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Online learning in primary schools: Designing for school culture change

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Abstract

This study explores how an online integrated learning environment (ILE) to cater for individual learning differences is used by teachers in two primary schools in Hong Kong. The findings reveal a positive change in both perception and pedagogy of the participants. Results indicate that students were better catered for and scaffolding activities led to an enhanced ability to engage in independent learning. Principals and teachers were prepared to alter systemic structures to support the use of the ILE. During the three year period, teachers developed coping strategies which led to ICT-enriched learning, provision of extended learning opportunities and development of study units for online delivery. Evidence also suggests that the adoption of the ILE allowed teachers to pay fresh attention to the need to engage students, to respond to them properly and efficiently and to ensure that each step of the way the students fully understand the work they are doing and that the work set is at an appropriate level.

INTRODUCTION

At the core of current efforts to reform school education is a commitment to changing how teachers use information and communication technologies (ICT) in their classrooms. Such a policy commitment, compelling schools to actively encourage teachers to make pedagogically effective use of ICT, including the use of online integrated learning environments (ILE), has

inadvertently led to major changes in the interrelationships between teachers, administrators and students. Haugen et al. (2000) have warned that “learning environments based on new technology impose new challenges on the teachers and the teacher training system (p. 205), while Norum, Grabinger and Duffield (1999) have pointed out that “roles and teaching and learning strategies are changing because technology fosters the use of more student-centred learning strategies” (p. 188).

Teachers engulfed in this wave of change need to develop the capacity to take full advantage of new technologies that enable them to enhance the learning of their students (Adelsberger, Collis, & Pawlowski, 2002; Bennett et al., 2000; Bowman, Newman, & Masterson, 2001; Levine, 2002; Morrison & Lowther, 2002; Thornburg, 1999; Valdez et al., 2000; Wetzel, Zambo, & Padgett, 2001). New models of introducing technology to teachers in schools, along with assessment and collaborative strategies have been proposed and reported in many studies. All of these models aim to provide teachers with rich environments to enhance teaching and learning in schools.

The persistent trend towards implementing ICT in student-centred classrooms is related to many contemporary ideas about teaching and learning and to inclinations toward greater individualisation in learning, the use of cooperative learning groups, integration of subject areas and an increasing focus on higher-order thinking skills (see, e.g., Duffy & Cunningham, 1996; Hannafin & Land, 1997). Research studies also indicate the need to assist teachers and students in effective scaffolding when using ICT to promote collaboration and successful learning.

In the present study the intent is to discover and analyze how an ILE can assist teachers to cope with these challenges. An initial set of research questions has guided this work:

1. To what extent does use of the ILE help students to

become independent learners?

2. How far are teachers and administrators prepared to alter or modify structures in support of the use of an ILE in the classroom?
3. What are the coping strategies used by teachers to meet the demands placed upon them when they are immersed in the curricular use of the ILE?

METHOD

Project Description and Participants

The study was commissioned in July 2000 by the Education Department, (now called Education and Manpower Bureau) Hong Kong Special Administrative Region as a research and development project for the duration of three years. The aim was to encourage teachers to enhance how students learnt in primary schools and to professionally support teachers to raise their awareness of strategies to cater for individual learning differences in traditional classrooms particularly when ICT tools were used.

The project would help teachers enhance students' learning by extending and enhancing their pedagogy through increasing their propensity to make appropriate choices about when and how they could utilize online ICT tools in their teaching and to understand the implications of such use. An integral part was an online integrated environment (ILE) which was carefully designed and developed to facilitate this process. Through use of this ILE, the project team will also be better able to analyze the different types of instructional scaffolding used by teachers when working in such an innovative environment.

In July 2000, expressions of interest were called for and two primary schools were selected to participate on the basis that they were not well advanced in the use of ICT. In the first school (School A) most of the teachers were young and energetic. Over half of them had five or less than five year

teaching experience. Apart from their teaching qualifications, many of them either possessed Bachelor Degrees or were studying for Bachelor Degree programs. Even though many of the teachers had basic ICT skills and about one third of them demonstrated IT skills at an intermediate level, they were very concerned and expressed worries about their ICT skills and the level of involvement in the project. The principal was also fairly new to the school.

