to provide access to an IT-enriched school environment for every child [CHEAH, 2001]. This Masterplan has injected resources into the schools and provided the foundation upon which an ICT-enriched environment can be built to make teaching and learning more effective. At each phase of the implementation, each primary school was provided with an initial student-computer ratio of 6.6:1, and spent about 10% of its curriculum time on IT-based learning. Secondary schools and junior colleges started with 5:1 and 10% respectively for the student-computer ratio and curriculum time. The budget provided for each school depended on its size and existing physical facilities. This budget was used for furni-ture, hardware, networking, software purchases, teacher training and technical manpower support (primarily in the form of system integrator). The Masterplan provides for the eventual targets of a student-computer ratio of 2:1 and 30% IT-based learning curriculum time.

The IT Masterplan for education has led to the extensive and prevasive use of ICT in teaching and learning in Singapore schools. The school students are increasingly exposed to an ICT-integrated teaching and learning environment. At the same time, students entering NIE are becoming increasingly ICT-savvy with each passing year. Fresh school leavers entering NIE have progressively higher expectations of the ICT environment they will be learning in. Teachers who have graduated from NIE will return to an ICT environment that would be more sophisticated than the previous one that they were educated in. The NIE will therefore have to ensure that it is able to provide the right context, tools, and learning environments pitched at the capacities and ICT experiences of these students when they enter the programmes.

Life-long learning has transcended all walks of life, and for Singapore, it represents one of the major national thrusts to continually equip its citizen with the necessary skills to thrive in a knowledge-based economy. As a resource-scarce economy, Singapore's continued economic survival relies on a population who can not only effectively respond to the constantly changing demands, but who will also have the ability to keep one step ahead of these changes. To achieve this, life-long learning must become a way of life. NIE has to start thinking of her trainee teachers as having a life-long relationship with the institution. The students should not be seen as being with the NIE only for the duration of their formal programmes, but possibly for the rest of their professional career. To achieve this, the NIE must be able to provide for most of the teaching and learning needs of the teachers. This need to have a coherent strategy to cultivate life-long learning becomes urgent in view of the teaching and learning potentials offered in the use of ICT in education.

2. STRATEGIC DIRECTIONS AND FOCUS AREAS

As part of an overall plan to meet these challenges, NIE has embarked on implementing her own IT plans in 1996 to integrate ICT into teaching and learning [KOH, 1999]. On top of this, NIE recognises her responsibility to actualise ICT-enriched teaching and learning models, at all education levels in Singapore, that are based on sound pedagogical principles.

The initial phase of NIE’s IT plans, from 1996 to mid 2000, focused on building up physical infrastructure and expertise in the area of ICT integration. By mid 2001, the infrastructure build-up in NIE, while incomplete, has reached a sufficiently advanced level to allow the NIE to begin exploring and experimenting with education in an integrated ICT environment on a systemic level based on sound pedagogical constructs. Since then, NIE has streamlined her strategic directions for ICT integration into three areas, namely (a) the continual development of physical and human infrastructure; (b) e-learning; and (c) R&D in use of ICT in education.

In spelling out the philosophy and implementing the strategic directions in the above three strategic directions, NIE has identified two major focus areas of work that will put NIE firmly on track to achieving its goals. These focus areas are (a) establishment of an information structure in NIE; and (b) promotion and establishment of an e-learning culture in NIE.

3. STRATEGIES AND IMPLEMENTATION

This section discusses the strategies and selected implementation details employed by NIE to fulfil the goals set out in NIE’s IT plans.

3.1 Physical Infrastructure

NIE recognises that the continued build-up of physical infrastructure is crucial to the success of her IT plans. As such, the institute aims to continually provide relevant ICT infrastructure at a level that will effectively support the proper integration of ICT into teaching and learning. Apart from needing the infrastructure to support the various teaching and learning models developed at NIE, it is also important to have a strong enough ICT-enriched environment that can encourage innovative uses of the technologies from both trainee teachers and staff members. In other words, NIE is prepared to allow staff and trainee teachers to explore and experiment with the use of ICT in teaching and learning that will lead to the re-defining and/or refining of the teaching and learning models.

The provision of a network that is efficient and reliable enough for the seamless delivery of multimedia content is central to the majority of existing teaching and learning models for an ICT-enriched environment. NIE has established such a network, and is committed to continue to build and maintain the network infrastructure that extends beyond the wired infrastructure into a wireless infrastructure.

