

# Learning to Teach with Information and Communication Technology in a Teacher Induction Program

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This paper reports on the impact of a teaching strategy based on the social constructivist view of learning in a professional development activity for beginning teachers. The finding shows that the participants who underwent the induction process of learning to teach with Information and Communication Technology (ICT) experienced gains in terms of ICT skills along with a conceptual change on the application of ICT to teaching and learning. A strong theme that emerged from the study was that beginning teachers saw ICT as a tool to facilitate learning. A second theme was that the participants became more reflective thinkers as well as more critical on the implementation of ICT in their classrooms and their schools. This study also finds that time scheduled for the adaptation of ICT to class teaching and collegial support are the key factors that determine the successful integration of technology in the classroom for beginning teachers. Corresponding suggestions were made to address the canvassed issues at the end of the paper.

Key words: ICT, Social Constructivism, ICT and Teacher Education, Teacher Induction, Teacher Development

## INTRODUCTION

In a study on the use of ICT in teaching, Kozma (2003) reveals that a majority of teachers across countries in the world are not sufficiently prepared for the instructional use of ICT, although they are often equipped with hardware and software skills in computing. The current situation in Hong Kong is much the same.

There is an up-to-date computing infrastructure in most schools, and majority of the teachers are trained in the use of ICT. However, there has been little change in teaching

practices in Hong Kong classrooms although there is an increase in the use of computers in teaching and learning. For one thing, the use of computers for teaching in Hong Kong seems to be restricted to teacher-centred presentations. For another, student-centred activities involving higher-order thinking skills on the part of the students and the use of ICT are still uncommon (EDB, 2007). This phenomenon may be due to the lack of relevant and effective teacher preparation programs as most of the current programs focus mainly on the mastery of ICT skills rather than on the theories and on the pedagogical uses of ICT in learning and teaching. Research shows that classroom teaching is strongly influenced by the learning experiences of a teacher in professional education (e.g. Adams and Krockover, 1997). A well-designed teaching strategy in such a teacher development program is believed to be influential as such a program is likely to have a great influence on the actual implementation of any teaching practice in schools (Brush, 1998). Another reason of this likely outcome is the lack of proper briefing in the initial years of teaching on the use of ICT. Research reveals that beginning teachers always express difficulties in incorporating technology into classrooms and that some contextual factors in their school affect their use of ICT in classrooms. These contextual factors include new teachers' beliefs in technology, self-image of being a novice on their part (Russell, Bebell, O'Dwyer, & O'Connor, 2003), heavy workload, and lack of support from colleagues and heads of school (Gold, 1996).

### **AIMS OF THE STUDY**

Given that the quality of a teacher development program and the experiences in a teacher's initial teaching years have due impact on the successful use of technology in classroom teaching, the authors attempted to derive a teaching strategy based on the social constructivist view of learning. The purpose of the said strategy was to enhance the understanding and application of ICT in teaching and learning on the part of beginning teachers. Hence, the aims of this study are (a) to examine the impact of this strategy on the professional development of teaching with ICT for a group of beginning teachers who took part in this induction exercise, and (b) to identify the factors that may have motivated or constrained the use of ICT in classrooms.

### **THE SOCIAL CONSTRUCTIVIST FRAMEWORK**

The social constructivist view of learning considers that meaning is derived from the context in which learning takes place, particularly from interaction with others (Greeno, Collins & Resnick, 1996). Knowledge and understanding are constructed socially through talk and activity on shared problems and tasks (Bruner, 1985). Therefore learning is a social activity in which knowledge is actively internalised through conversation and/or interaction between the learner and a more knowledgeable other (Vygotsky, 1978). Other proponents of constructivist learning such as Salomon and Perkins (1998) also emphasise the contribution of the social aspects to learning. Apart from a knowledgeable other, they perceive that learning can be a social mediation process, and meaning is constructed with the help of cultural artefacts. These artefacts may be in the form of information sources such as books, videos, articles, or other resource materials, and may also be the tools used for handling information such as calculators and computers. Such artefacts implicitly embody shared cultural understandings (Perkins, 1986) and, in result, allow learners to acquire knowledge from the accumulated wisdom of a particular culture or discipline (Brown, Collins & Duguid, 1989). Some scholars believe that learners can achieve maximum benefits from the interaction process with a variety of resources (Hill & Hannafin, 2001; Kozma, 1991;

Laurillard, 1993). Such resources including the knowledgeable person(s) formulate a scaffolding environment that facilitates and assists the cognitive development process and finally, a better understanding of the learning contents like teaching with ICT in this study.