In the second school (School B) most of the teachers had been teaching in the school for a long time. About one third of these teachers had obtained their Bachelor Degrees. Many of them had reached the ICT basic or intermediate competence levels. Similar to those teachers in School A, they were concerned and perhaps more apprehensive about their ICT skills in their participation in this project and requested to have more training in this respect. Unlike the principal of School A, the principal in School B had been serving in the school for a long time. Both principals were equally keen to promote the use of ICT in the school and to encourage teachers to organize classroom activities with ICT.

Upon commencement of the project, 20 primary three teachers from School A and 12 primary four teachers from School B were chosen by the school principals for active participation in the project. Teachers involved were given guidance on how to consider the integration of the ILE within the overall teaching and learning strategy of the year level concerned. Teachers had to deal with the details of the learning and assessment activities within each subject area when using the ILE. Teachers in the two respective schools had to identify relevant topics which could be included for use in the ILE and would include activities that would be sufficiently engaging to enhance student motivation and levels of participation. In order to successfully implement all of the above, the following common understanding had to be established among all parties concerned at the outset:

- Ensure that students had the requisite ICT skills to enable them to concentrate on the learning and not be distracted by the technology. (Classes were conducted to assist students to consolidate their ICT skills: for example, classes for Chinese input and computer literacy skills were conducted by the project team after school hours and on weekends.)
- Ensure that the ILE is readily available: the school was asked to open up additional "open access" sessions in the computer room for students to gain access; a home PC ownership scheme was organized to enable parents to purchase PCs and to connect to the school Intranet.
- Avoid barriers: ensure that the tools were easy to use to access the learning materials.
- Close collaboration between teachers and project team members to carefully choose assessment strategies and activities. This was an ongoing consideration. The appropriate mix and sequencing of the learning activities was also an important part, and, activities placed on the ILE had to encourage the students to be actively involved in the process of learning and to interact with others (with teachers and with other students).
- Keep a log of student activities to provide a detailed profile of student progress in learning and to gather qualitative data on student self-perception and attitudes to their own learning progress.

In conjunction with the above points, all teachers agreed that a strong emphasis had to be placed on trialing innovative ways (although time consuming) of using the online environment.

Each school further identified three focus teachers who would be key participants of the project. This provided a total of six case studies. In addition to the six focus teachers, other teachers teaching at the same level were also involved to keep them informed of any progress. These teachers organised by

subject: Mathematics, English and Chinese, also participated in regular meetings to discuss curriculum content and took part in sharing sessions where progress was reported and were fully engaged in discussions about aspects of the project.

Implementation Factors

Professional experience informs us that it is not the technology per se that teachers indicate having difficulty with, but, more so with their limited ICT integration experiences in class. They find it difficult to focus on collaborative, knowledge construction as this relates essentially to prior beliefs and values about classroom practice.

In recent years, much effort and money have been spent in making ICT available to teachers and students in Hong Kong, but, timely and appropriate professional development programmes were not readily available to fully prepare teachers to alter their conceptions of teaching and learning especially when ICT is introduced. It is only very recently that ICT was recognized as an integral part of teacher education programs. Prior to 1999 many in-service teachers in Hong Kong had no professional preparation in the integration of ICT for teaching and learning. So it is not surprising that current evidence does not point to meaningful change in Hong Kong schools (Lee, 2001), just as their counterparts in other educational systems, even after many years of infusing them with new technologies and increased levels of funding (Cuban, Kirkpatrick, & Peck, 2001; Kozma, 2003).

The lack of teacher skills to frame pedagogy was given much attention in the *Information Technology in Education: Way Forward* (Education and Manpower Bureau [EMB], 2004) consultation document, which presented a list of major obstacles that affect the use of information technology (IT) in learning and teaching. This document stated that “while all teachers have been provided with basic training in the use of IT, many are still not familiar with the application of IT to enhance the effectiveness of learning and teaching” (ibid., p.5). It also

goes further to highlight that “some training courses provided have been skewed towards training in IT skills, not the application of IT to enhance learning and teaching”.

