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Projecting ICT Developments in Teaching and Learning for the Near Future: Restructuring the Landscape of Teaching and Learning Interactions

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Abstract

In the current milieu of technological advancements, we are increasingly witnessing how technologies such as wireless and telecommunications can be integrated and taken advantage of in the daily interactions of the classroom and beyond. In this paper, we illustrate in simple yet novel ways how these technologies, which would in our opinion be prevalent in the near future, can be possibly adopted for teaching and learning. A case example of a teaching and learning environment as designed and developed will be illustrated. This case example illustrates the applications of wireless and mobile handheld devices, video-based learning management systems, and a flexible environment which facilitates group work.

Introduction

Recent developments in education and learning in particular are seeing a rise in notions such as interdisciplinary work and authenticity in learning with particular respect to greater disciplinary connections. These developments are giving rise to pedagogies such as project work, problem-based learning, and combinations of such emphases where learning is discipline or practice related. In this regard, many schools are now involving parents with disciplinary-related expertise to assist students in their learning efforts where projects as real-life as possible are encouraged. These developments arise from the recent surge of interest in theoretical foundations such as situated cognition (Brown, Collins & Duguid, 1989) and authentic problem-solving (Resnick, 1989).

As a group of academics and practitioners at the National Institute of Education, we have also been exploring the developments in ICT technologies with particular interest in handheld mobile and wireless devices, video-based learning management systems, and flexible learning classroom layouts. These technologies are in constant evolvement even in the midst of crafting this paper, and in our discussions we have found that these tools are able to complement the recent interest in interdisciplinary projects with experts' or practitioner involvements.

Wireless and Mobile Technologies

The predominance of handheld devices can be seen in the wallet-sized handheld devices used by professionals and even many students to keep track of schedules and appointments. Can these devices be used for learning and instruction by schools?

The wireless and mobile technologies with the accompanying portable devices in the classroom can qualitatively enhance the classroom interactions because of their flexibility and mobility. No longer do we need to "go to the computer lab" where tables and chairs are "rooted" to the positions in a rigid manner. With no wires and heavy computers that cannot be shifted easily, teachers in the traditional set-ups of computer labs have not been able to adopt alternative modes of learner-centred pedagogies. Classroom interactions were also merely confined to the classroom, whereas now mobile and internet technologies can bridge students to learning situations or project work with experts outside the classroom. These technologies need not only connect students to experts, but can assist in peer-tutoring or collaborative situations with other students outside the boundaries of the classroom and school. In essence, the wireless and mobile technologies enhance flexibility of instructions within a classroom and afford the ability to transcend the physical boundaries by effectively linking the classrooms and the external resources. In the following sections, we illustrate these applications with real-life examples and case scenarios.

Applications within a Classroom

In one of the local Singaporean schools, we witnessed a classroom where handheld devices are used for the teaching of English. Each group of students was responsible for collating a group of words centred around a particular topic. As each group researched upon the topic, students in that particular group were noting down salient pointers into their handheld devices through the wireless set-up in the classroom. Subsequently, each group of students with a consolidated list of words was made to "beam" their list to the teacher's handheld, which consolidated all the individual groups' lists. The teacher was then able to use the "zig-saw" collaborative learning pedagogy (Johnson & Johnson, 1997) to integrate the entire class's findings and present them to the students. With that list, the students' continued to reflect upon the task making amendments to their conceptualisations.

Another example is in Mathematics. Let us illustrate this using the SimCalc Project (http://www.simcalc.umassd.edu) where teaching calculus is only made possible by technology. For SimCalc, a key technology is directly editable graphs of piecewise functions, connected to simulations of motion. From the research done, learners were able to explore concepts, apply their understanding, and subsequently reflect on their conceptualisations (see http://www.cilt.org).