While a more knowledgeable other and a cultural artefact are considered important social components for communication, interaction, and scaffolding in the cognitive development process, many teacher educators consider that such an environment can only promote understanding of the value and theories of teaching with ICT but has little influence on the actual practice of using it in daily classroom teaching. Other conditions are necessary if understanding can be put into practice. First, it has been argued that teachers will never be competent in using ICT in teaching and learning if they are not given opportunities to observe other more experienced teachers using ICT in teaching (Collis, 1994; White, 1996). Such modelling of teaching practice is considered to be an effective strategy for ICT and teacher education. Second, for enhancing this modelling effect, the educators should take an active role and make use of every opportunity to explicitly communicate their beliefs and the rationales of particular teaching acts to student-teacher (White, 1996). With a similar line of thought, Shunk (2000) puts forward the concept of cognitive modelling, in which the cognitive models (i.e., faculty or other teachers) articulate their thoughts and give reasons for particular behaviours or actions through dialogue or through texts. Collins (1991) calls this kind of cognitive modelling the *modelling of expert performance*, and places emphasis on making the thought process, such as the pedagogical use of technologies in the present study, explicit to the student learners by the cognitive models. Third, through such explicit articulations, a teacher learner has to begin with self-evaluation and finally adopt appropriate methods to make his/her learning visible to peers or community members in a particular discipline. This self-evaluation process on the part of the teacher learner is actually a reflection process that is considered as another important condition in the present strategy. Some also argued that reflection allows the teacher learner to monitor and to criticise the level of acquisition and the ability of application of knowledge and skill in a learning context as compared to those of an expert or other peers. Feiman-Nemser and Remillard (1996) suggest that reflection is an effective means of providing opportunities for prospective teachers to examine their values and beliefs associated with particular teaching practices; in the case of the present work, it is teaching with ICT for constructivist-based learning. Finally, teachers must be given opportunities to experience the promoted practices firsthand (Raymond & Santos, 1995). Some scholars have argued that they should be given opportunities to practice what they have learnt in actual teaching situations (Cuban, 1995; Smaldino & Muffoletto, 1997). The tasks or problems offered in such situations must be realistic and authentic in the sense that the acquired knowledge and skill should be readily applicable in the learning context or the environment resembling it (Schell & Black, 1997). It is therefore important to allow teachers to practise what the instructor has preached in a normal classroom situation.

### **THE TEACHING STRATEGY IN THIS STUDY**

Premised on the above theoretical underpinning, a conceptual framework that drives the design of the pedagogy model in this study was developed. There are five major components in this framework. In a learning process, a teacher learner should be given the opportunities to (a) interact with cultural artefacts such as learning resources and tools that scaffold the learning process, (b) to observe teaching of more experienced teachers, (c) to communicate with a cognitive model who provides explicit articulation or sharing of theoretical underpinning of an instruction, (d) to practise the modelled instruction in an

authentic context and (e) to make reflection on such practice. Connected to the above framework, in the teacher induction program of this study, the researchers arranged a scaffolding learning setting on one hand, and acted as the cognitive models on the other (Collins, 1991) by demonstrating the use of ICT in his daily teaching, sharing his knowledge and beliefs on ICT in learning and teaching, assisting and guiding the participants through the learning-to-teach with ICT process via a workshop, phone conversations, e-mails, school visits, and discussion venues as well as providing reading and teaching resources offered at a Web site throughout the planning and implementation of the teacher learners' ICT projects. The participants were also prompted to reflect on the learning and teaching experiences in these induction activities during the subsequent interviews.