Given the context outlined above, and the recognition by authorities that teachers lacked the ability to frame pedagogy when using ICT, it became imperative to ensure that one of the key goals of the project was to alleviate these problems. The successful use of ICT requires more than mastering computer skills and more than a collection of PowerPoint slides, notes or exercise sheets delivered by a computer in a teacher-centred manner. At the start of the project it would be true to say that a high proportion of Hong Kong teachers still adhered to the “sage on the stage” model, rather than the empowering ”guide on the side”. They have difficulty imagining a role that places them as facilitators of learning, rather than transmitters of knowledge. Besides the teachers, it was also important for principals to play a key role in changing deeply held beliefs about pedagogy and in promoting successful integration of ICT in schools.

Research conducted in various countries persistently highlight that change in schools has been inconsistent (Lankshear, Snyder, & Green, 2000). In England and Canada, for example, there was evidence of some change, but as Goodson, Anstead and Mangan (1998, p.119) indicated, it was merely the “reshuffling of a pack of cards” with little evidence of anybody trying a new game. Despite some positive changes, numerous barriers have also been identified by researchers (including lack of equipment, inadequate skills, inadequate teacher knowledge, minimal support, time constraints and the teacher’s lack of commitment, negative teaching perceptions, no room for IT in the curriculum), further suggesting that it may be a hasty decision for educators to re-design the school curriculum to include the use of ICT if proper staff development and support was not given (Lee & Lam, 2001; Means & Olsen, 1997; Pelgrum & Anderson, 1999).

In what follows, valuable experiences are delineated concerning the use of the online ILE in Hong Kong schools.

Data Sources and Analysis

Two questionnaires were designed with an extensive list of topics and questions. The Teachers' Questionnaire focused on teacher's IT skills, knowledge, and perceptions while the School Principals' Questionnaire focused on school culture and support given to teachers.

Semi-structured interviews were employed to probe the idea and feelings of principals, teachers and students. With the intention of getting into the minds of the teachers a few questions were asked at the beginning of the interview to collect data and provide a common context. Quarterly individual interviews were conducted with each focus teacher per year. These interviews lasted 30 – 45 minutes. Although semi-structured there was room for redirection according to the willingness of the teachers to share information and ask more questions. This was a longitudinal study to gain in-depth understanding of how teachers changed their perception and teaching strategies to meet the needs of individual students. Time was given for informants to offer free comments and responses on project philosophy, project implementation, curriculum issues, the support mechanisms and the use of IT to cope with individual differences in classrooms.

Logged data was collected on the ILE and online analysis tools were developed to extract data into an Excel file, or HTML file for easy assess and analysis. The data was presented in a pre-determined format so that the learner profile (student progress, time spent, activities completed, status of progress through set work, levels achieved) could be easily understood by team members and the teachers responsible for teaching them. The logged data on the ILE provided quantitative data about the individually designed study plans and how students used the ILE for learning and for interaction. On the one hand,

this logged data provided rich information on how teachers were busy in scaffolding their students' learning by offering information sources from the network and the Internet, but on the other, the data could not be generalized because it was affected by many other external factors beyond the project's control. One obvious factor that would limit a students' access time to a study plan was the fact that some students did not have computers at home. As these external factors were difficult to control, the quantitative data could only be used to provide further evidence on the findings drawn from the qualitative component.

Feedback from the project team and from the research assistant also provided additional data. This was a valuable source for evaluation of project implementation and provided evidence on the appropriateness and effectiveness of the coping strategies developed and implemented by the team.

Qualitative methods were used to analyze the data collected from interviews. The case-study approach was employed to enable the project team to gather data to reveal the ways in which events and situations come together to create particular types of outcomes (Haertel & Means, 2000) when teachers prepared themselves for a paradigm shift to effectively embrace use of ICT in their classrooms.