Beyond the Classrooms

Students have been confined to classrooms and experimental laboratories for a large part of their schooling life. Would students now be able to extend their learning experiences to field trips and study groups outside the traditional classrooms? Imagine students using data-loggers attached to their handheld devices where they can collect data of water samples, and collate the data on the spot with spreadsheets. The data is immediately sent back to the teacher or other groups of students in the school classroom through mobile telecommunications technologies.

Consider another scenario – the "control tower" approach. Take the tablet PCs which are becoming popular in the personal computer market. Students can take along these tablet PCs and record data of phenomena and communicate with experts at any location (in the world) or with supervisors at the local universities through Internet technologies, either through the traditional e-mailing features or through synchronous means accompanied with a talk-head video facility. Instead of waiting to return to their schools or classrooms, students can communicate with experts "on the fly" because real-time information is needed before students can proceed with their next steps in their discovery and experimentation in the field. The supervisors at the local universities are acting like air-traffic controllers, providing real-time advice to the several groups of students. These "control tower" supervisors can even collate data from different field sites and transmit the data back to students so that they can compare and contrast the data and decide on further actions (Fig. 1).

Here are some possible scenarios where portable devices such as Personal Digital Assistants (PDAs) can be used:

Scenario 1: A student is late for class, and upon arrival to the designated location finds no one in the tutorial room. He taps his PDA to get the latest update of the venue change, sends a quick internal e-mail to his tutor to say that he is coming. When he arrives at the new venue, his tutor is expecting him because of the internal e-mail notification.

Scenario 2: The lecture hall is full and some students are unable to be inside. They sit on the wooden benches outside and view the lecture on their laptops. When the lecturer interacts with the class, the students sitting outside send their questions via some communication channel to the lecturer, and they hear the lecturer's answers via the video broadcast.

Scenario 3: An outside participant/visitor enters the University and wonders where the venue is for his seminar. He taps on his PDA to view all events happening on that day for the institute, locates his seminar title and location map, and makes his way to the venue.

Scenario 4: A student checks his PDA to see if his lecturer has indicated an "available now" on his/her schedule (found perhaps on the staff portal). If the status is "yes" (i.e. the staff is available), the student will request (via internal e-mail) for a meeting. The lecturer can decide to accept or reject (via internal

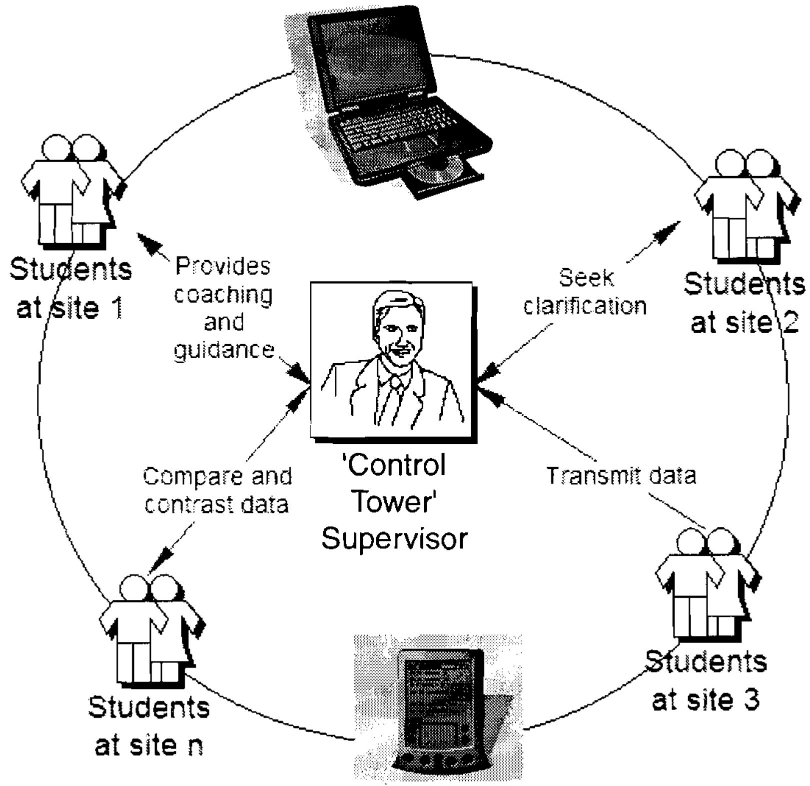

Fig. 1. "Control Tower" supervisor advising and connecting students working at different sites with mobile and wireless technologies.

e-mail). Thus the students do not need to come knocking on the door of the lecturer(s), and not knowing if the lecturer is available or otherwise.