To achieve successful actualisations of ICT-enriched teaching and learning environment, it is important to equip academic staff members (and hence trainee teachers) with the necessary skills set to do baseline web and ICT-based content development. This baseline skills set is expected
to need constant review and revision. For instance, web page creation, which used to require some programming skills, is now considered part of the baseline skills because of the availability of editors such as Dreamweaver and Frontpage. It is NIE’s firm belief that, in order to achieve an institutional transformation and appropriate integration of e-learning in the curriculum, staff members must have both the capability and support for content development. As such, basic content development facilities, such as digitisation and imaging stations, have largely been decentralised and provided within each academic group or clusters of academic groups. More advanced content development could either be done with in-house expertise from supporting centres such as the Centre for IT in Education (CITE), AG-developed technical expertise etc; or out-sourced to professional developers.

### 3.2 Human Infrastructure

A support structure has been set up to enable staff members to do baseline web and ICT-based content development. Briefly, it consists of three levels of support:

(a) **Level 1**: Management Support Officer (MSO) & Clerical Support Officer (CSO) provide basic support within each AG.

(b) **Level 2**: IT Support Officers (Computer lab technicians with wide job responsibilities) provide mid-level support for all twelve AGs.

(c) **Level 3**: High-level support provided by selected programmers and network engineers from the Computer Services Centre (CSC) and CITE.

Apart from the above, pedagogical advise from instructional designers is also available from CITE.

An integrated helpdesk was set up in February 2001 to cater for the computing needs of NIE staff members and trainee teachers. The helpdesk ensures that support for all computing and audio-visual facilities provided by the division of Academic Computing and Information Services (ACIS) can be obtained by making only one call to the helpdesk. The helpdesk team consists primarily of staff members from CSC and CITE (both centres are in the ACIS division), and it took several months to properly mould the team into an efficient and responsive force. The following main strategies have been used to achieve this: (a) Continual team-building activities; (b) provision of customer service and related course; and (c) rotation of jobs to broaden the skills set of the members. To date, NIE has seen marked improvements in service support level.

In the plans for ICT skills development for staff members, NIE has adopted a ‘learn together’ philosophy. For basic ICT skills, staff members are expected to acquire them through actual application (primarily for content development) with appropriate help from the MSO, CSO, IT Support officers or ACIS staff members. Co-ordinated and ‘just-in-time’ training opportunities are also made available. For instance, an online support management system was set up to provide online help for ‘blackboard’ users.

### 3.3 e-Learning

The main work in this strategic direction focuses on two main areas; namely, in the development and adoption of e-learning platforms; and the actualisation of teaching and learning environment of the future. While NIE was tempted to develop its own e-learning platform in-house to cater to our specific needs, it was decided that resources would be better deployed in adapting and modifying a commercially available e-learning platform.

Although there are a wide variety of e-learning models, the features of the majority of online delivery systems are almost identical. To facilitate the move towards an ICT-enriched environment, NIE has adopted ‘blackboard’ (http://www.blackboard.com/) as its entry-level course delivery system. The choice was based largely on the user-friendliness of the system. ‘Blackboard’ thus provides the basis upon which the various e-learning models used by NIE could be built. The strategy adopted in this area is two-fold. First, basic pedagogical templates based on ‘blackboard’ had been developed for each AG. The templates provide an easy entry to online course development for staff members using online teaching for the first time. Second, staff members who already have experience with online teaching and learning are encouraged to explore other e-learning platforms and models, particularly those that go beyond the confines of systems such as ‘blackboard’ that have predefined pedagogical models.

As mentioned earlier, NIE recognises its responsibility in defining, developing and actualising teaching and learning environments of the future that are based strongly on pedagogical principles. NIE has plans for up to five such environments at different educational levels. The first such environment has been established in October 2001 for the tertiary level. Two other environments, one for primary and one for secondary, are in the formulation stages, and are expected to be completed by the end of 2002.

### 3.4 R&D in the use of ICT in Education

The primary focus in this strategic direction is on researching applications of ICT in teaching and learning, and not on ICT. In particular, it is intended that NIE will channel R&D efforts in this area towards addressing pedagogical needs and challenges in the Singapore schools.

To do this, it is important to recognise that the rate at which new ICT emerge is likely to outstrip pedagogical adoption and/or application of new ICT. In view of this, NIE has adopted two broad strategies. First, a group is established within NIE to constantly look out for new ICT with the intention of identifying possible applications in teaching and learning. Selected ICT will then be pilot-tested in small-scale projects. These projects included WAP devices and PDAs. Second, a separate group has been given the task to translate ‘established’ ICT into teaching and learning environments. An example is the use of ‘microLESSONS’ (http://www.microlessons.com/). “Micro-LESSONS” are focused IT-based instructional components that are developed using ubiquitous software such as Microsoft Powerpoint to teach specific objectives within a lesson. Teachers and
teacher-trainees could easily create and modify learning units using a wide range of pre-prepared presentation templates and pedagogical models based on the Microsoft Powerpoint software.