The teachers' reflective journals provided another source of data for mapping their feelings about change and to gauge their degree of professional growth. The data collected were used to triangulate interview data in order to identify key issues and concerns. These findings were also used in teacher sharing seminars throughout various stages of the project.

One of the strengths of the case-study approach was that it allowed the researcher to focus on a specific instance or situation and to explore the various interactive processes at work within that situation. It allowed collection of extensive data for analysis that formed the research base for further

exploration. Qualitative data from questionnaires, face-to-face interviews, reflective statements of students and teachers, perceptions of and reactions to ICT use, online data of student profiles, documentary analysis – all of these were used to answer the specific research questions.

Interviews with target students were conducted to collect their views about learning in an IT enriched environment in general and the use of the integrated learning platform in particular. Since only students at the primary three levels were involved in this project, three different cohorts of students were invited to the interview activity. This represented a snap shot view of students at different project stages and provided good feedback to the project team and teachers for analysis of the coping strategies.

Principals were also interviewed at six-monthly intervals. The purpose of this was to understand the supportive mechanism schools had provided to the teachers in order to implement education change. The interviews were unstructured. Data collected from these interviews were used to explore the change in school culture and identify key factors that influenced the success of innovations, such as formulating of school IT policies and the team spirit that existed among teachers.

RESULTS AND DISCUSSION

To what extent does use of the ILE help students to become independent learners?

Changes in the ways students learnt. Most teachers found that the students became more motivated because they were using computer-based activities during lessons. They felt that the students had more time to learn on their own, especially the high ability students, and they were demonstrating good initiative by searching for related information on the web when

they had free time or time to spare in class.

The student interviews revealed that:

- their interest in learning had increased because they were attracted by the animations, multimedia elements, and the different yet flexible functions on the ILE;
- the students readily showed willingness to go to other web sites to explore and look for more information on their own, with minimal teacher guidance;
- they felt that they could always use the information on the ILE to achieve better scores since the exercises and activities were repeatable and they could continually work to improve;
- many of them preferred doing the exercises on the ILE because they could get immediate feedback and avoid any embarrassment;
- they felt that they could always move on to the next set of exercises when they have finished the ones they have been assigned;
- they had more time to think for themselves; and,
- they gained more satisfaction from their own achievements.

Some teachers were concerned that because the exercises did not ask the students to input their working steps (Mathematics exercise for example), they would not know if the student had actually mastered the concepts or if they had worked out the answers through guessing. So, while giving students the freedom to explore for themselves, teachers still needed to continue to monitor their progress regularly to enhance their understanding of the subject and provide assistance to motivate them when necessary.

In general, students spent more time engaged in self-paced learning. They were motivated by their achievements and began to develop independent learning abilities.

<u>How far are teachers and administrators prepared to alter or</u>

modify structures in support of the use of an ILE in the classroom?

To investigate this area, teachers were asked questions which included impediments such as the lack of space and lack of IT equipment.

The responses were rather high on all counts with '*inadequate professional development programs for teachers*' being seen as the most significant barrier by both schools (School A 69%, School B 62%). School B teachers still faced significant impediments such as '*lack of space'* and '*lack of teacher knowledge*' (both 65%), while 58% mentioned the '*lack of educational software*' followed by 54% who stated a *'lack of equipment'*. At School A the problems were less severe with 56% indicating a '*lack of teacher knowledge*' and an almost similar per cent (53%) mentioning the *'lack of equipment'* in the school.

Results from the questionnaire revealed that teachers were more concerned about the lack of hardware, lack of equipment and difficulties in developing multimedia software. However, it was difficult to understand why teachers showed no or little concern about time-table arrangements as indicated below. One possible explanation would be that teachers were not ready to confront the administration when it involved systemic change. The two questions below provide more details on teacher responses over two years:

When the school decided to join the project, what were you prepared to change or modify?