The above are just some scenarios for enriching the learning environment within the institute. Below are some scenarios more directly related to teaching and learning outcomes.

Scenario A: A student is not able to afford a specialised software that he needs for his class. He comes to campus, logs on with his notebook, and accesses SOFTWARE-RESOURCES@NIE, locates his software and uses that software from the virtual drive. Since the software is covered under a campus site licence, many students are allowed to use the software at any one time. He finishes his work, logs out of the virtual drive, and carries on with other activities.

Scenario B: A student who has an assignment to do is not quite sure how to do the analysis of the problem. He logs on to LEARNING-AIDS@NIE, and accesses stored information on problem analysis and critical reading. He picks up the pointers he needs to carry on with his assignment.

Scenario C: Two groups of students are working at two different locations of the campus, e.g. one group at the library and the other group at the science laboratory. The two groups access a common collaborative workspace, and share information with each other synchronously. The group at the library sends scanned images from books and magazines (using their handheld scanners or web-cams) while the other group collates incoming data captured from their science experiments and internet resources accessible from the laboratory.

Scenario D: One professor shows a live video of his colleague in the specialised discipline related laboratory during the lecture. The colleague is showing how his research assistant (RA) has obtained the experimental results. Students in the lecture theatre can send their questions verbally or via internal e-mail to the colleague or RA at the laboratory, and hear the answers from the video. The RA sends his experimental data to the shared workspace so that it can be picked up by the students later, or be displayed by the professor for a later part of the lecture.

Scenario E: A student collects digital information (e.g. articles, images etc.) during the day on his laptop and backs-up his data collection into his personal virtual space. He posts relevant information into his various project teams' virtual collaborative shared workspaces. The students who share the information resources subsequently interact with the digital information, making associations with other forms of data in order to complete a project.

Scenario F: A group of students work on an intelligent white board (contents of which can be digitised and stored into the shared workspace) within a face-to-face context. At the end of the discussion, the contents of the white board are stored in their collaborative workspace for future use. These students subsequently meet virtually to expand on their ideas as initiated by the whiteboard discussions using collaborative mediated tools such as knowledge building applications and concept mapping tools.

The possibilities for the use of portable devices with the combinations of mobile and wireless technologies would be manifold. We wish to encourage educators locally and internationally to consider how these technologies can be capitalised on in your school's efforts in interdisciplinary work and problem or project-based learning efforts. Along side these handheld devices are smart probes for data collection – particularly useful for science concepts – which can fit in well to project work. In addition, these mobile and internet technologies can keep students' interest connected to available resources – both information and experts. See Fig. 2 for an illustration of the use of portable devices in the classroom.

Notice in Fig. 2 that the classroom environment is far from the conventional traditional computer lab. In this environment, portable devices can be "charged" (batteries) using the docking or charging stations made available to the students.

Video-based Learning Management Systems

A video-based learning management system is similar to the web-based management systems such as the BlackBoard Management System®. In addition to the features of administrating and managing students' accounts, these systems enable the course materials to be put online, facilitate discussions, have whiteboards for