## **REARCH METHODS**

### *SAMPLES*

The participants of this study were five beginning teachers who just graduated from a teacher education program in Hong Kong and who had attended an ICT-related module taught by the lead author in a teacher education institute<sup>1</sup>. The five beginning teachers are named by pseudonyms: Amy, Betty, Chris, Doris, and Flora.

### *PROCEDURES*

They were invited to take part in an induction workshop for beginning teachers, which was started three months after the commencement of a school year. The major purpose of this workshop was to enhance these teachers' abilities to apply a constructivist framework for student learning with ICT. After a three-hour workshop, these beginning teachers recapped the concepts of the application of ICT in teaching and learning from a constructivist perspective, which were already promoted in the initial teacher education program. In the workshop, an instrument for evaluating the degree of constructivist learning which was developed by Yager (1991) was introduced. The participants were then asked to develop school projects based on this constructivist model with the use of ICT, and to try them out before the end of the academic year. The five ICT plans are described briefly in Appendix 1.

### *RESEARCH DESIGN*

The data for this study came mainly from the semi-structured interviews with the five beginning teachers who took part in the induction workshop and attempted their ICT projects in their respective school. Hence, the qualitative data analysis method which consisted of a series of data clustering processes on the interview transcripts was adopted. The purpose was to identify patterns or themes that might emerge from the data gathered. (Miles & Huberman, 1994). The interviews were conducted at the end of the ICT projects. Participants were asked the following main questions. Some probing questions to solicit more in-depth data followed:

1. Can you tell me something about any event(s) that you considered to be successful, unsuccessful or discouraging in applying ICT in your teaching?

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<sup>1</sup> Invitations were sent to the students in the class who initially agreed to take part in the study. However, only five of the recipient students completed the workshop and try-out projects at the end.

2. Have you observed any changes or effects concerning the use of ICT in your school?
3. How do you feel about the induction workshop and try-out projects?
4. What are your comments about these induction activities?
5. What are your comments about the adaption of ICT into daily teaching in your school?

## RESULTS AND DISCUSSION

The results of the qualitative findings are categorised within two sections according to the aims of this study and is discussed below.

### *IMPACT ON TEACHER DEVELOPMENT*

This section explores the themes and sub-themes identified from the qualitative data of the beginning teachers on the impact of the induction experiences on their students and on them as teaching professionals, with particular focus on their reflections (Table 1).

*Improvements in classroom learning as a result of the ICT projects.* Amy and Flora were satisfied with the academic performance of their pupils. They based this evaluation on a comparison of test results of their pupils with those from other classes that did not include the use of ICT. Amy commented students in her class did better in the section on fractions in an examination paper. Some students in another class in which ICT was not involved in teaching had not answered the question on fractions. Betty likewise felt that her ICT project had a positive effect on her pupils' attitudes and behaviour. For example, she observed that during the project week, her pupils cooperated well, and the final result was a very good 'ending' for the story the students had worked together. She felt the group work would not have been successful without using the computing facilities. She also observed that her pupils became more considerate towards each other and there were fewer disputes amongst themselves.

*Table 1: Themes and Sub-Themes after the data Clustering Process*

	Amy	Betty	Chris	Doris	Flora
<i>Improvements in Classroom Learning</i>					
Better academic performance	*				*
Positive attitudes and behaviour		*			
More motivated and attentive	*		*		
More engaged				*	
<i>Gain in ICT Knowledge and Skills</i>					
Learn something more	*				*
Consolidate knowledge and skills	*		*		
<i>Belief in Student-centred Learning</i>					
Understand more	*				
Learn from examples		*			
Think more deeply			*	*	*

Chris reported that the use of ICT had aroused interests in learning amongst his pupils. His students appeared more motivated and attentive than students in the class ICT was not used for learning and teaching:

For example, I could see that some of the pupils who were previously apathetic toward mathematics also put effort in building a bar graph in the lesson. They were attracted and motivated as they were given the chance to actually operate the building of a graph rather than just listen and see the demonstration of the teacher. (Chris)

Doris had not compared the academic achievement of her pupils with other pupils because she felt that 'the time of the project was too short to see any effect on the pupils' achievement'. Nonetheless, she was very satisfied with the performance of her pupils, considering the project as a success because she felt that her pupils were actively engaged in it. She was also impressed by the quality of her pupils' work, commenting that the ICT project motivated her pupils who were originally indifferent to learning English:

I am very happy to see that their (pupils') work is so divergent and creative. Some of them sent in their work with a floppy disk. Some sent by e-mail, and one of them even sent me a CD-ROM. I guess that this student might have sought the help of his family ... but I consider it a learning process too ... I think that the project was quite successful. (Doris)

Amy had also advised as Doris had. She observed that the pupils in her mathematics class were more active and willing to participate in class. They were more cooperative and compliant to teacher's instructions and appeared to have less misbehaviour in the other lessons that Amy also taught. She also found that the apathetic pupils were motivated too.

The above findings indicate that these beginning teachers felt their ICT projects had some effects on student learning including improved academic performance in some cases. The most consequential influence seems to be in terms of a more pleasant learning ambiance in which students were seen to have better behaved, more attentive, more motivated, and more importantly, more actively involved in their own learning.

*Gain in ICT knowledge and skill.* All the beginning teachers felt that the induction activity offered a good opportunity for them to learn, revise, and apply the required ICT skills for their ICT projects, thus contributing to their professional development. 'I have at least learnt something more about building a Web page', Flora commented. She also advised that she would have hesitation in using ICT in her lessons without the benefit of the induction activity. The specific tasks the beginning teachers had offered in the induction activities had enabled the teachers to practise the skills they had become acquainted during their initial training: 'I have learnt more deeply about Excel, as I have to teach my students to use it in the lesson on the ICT project', advised Chris. Amy had perhaps summarised the general feeling among the participating teachers on the influence of the induction experiences they had garnered on their knowledge and skills in ICT:

The induction activity gave me a chance to reflect on what I was lacking in terms of skill and what I had to master before the implementation of my teaching tasks. I am now more confident in using ICT for teacher than ever before. (Amy)

With clear and specific student-centred learning activities for completing the ICT projects executed within the induction program and provision of resources from the lead

researcher, the beginning teachers either learnt new ICT knowledge and skills or improved their present ones that were used in their ICT projects.

*Affirming the belief on the student-centred learning approach.* Amy valued her experiences in the induction activity, commenting that the process helped her ‘understand more about the values and impacts of a student-centred learning strategy’. She believed that the group activities and multimedia capability of the learning software helped her pupils understand the mathematical concepts behind fractions more effectively. The induction activity experience also reinforced her commitment to group activities: ‘I started to understand that mere talking (by the teacher) is not a good strategy’.

Betty also appreciated the opportunity of seeing the examples provided during the induction activity. She found the materials ‘inspiring’, and felt that her experiences with the induction activity reinforced her belief on student-centred learning strategies:

It is the student-centred strategy adopted by a teacher that influences learning. ICT is only one of the tools that help me implement the learning activities, but I find that ICT to be a very useful tool indeed. (Betty)

Flora valued the opportunity to try new strategies during the project part of the induction activity, commenting that without the encouragement and support of the researcher, she would not have engaged in the use of ICT in her school practice:

The ICT project has provided me a chance to think more deeply and to try using ICT for student-centred learning ... I planned my teaching carefully from the perspective of my pupils. For example, when building a bar graph from some data, I considered the problems and questions that the pupils might meet and ask, such as the selection of data for the X- and Y-axes, the scaling of the Y-axis, and so on. I emphasised the explanation on these parts in the demonstration process. Before this, I used to follow the teaching steps suggested in the textbook just like the other teachers did. (Flora)

Chris pointed out that his induction experiences allowed him to think more deeply about his teaching and to practise what he has learned about student-centred learning strategies and the use of ICT. During the implementation of his project, he was guided towards a number of student-centred learning strategies. His use of PowerPoint as a construction and analysis tool for a bar graph exercise was a direct result of his discussions with the lead researcher during the development stage of his ICT plan. He commented that he had gained a number of ‘insightful ideas’ and found his interaction with the researcher reassuring, especially at the beginning of the school year.