(Respondents can choose more than one, 2002 N=24 Return=100%, 2003 N=41 Return=100%)

Suggest to the school to install multimedia software in the classroom

yr_2002, 67% yr_2003, 63%

Achieve curriculum adaptation by incorporating web resources

yr_2002, 42% yr_2003, 47%

Encourage student to learn in groups
yr_2002, 50% yr_2003, 42%

Suggest to the school to change the time-table
yr_2002, 0% yr_2003, 2%

In order to carry out this project, how do you plan to design and develop teaching materials?
(Respondents can choose more than one answer, 2002 N=24 Return=100%, 2003 N=41 Return=100%)
Subject Panels allocate jobs to teachers, teachers design teaching content while the software house produces the software
yr_2002, 63%, yr_2003, 85%

Take relevant teaching resources from the web and then develop teaching materials
yr_2002, 50% yr_2003, 49%

To develop teaching materials by working collaboratively with colleagues who are more confident with ICT
yr_2002, 33% yr_2003, 24%

Design teaching materials by integrating relevant software
yr_2002, 25% yr_2003, 14%

It is worth noting that a relatively lower percentage of teachers indicated their willingness to develop teaching materials by working collaboratively with colleagues who are more confident with ICT. This was not a surprising outcome as teachers in Hong Kong schools are not used to collaborating or to openly share teaching materials. In fact in School B, the principal expected all work developed to be of professional and commercial quality before teachers were encouraged to share any of them. This proved to be quite an impediment to the teachers of School B.

Although teachers and administrators in both schools realized the needs to alter or modify the school structure to support effective use of ICT in the classroom, the principal of School A showed more support than the principal of School B.

What are the coping strategies used by teachers to meet the demands placed upon them when they are immersed in the curricular use of the ILE?

The project was conducted over three years. In the first phase (2000-01), the project team conducted a needs analysis, then organised professional development programmes to help teachers in the participating schools to acquire foundation IT knowledge and skills. This preparation put their fears of lack of competence with ICT to rest.

In the second phase (2001-02), the project team helped teachers to develop interactive multimedia software for the students, to write study plans that fostered active learning, to develop teaching strategies that integrated the use of IT for coping with individual learning differences in their teaching, and to conduct a series of case studies for analytical purposes. The IT resources along with the teaching strategies constituted an Integrated Learning Environment which allowed individual students to reach their optimum potential in the learning of Chinese, Mathematics and English. The following three teaching strategies were identified and implemented during the second year:

a) ICT-enriched cooperative learning;
b) Extended learning opportunities; and
c) Online study within class ability groupings (three levels of difficulty were designed for each activity).

In the third phase (2002-03), the project team concentrated on improving various aspects of the work done so far in the project. Teachers were required to refine their teaching strategies,

explore innovative ways for using IT to cater for individual differences in their classrooms, and monitor the students' progress via the integrated learning platform. Interview data with teachers and students, together with data on student's learning profiles; achievement and feedback were collected and collated to provide evidence for a thorough evaluation on the effectiveness of the coping strategies applied. This was a crucial stage of the project. It was during this stage that the project began to identify changes occurring over the course of the intervening year.

When working with the teachers in the first two years it was apparent that they tended to use ICT as an add-on element and only began developing their coping strategies at a much later stage.

Beside the teachers' problems and frustrations in coping with change at the school level, various factors impacted on the implementation of the project. While strong leadership of the principal was important, the teachers also had to acquire a strong *self-belief,* otherwise the implementation effects would have been easily diluted (Fulton & Torney-Purta, 2000). Most importantly teachers had to possess an ability to overcome frustrations which manifested in many unforeseen ways during the course of the project. These were eventually overcome.

The researchers of this project devoted an enormous amount of time to gain an in-depth understanding of the constraints faced by the participating schools in the first and second years also contributed to success of the project. The importance of the findings below cannot be overlooked:

IT Infrastructure: Very early on during the project, the teachers' concerns about the IT infrastructure were taken very seriously. A new server was installed, more hard disk space was provided, network IP and sub-groups were redefined, the "apple computer room" was refurnished with IBM PCs, and more computer facilities were installed in the staff room. Teachers in the final

year were satisfied with the IT environment in a general sense, although they still expressed their desire to have more notebook computers for staff use. A stable IT infrastructure was crucial to the smooth running of the ILE.