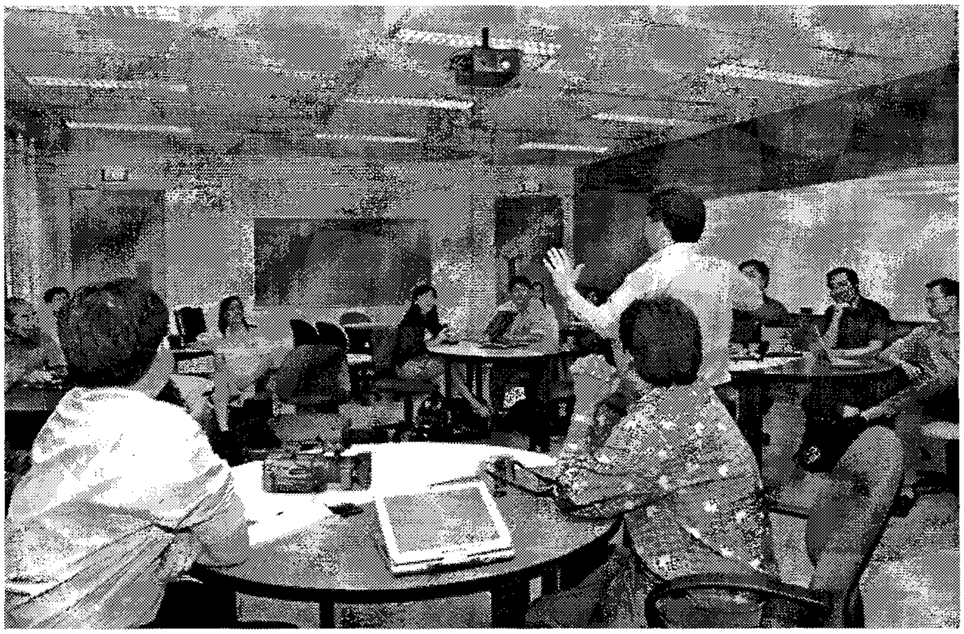

Fig. 2. Students using the portable devices to record information and communicate with people outside the classroom.

illustrating pictorial concepts, make available web-resources, etc. A video-based learning management system features the additional dimensions of having video-based materials to be made easily accessible in a non-real-time manner, and also real-time live videos (such as lectures and discourse with persons). These real-life videos could be in the form of video-conferencing or lectures.

At the National Institute of Education, we have envisaged how these video-based Learning Management Systems (LMS) can be used to facilitate our teaching pedagogies. First, we envisage that video-based LMS can be used to complement the teaching supervision efforts by our lecturers. Supervisors could meet up with their trainee-teachers in pre- and post-conferences where the students (perhaps up to six of them) can interact with their supervisors in real-time and the trainee-teachers can hear out each others' problems. This method is adopted from a research project entitled Multi-Point Desktop Video Conferencing (MDVC) where the processes of practicum are facilitated (Sharpe *et al.*, 2000; Hu *et al.*, 2000).

Second, video-based LMS can facilitate in-service modules where students or in-service trainees may not need to come to campus for face-to-face interactions for all the sessions scheduled. Faculty could adopt two of the ten sessions on the video-based LMS where the learners could link themselves online to the instructor(s) at their own schools where perhaps a project is to be engaged upon. In other words, video-based LMSs can complement the traditional face-to-face settings.

A third function of video-based LMS is the learning of materials and resources at anytime and anywhere. Because all video interactions can be recorded, for example, live lectures or discussions, this footage can be accessed at the availability of the students. Students who cannot attend live sessions can pursue the materials and video recordings from their schools or work places. In these LMSs, videos can be synchronised with corresponding materials of practically any format such as pdf files, Micorsoft Word documents, etc.

It is our opinion that video-based LMSs are to be soon predominant for e-learning. We recognise that these environments are not stand-alone systems but they can be very powerful mechanisms when complemented with face-to-face situations. Learning can be made more flexible and students can be given more options as to the mode of interactions and attendance. Flexible modes can eventually be extended to forms of course participation beyond the semester or module system where learners can take their "passing out" examinations only when they have finished with the materials and course interactions. Perhaps within this decade, technologies can facilitate these forms of flexible learning in the universities. See Fig. 3 for a classroom interaction using video-based LMS to interact with an expert outside the classroom.