Doris felt much the same as Chris did on the impact of the induction experience on her professional development: ‘I could apply the knowledge and skills that I have learnt from the teacher education program. The induction activity provided me a chance to practice these again and to reinforce my understanding of student-centred learning’. She further commented that the induction activity provided an opportunity for her pupils to master the ICT knowledge and skills through the student-centred activities she enacted. She felt that the school curriculum should be such that the pupils could apply ICT in a variety of learning activities.

Aside from seeing ICT as a valuable tool to facilitate student learning via student-centred learning activities, Doris also felt that ICT should be a major content area in the school curriculum. In her view, student learning experiences should allow pupils to develop ICT skills at the same time as learning other content and skills. Doris also

commented that the focus of teacher development in ICT as an education area ‘should not be on the mastery of ICT skills but on how these skills can be helpful in teachers’ daily teaching and how the teachers can provide opportunities for the students to use these skills in daily life’.

This section has described the influence of the induction experiences on the pupils’ learning and the professional development of beginning teachers. Similar to the results of other studies, better academic achievement and higher motivation were reported. The above findings also suggest that the beginning teachers gained or consolidated their ICT knowledge and skills when doing their school ICT projects. The induction experience reinforced their belief on the value of using ICT and student-centred learning strategies (Sandholtz, Ringstaff, & Dwyer, 1997; Watson, 1993).

### *FACTORS IMPACTING PROFESSIONAL DEVELOPMENT*

This section explores the factors arising from the school context that affect beginning teachers’ use of ICT in classroom instruction. Insufficient time for the adaptation of ICT to class teaching and professional development, and collegial support remain as the key factors that determine the successful integration of technology in the classroom for beginning teachers.

*Lack of time due to heavy workload.* The beginning teachers clearly valued the opportunity of participating in the induction activity. However, they were faced with a dilemma: on one hand, they were keen to practice what they learnt from the previous phase of the study, but on the other hand, they had real concerns about their workload. All of the beginning teachers felt that the content of the school curriculum was too heavy. Chris, for example, stated that he was ‘always under pressure’ and feared that he ‘could not finish the prescribed schedule assigned by the school’. Concerns about a tight teaching schedule also were expressed by Flora: ‘My teaching schedule is too tight. I always rush into my other class immediately after a lesson. I have no time to rest in between’. In fact, Flora’s description is a fair depiction of the daily life of a primary school teacher in Hong Kong (and perhaps elsewhere). Hong Kong primary teachers teach about 30 lessons out of 35 scheduled lessons each week. Clearly, such teachers must commit a considerable amount of time outside normal teaching hours, if they are to become involved in any additional projects such as induction activity. The comments of Flora reflect the common feeling among the beginning teachers who participated in the induction activity.

I think that we have to be realistic. My experiences prove we hardly have time to think about student-centred activities. We are occupied in many trivial, non-teaching jobs apart from daily teaching and marking of pupils’ assignments. If I was not invited to do this project, I will never think about the way of using ICT in my teaching as in the present project.  
(Flora)

Amy taught in a school with a ‘favourable’ culture, with good support, and in which student-centred learning was common practice. However, even given this ‘technology-rich’ environment and strong support from teaching colleagues, workload was still an issue. She commented, ‘Time is a crucial factor for professional development in the area of ICT in education’. She continued, ‘the teaching schedule is too tight that the teachers can hardly produce any tailor-made learning materials for individual pupils’.



*Importance of support from colleagues and school principals.* All the beginning teachers saw support from their colleagues and the school principal as crucial for the successful implementation of any innovative teaching activities in their schools. Of the five beginning teachers in this study, three (Amy, Chris, and Flora) found their schools to be supportive. The acceptance of using ICT in teaching among the teachers in Amy's school was high, and a sharing culture was well established in the school. This clearly impacted upon Amy's feelings about teaching: 'My principal is very supportive in using ICT in our teaching. My colleagues are supportive too, and we like to share our experiences among ourselves'. The supportive and sharing culture was also reflected in her induction experiences. She was very satisfied with her ICT project, and felt it was well received by her colleagues in the induction exercise: 'Some of my colleagues have observed my lesson. They felt good and were impressed by the learning ambiance ... and they will try to teach with the learning software and the same strategy next school year'. Chris was also supported by a group of colleagues of similar age, beliefs, and attitude toward using ICT in teaching. The school principal in Chris's school was very supportive about using ICT in teaching: 'Despite the conservative attitudes of the elder colleagues, my school principal is very supportive. He always encourages us to use a computer in our teaching'. Flora also found her school principal supportive but did not feel that support was realised in the implementation of ICT in the school. This apparent dichotomy resulted in some conflicts between the new teachers and the veteran ones:

She (the principal) is supportive, but she knows very little about ICT at all. Therefore, she tends to be not too radical and aims to meet only the basic requirement of the government ... However, she is not too good in her leadership in this aspect (implementation of ICT in school teaching). She even exerted pressure on some new staff who tried to develop some learning software. Furthermore, she was not tactful enough to avoid other staff members from feeling bad, especially when she praised the work of some of them in front of all the teachers in a meeting ... Thus, I was one of those who were criticised as 'showing off', and a 'wall' was built between these teachers and me. (Flora)

Under these rather trying circumstances, Flora received little support from her teaching colleagues, especially after an argument with her ICT subject panel. This proved troubling for this beginning teacher; her colleagues excluded her from some school activities, and she drew upon the lead researcher for support that might normally have been offered by her colleagues: 'I like to talk with you. I feel your support because I do not have the chance to vent my thoughts and feelings at school'. She was quiet and inactive in school, and eventually followed the practice of the other teachers.

The other two school principals were seen as 'authoritarian' or 'inactive' by the beginning teachers. Betty found her principal very demanding and authoritarian, expecting the teaching staff to follow her instruction strictly:

She (the principal) will require you to do more (computer projects) so that the work can be shown on the school Web site for promoting the school. For her, the fame of the school is more important than the actual benefits the pupils can get from the learning process of using ICT. She also never cares about our workload and how we feel. (Betty)

Betty felt unsupported by her colleagues, and she thought there was not a 'sharing' culture at her school. Her colleagues were used to their traditional teaching approach,

and were thus resistant to new teaching methods because they felt the old methods were 'safe'; they were also not keen on taking on any extra work. Moreover, Betty was unhappy with the authoritarian attitude of her school principal and teaching colleagues. Doris also found her principal 'inactive': 'He just follows the instructions of the school board and asks the senior teachers to implement the policies. He is not at all active'. However, she felt supported by her teaching colleagues who had similar beliefs.

Two crucial factors related to the implementation of the induction exercise as a teaching practice in a school identified in this section. The present ethos in Hong Kong primary schools regarding teaching workload is not favourable for teacher professional developments in the use of ICT for teaching. Lack of collegial support is another crucial barrier for an effective integration of ICT in the initial teaching years. The results were similar to those of other studies, such as that by Novak and Knowles (1991) that time or more specifically the lack of is a factor affecting beginning teachers' use of ICT, and that by Sandholtz (2001) that appropriate technical, collegial, and administrative support is vital to the successful integration of technology into classroom instruction. This study also reveals that the beginning teachers were more able to adapt to the school culture if the school teaching practice was similar to their own beliefs on teaching and learning. Like the result of other comparable studies, this study claimed that the social-cultural influence of a school is one of the major factors affecting the use of ICT in classroom instruction in that school (Ertmer, 2005).

## CONCLUSION

This article reported on how the social constructivist-based teaching strategy helped the development and implementation of the ICT plans in an induction exercise. The findings suggest that such a learning-to-teach process enhances the understanding and mastery of ICT skills and knowledge in teaching. The themes that emerged from the reflections on the induction experience on the part of the participating teachers showed that beginning teachers enhanced their analytical thinking on the application of ICT to teaching and learning, appreciated the opportunities the induction exercise had offered, and they had commented positively on its impact on student attainments and beginning teachers' professional development. Such findings further validate the need for an induction exercise on the use of ICT in classroom instructions in the initial teaching years. It was also observed that the lack of time owing to heavy workload, collegial support, and school culture are crucial factors that either promote or restrict the use of ICT in teaching. However, these factors are highly related to the leadership of the head of a school and the relevant ICT personnel in the school. Hence, we would suggest that professional development focusing on the conceptual understanding of the value of ICT in instruction as well as the influence of leadership in its implementation should be incorporated in a school development plan. Meanwhile, the establishment of a mentoring system by matching a number of beginning teachers with an experienced ICT educator either within a school or in partnership with a teacher education institute is also a good measure to tackle the observed problem. Finally, the social constructivist framework identified in this study should form the major reference to guide the design and implementation of the professional development programs as well as the mentoring process.