Timetable arrangements: To overcome the problems, both participating schools adjusted their timetable arrangements in response to the teachers' request. Students were allocated an hour or more for each lesson in the classroom or computer room. They now had sufficient time to learn through the ILE and to interact with teachers and other students in the class. There were also double lessons in their timetable so that tasks on the ILE and additional activities like Internet searching (extension activities) and student discussions (facilitating group collaboration) were possible.

Workload issue: Teachers needed more time and space to design and develop teaching strategies for use on the ILE to cater for individual differences in primary classrooms. Appropriate time release was given to the participating teachers. However, School A was more able to release teachers from extra-curricular activities than School B.

Professional development and support: The participating teachers were exposed to various types of IT resources, giving them plenty of ideas of how to design an ILE that was geared to their needs and working style (at times project team members visited the teachers twice a week and kept in constant contact by email). Online tools were later added to the final version of the ILE to allow teachers to analyze student progress and to give individual/group feedback to students. This had not been feasible in face-to-face classes, and, moreover it was not common practice for teachers. In the process, teachers were reminded of the need to have reflexivity to innovate. They were strongly encouraged to continually reflect and to have agency in making change. They were expected to be the leaders, not followers. It became evident later the resource book (as well as the ICT strategies and resources provided by the team) did help

the teachers achieve substantial progress.

Changing teachers' teaching strategies: Besides acquiring the necessary ICT skills and knowledge, the introduction of online ILE elicits anew familiar questions about pedagogical practices. The participating teachers working in these technology-rich classrooms quickly became aware that they could not carry out the teaching task as usual. Just as what Norum, Grabinger, and Duffield (1999) have stated, "technology affects the way teachers teach, students learn, and administrators operate" (p. 188). In this case, computers changed the arrangement of classrooms, the social organisation of student learning and interactive patterns between teachers and students. Classrooms were re-arranged in ways that allowed students and teachers to move around particularly for individual and group work.

According to Sandholtz, Ringstaff, and Dwyer, (1997), "(t)he direction of change was toward student-centred rather than curriculum-centred instruction, toward collaborative tasks rather than individual tasks, toward active rather than passive learning" (p.17). Students in the participating schools were indeed being promoted to assist each other in completing the learning tasks and solving problems collaboratively, often with their teachers as partners. Data collected revealed that students participated in the evaluation process and frequently evaluated each other's work. The participating teachers worked with individuals and small groups rather than direct attention to the whole class, just as what researchers have noted in other educational systems (Chin & Hortin, 1993-1994; David, 1990; Riel, 1989; Sandholtz, Ringstaff & Dwyer, 1997). In facing the challenges of using the ILE evidence of effective scaffolding by teachers began to unfold.

By the third year the project team realised that even when teachers had taught for many years, the use of an online ILE still meant that they needed to make major adjustments to the way they worked. The adoption of the ILE called for fresh

attention to the need to engage students, to respond to them properly and efficiently and to ensure that each step of the way the students fully understand the work they are doing and the work set is at an appropriate level. The ILE teachers needed to learn and be open to new approaches and to realistically use the technology to add fresh approaches to their daily instruction.

It became clear that with the introduction of the ILE, the teachers were for the first time pushed beyond their comfort zone to rationally consider how they could in fact generate a higher degree of classroom interaction. The ILE also opened doors for students to use self-assessment as an instructional tool. Customised worksheets completed periodically on the computer at school or at home acquainted students with the learning objectives of the unit and allowed them to gauge their level of mastery at their own pace.

While teachers' open-mindedness is essential, their ability to achieve curriculum adaptation was keenly noted in the project. The participating teachers needed to have a thorough understanding of the subject curriculum before they could tailor curriculum materials for students to meet their ability level and interest. They also needed to know how to evaluate students' learning process, analyze log data on the ILE and identify areas most students had problem with. All these helped teachers in deciding which courseware they needed to produce for their students and what strategies they would use to cater for individual differences in the classroom. Once the teachers found their efforts to be fruitful, they quickly became more motivated to invest more time and energy in mastering the needed knowledge and to further develop their curriculum adaptation ability.