The students in Fig. 3 are interacting with the "talking-head" (see screen on Fig. 3, top left-hand corner). Within the video talking head, files such as the ones needed to be illustrated are synchronised accordingly on the right-hand side of the screen.

Flexible Layouts

The third and final feature we would want to illustrate in this paper is the accompanying flexible layouts that fit the "no-wire" (wireless) designs. Now that there is no need for wires lying around the classroom, movable tables and chairs that can be taken advantage of should be considered. Different arrangement plans of seating and grouping including the use of colour codes can be taken advantage of. In such a learning environment (Fig. 3), chairs are in different colour combinations where groups of students sitting around certain tables can be grouped through the use of colours for meaningful learning. Within this environment, students can move around, yet their work can be sent to the teacher's screen to be seen by everyone. The wireless technology in the environment enables the teacher to pick up

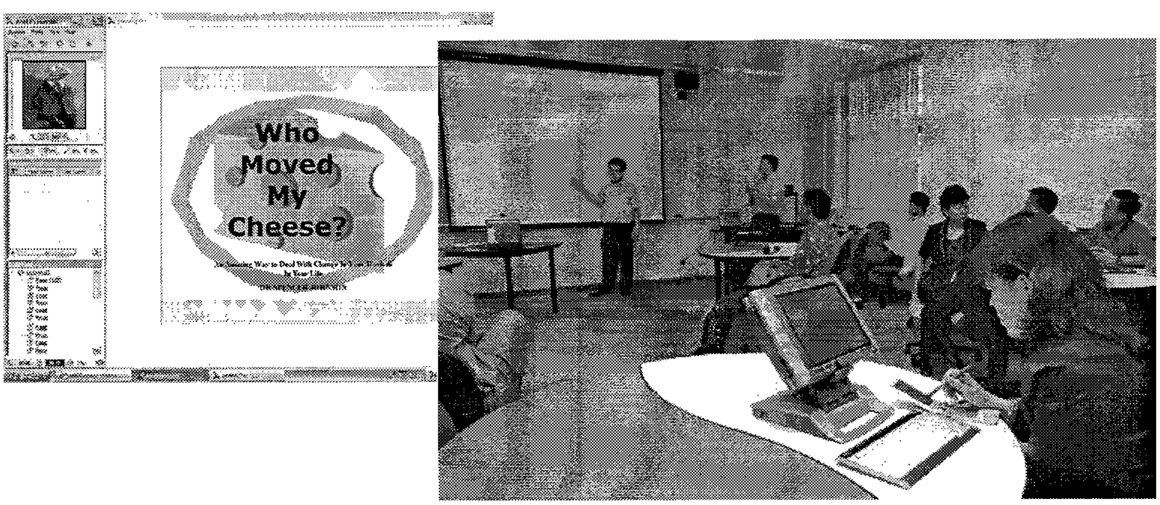

Fig. 3. Interactions with the video-based LMS.

any student or trainee-teacher's work to be shared to the class and beyond. The environment is flexible in that it also allows trainee-teachers to communicate with mobile technologies to anyone in the world. Trainee-teachers can move up front with their portable devices to communicate with anyone else.

Final Comments

In the recent emphasis of learning to expose learners to practitioners' ways of thinking through pedagogies such as project work and problem-based learning, we find that ICT as depicted in the above serves a good purpose. In the past, problem-based learning was confined to classroom- and school-level interactions and should now be opened up to interactions way beyond the traditional classroom.

The concepts of "bringing the students to the community" and "bringing the community to the students" can be better actualised through ICT. The way ahead can be exciting if these technologies can be perceived with optimism. Technology hiccups would abound. But educators should see how these technologies can add value to the learning and instructional process, rather than demean the advantages technology can bring to our lives. Just as if a doctor would resurrect from a hundred years ago and see the surgical room in our hospitals today, he would be quite lost; we hope that in a similar vein, a teacher of a hundred years ago would enter into today's classrooms and "be quite lost", albeit in a meaningful perspective.

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