3.5 Focus Area: Information Structure

From July 2001, NIE has embarked on creating a knowledge and information management system that will provide staff members, trainee teachers and teachers in the schools a ‘one-stop’ access for all information, administration, teaching and learning needs. Broadly, this system will consist of three main layers; namely, database, application and interface layers.

The database layer will house all relevant data and resources of NIE within a security strata structure, where access to different databases will depend on the access authority of the user. The consolidation and integration of these databases have began since late 2000, with the primarily goal of achieving a state whereby the same data required by various application systems need only be entered once.

The interface layer specifies the interaction between users and the system. As far as the user is concerned, they will need only to negotiate this interface to access all information and resources of the system. This interface layer is implemented in three phases as the ‘NIE Portal’ (http://nieportal.nie.edu.sg/main.htm), with phase I, intended for trainee teacher use, completed in July 2001. Phases II and III, for school teachers and staff members, have been started simultaneously, but will take a longer time to develop, as proper integration with the databases is needed.

To achieve an anytime-anywhere access to the system, it is necessary to build applications that are web-based. NIE is gradually translating its current client-server application systems into web-based applications. This, together with the development of various new web-based applications, such as facilities management system and online leave system, will form the application layer. It is anticipated that this layer will take up to 2 years for completion.

3.6 Focus Area: E-learning and Cultural Mindset Change

For successful integration of ICT into teaching and learning, there needs to be a definite cultural mindset change for NIE staff members. Although the emphasis has always been on the appropriate use of ICT rather than ‘using ICT for the sake of using ICT’, an open mind plus a familiarity with a ‘click and learn’ culture have to be established. To accomplish this, NIE has several strategies and broad activities, a selection of which is briefly discussed below.

The use of e-learning is promoted among faculty members through a series of regular mass and selective updating of e-learning and e-learning related activities established within NIE and beyond NIE [OVERHOLTZER, 2001]. Two teams, one led by the IT Sub-Dean for e-learning and the other by the IT Sub-Dean for Projects, have also been formed to help in such efforts and at the same time provide the necessary support for academic staff members. The work of these teams is focused on two aspects; first, is to get staff members on board in the e-learning environment; and second is to achieve depth in specific e-learning niche areas. Full engagement of staff members in institute-wide initiatives is carried out whenever possible. For instance, open and selective invitations were made to staff members to participate in the design of teaching and learning environments of the future. Other activities include the regular sharing of best practices in the use of e-learning.

The proper recognition of achievements in e-learning efforts has to be established. This may come in several forms, such as the setting up of a ‘Course of the Year Award’ in addition to the annual ‘Teacher of the Year’ award. Participation and showcasing of various efforts and projects in appropriate settings have also been regularly carried out.

The fundamental idea in building an e-community in NIE is to establish a propensity for e-interactions among staff members. For instance, when the support management system that provides just-in-time online support for ‘Blackboard’ was established in mid-2001, the ‘offline’ support in the same areas was removed. The basis for a successful e-community lies in creating real reasons for staff members to participate. During the use of an online discussion and sharing system, called ‘webinar’, for the 3-week e-activity in October 2001, staff members were actively engaged in crystallising the attributes of a learner-centred teaching and learning environment. Lessons from this activity have also indicated that it is useful to integrate part of curriculum within the e-community to address teaching and learning issues, which in turn, could attract the participation of teaching practitioners outside of NIE, such as schoolteachers and principals.

4. FUTURE TREND: Life-Long Learning

This paper shall conclude by reiterating the importance of a proper life-long learning model for NIE. Although such a model has yet to emerge in a definite form, several of its attributes have been identified. These are broadly listed below:

(a) Need for collaborations

The professional needs of teachers generally go beyond that which can be provided by NIE. As such, meaningful and mutually beneficial collaborations with other institutes of higher learning, the Ministry of Education, schools and industrial partners that can complement the expertise of NIE have to be enacted.

(b) Flexible, Bit-size modules

The model in which learning is to take place for a working person needs to take into account his/her constraints of space and time. Modules within such a life-long learning model will necessarily have to be flexible both in terms of duration and content. At the same time, they also need to be very specific in addressing the professional needs of the teacher (or worker).

(c) Just-in-time learning

Although just-in-time learning has always been desired, a proper implementation of this has yet to emerge.
This element of the model must address specific needs fast enough, which an e-learning environment can potentially fulfil.

\[(d)\] Smooth transition between formal and adult learning
The learner should feel that learning is second nature.

\[(e)\] Proper certification
Proper certification of modules undertaken has to be established.

References


Website: [http://www1.moe.edu.sg/iteducation/](http://www1.moe.edu.sg/iteducation/)