Without doubt the prospect of using the ILE unsettled some teachers and stirred fear among them for their future work. The project team took steps to ensure that the administration was aware of the importance of this factor when making policies regarding the implementation of the ILE. Principals had to

make certain that teachers could have the fear for failure alleviated and were given the opportunity to take greater cognisance of the impact on teaching. Schools also had to recognize that as they move toward an online presence that success depends on acting in ways that encourage and assist teachers to alter their habits and attitudes that have sustained their entire careers. Teachers must change their ways significantly, but with support from their school.

More importantly, in order to incorporate the use of the ILE, the participating teachers needed to reconsider a lifetime of habits, replacing or at least modifying their daily methods. Thus, teachers in the schools were urged by the project team to carefully review every aspect of their face-to-face teaching to assess the appropriateness of the activities for online teaching. Good use of the ILE required considerable preparation. Just as in any instruction in a traditional classroom, content came first and then technology entered into the picture, rearranging the elements considerably differently.

These requirements meant more work. External incentive and positive reinforcements had to be present, in addition to teachers' personal satisfaction derived from getting their teaching job professionally performed. By the third year the schools were in the position to provide the needed incentive and reinforcements. The project team members repeatedly made the case to school leadership to coerce them to recognize the teachers' needs and to offer praise and recognition for their accomplishment. Often, genuine appreciation from the school principal as well as the teaching staff of the school, greatly helped to reinforce the participating teachers' resolve to persevere.

The school principal also contributed in an active way in development work and in reviewing the current management arrangements in the school to ensure that teachers could change and also become change agents having opportunities to induce influences on other teachers' teaching and to exercise

leadership.

CONCLUSIONS AND RECOMMENDATIONS

This study had documented a positive change in both the perception and pedagogy of the participating teachers' using ICT in teaching, as expected in the field (Glennan & Melmed, 1996; Jonassen, 1996; Jonassen, Glennan, & Melmed, 1999). It was further established that the success or failure of use of ICT in classrooms was more dependent on human and contextual factors than on hardware or software problems. The following findings explain why the two schools progressed differently and achieved different outcomes:

- The extent to which teachers were given time and access to appropriate training to use computers to support learning plays a major role in determining whether or not ICT had a positive impact on achievement.
- The best integration training does more than just simply show teachers where in the curriculum they can squeeze in some ICT elements. Instead they should be shown how to select the appropriate digital content based on the needs and learning styles of their students and infuse it into the curriculum.
- The success or failure of ICT required that teachers involved saw it as a valuable resource and not as an add-on or peripheral item. The success or failure of ICT-enabled learning experiences often depends on whether the software design and instructional methods surrounding its use were congruent. (School A managed to achieve ICT integration whereas School B used ICT more as a complementary or add-on tool)
- The success of use and integration of ICT depended on having significant critical access to hardware and applications that were appropriate to the learning expectations of the activity.

- Teachers had to be provided with instructions and plenty of practice and ongoing support in integrating the curriculum with the technology and to become familiar with hardware and software – its use in the classroom should be transparent.

In hindsight, this project would have fallen flat on its face if the spirit of experimentation were not present in the classroom. According to Bates (2000), fear is the biggest obstacle to change and these fears need to be addressed constructively (p.104). The hurdles for teachers were not easy to surmount. The implementation of the ILE had to be aligned with a person-centred philosophy and the integration of ICT needed to be an integral part of the overall curriculum. It was imperative for the teachers be able to focus on the curriculum and at the same time integrate ICT in their day-to-day educational practice.

Despite the difficulties, teachers were able to make a thoughtful interweaving of the old and the new, making the learning of a subject more than a collection of repeated or re-cycled notes or exercise sheets delivered by computer. There was evidence that the teachers had after the three year period developed their capacity to take full advantage of new technologies that now enable them to enhance the learning of their students of all ability groups. This kind of learning had penetrated the daily work of the school and has demonstrated its worth and reliability, contributing to the fostering of a school culture that treasures effective teaching, student-centred learning, innovative practices and peer-support development.