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### Appendix 1

#### A Summary of the ICT Plans of Beginning Teachers in the Induction Activity

	<b>Amy</b>	<b>Betty</b>	<b>Chris</b>	<b>Doris</b>	<b>Flora</b>
<b>Subject</b>	Maths	Chinese Language	Mathematics	English Language	Mathematics
<b>Class</b>	P.3	P.1	P.4	P.5 (extra-curricular activity)	P.3
<b>Topic</b>	Fraction	Cooperation	Bar graph (two data series)	"Must and mustn't" and Guided Writing	Simple bar graph (one data series)
<b>Resources</b>	Game Card, PowerPoint Program (PPT), Picture, School intranet	Paper, glue, scissors, cloth, Picture, Software: MS Paint	PowerPoint program (PPT), worksheet, File/Web server for downloading	Digital Camera, Scanner, Computer, Web server, software: Dreamweaver	PowerPoint program (PPT), overhead transparency (OHT) worksheet
<b>Time</b>	2 x 35 minutes (minutes).	After class (1 week)	3 x 35 minutes	After class (3 weeks)	35 minutes + 15 minutes recess

<b>Venue</b>	Classroom with computer	Classroom with computer	Computer laboratory	No fixed location, School intranet, classroom with computer for sharing at the end	Classroom and Computer laboratory
<b>Activities</b>	<p>Theme 1: How can a number less than one be described? S plays game card (Dividing a paper pizza and Paper folding); T invites S to present (describe the results as instructed in the game card); S constructs the questions about dividing the fruit for other groups.</p> <p>Theme 2: What is a fraction? T exposition with PPT (consolidates the concept and introduces mathematical representation); T asks questions with PPT; S answers (as evaluation); T feedback; T gives class work. S revises with school intranet</p>	<p>Theme 1: Making a banner on cooperation S group activity with paper, glue, scissors; T invites S to present</p> <p>Theme 2: Clean our classroom together S group activity with cloth (for cleaning)</p> <p>Theme 3: What is the end of the story? T tells a story with a picture (without ending); T invites S to complete the story; T demonstrates the group activity with MS paint; S group activity with MS paint (draw the ending)</p> <p>Theme 4: T invites S to present the completed story with MS paint; T feedback.</p>	<p>Theme 1: Use of PPT to create a bar graph T demonstration with PPT; T asks S to practice with a worksheet &amp; PPT (students download resources from the school file server)</p> <p>Theme 2: Build your own bar graph T invites S to collect information with a worksheet (before the lesson with suggested topics); S group activity with PPT (to complete a bar graph with collected information; T invites S to present with PPT. S revises with school intranet.</p>	<p>Theme 1: Ms Chan's Home Page T creates a home page with the school Web server (extended contents of the topic)</p> <p>Theme 2: Students' Home Page T demonstrates activities using Ms Chan's Home Page); T invites S to write sentences with illustrations (not restricted to using a computer); T scans some students' work; T posts students' work on the Web site; T invites S to present; T feedback.</p>	<p>Theme: Use of Excel to create a simple bar graph</p> <p>Theme 1: T asks questions with OHT); S answers; T feedback/elaborates (about the use of 1 to represent 10 in a graph)</p> <p>Theme 2: T demonstration with PPT; T instructs S on group practice with the use of a worksheet &amp; PPT (use template in prepared disks to create a bar graph); T invites S to show the results; T feedback</p>
<b>Evaluation</b>	Evaluation in the classroom; after-class interview with student; homework and test result; comparison with other classes.	Observation	Students' presentation of the PPT; students' self-evaluation, student interview.	Observation	Observation, Students' presentation, interview with students; homework result

Key: T = teacher; S = student