Suffice to mention at this point that any change strategies arising from external reforms must take into account the fact that all schools are different. The focus for change needs to include the managerial arrangements of the school as well as specific curricular or pedagogical issues. Change strategies implemented must take heed of the patterns of collaboration in which the school is located and the roles of a variety of stakeholders and partners. There needs to be an appropriate

balance between “top-down” and “bottom-up” strategies.

Based on our findings, we recommend several changes that will support future efforts in schools that seek change:

1. *School-based adaptation of strategies:* When adopting ICT for teaching and learning in primary school classrooms, teachers should be sufficiently open-minded to explore different approaches and apply adaptation strategies.
2. *Catering for individual learning differences:* When using the ILE, teachers should pay more attention to less able groups of students and to engage them in the normal suite of classroom events. The more students differ in class, the wider the range of individual differences, the more responsive teachers need to be when designing activities for the ILE and to be willing to tolerate different rates of learning by students. Teachers should not be afraid to admit to deficiencies in their current classroom pedagogy and be ready to concede that different ways of learning when carefully crafted for the ILE can in fact help those who have been typically neglected in normal classrooms.
3. *Creativity and collaboration:* Teachers should use the ILE to find ways to be more imaginative and collaborative and to adapt their teaching and learning in such ways (e.g. using the ILE to formatively assess and diagnose students instead of endlessly marking student workbooks) so that they can help themselves to “work smarter, not harder”.
4. *Flexibility in timetabling:* Schools must be willing to implement flexible timetables and provide adequate access time for students to use computers.
5. *Trimming down the curriculum:* Teachers should be given the freedom to trim down the current curriculum and to adapt curriculum topics to suit the individual learning needs of students. School panels and coordinators need to fully support this change.
6. *Planning time and skills:* Schools need to invest resources to provide teachers with planning time and adequate time

to develop skills if teachers are to meaningfully develop teaching and learning resources to cater for different ability groups.

7. *Full technical support:* Teachers need full technical support when using the ILE, and students need to be given recognition by way of rewards for their active participation.
8. *Principal and teacher training to change mindset:* School principals and senior staff members need training to fully understand the rationale and philosophy for the use of ICT to cater for individual differences.

Last but not least, if any school is to adopt the ILE we stress strongly the importance of maintaining the profile and status of the group of participating teachers within the school. These participants need to be supported, actively and visibly, so that as individual change agents they are allowed to flourish rather than be subdued through closed management structures or the apparent lack of interest. Teachers need to develop the ability to reject unwarranted criticism and work around very daunting and unwelcome barriers. The proactive teachers must never be allowed to become easy targets for those more traditionally focused opponents who continue to resist change.

In a more general sense, the use of the ILE as cognitive tools in classrooms signifies a pervasive transformation of the means by which teaching and learning occurs in schools. Indeed, in our analysis of the changes which are evident in this study, there has been a rather radical change in the nature of learning and potentially a redefinition of the teaching profession in Hong Kong.

More importantly, many teachers, experiencing reinforcement from their peers, began to have passion for quality teaching that enhances student-centred learning, making their striving to achieve effective online teaching a natural act of their professional self. The findings so far contribute new angles to the literature on integrating ICT in schools and may provide

guidance to others who seek to implement online learning in primary schools.

In future studies more attention would have to be given to understanding how instructional scaffolding is related to the learning activities of different kinds developed by teachers who held different perceptions and beliefs of their roles. A further extension of this study could proceed towards a better understanding of how different activities on the ILE achieve different learning outcomes for students.

NOTE

The term Information Technology (IT) is used in this article to align with its use by the Education and Manpower Bureau in Hong Kong. It is synonymous to the term Information and Communications Technology (ICT) used in various other countries. In this article both IT and ICT refer to the use of a range of computer-related technologies (hardware, software, communications and associated technologies) in an educational setting.

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