

**ICT and Teacher Change:
A Case Study in a Hong Kong Secondary School**

Mo Hoi Ling, Stella

This thesis is presented as part of requirements for

the award of Degree of

Doctor of Education

of the

University of Nottingham

2011

Abstract

The 21st century is considered an era of information explosion. Information and communication technology is developing fast and penetrating into everyone's life and daily living. Governments of countries all over the world have invested huge amounts of money into the development of ICT in teaching and learning over the past 20 years. The Hong Kong government, with no exception, has invested huge sums of money alongside the declaration of initiatives for implementing the use of ICT into teaching and learning. However, the progress is still lagging behind the expectation despite the money and human resources invested. The implementation involves not only the introduction of a tool in changing classroom practice and pedagogy, but also a paradigm shift. The complexity of change, as Fullan (2001) describes it, is far beyond people's expectations.

This multi-phase single case study on the implementation of using ICT in teaching and learning in a secondary school in Hong Kong attempts to look at the process of change through the lens of Activity Theory (Jonassen & Rohrer-Murphy, 1999). It is argued that Activity Theory, as a dynamic and evolving body of thought, is a suitable framework for analysing change by describing and comparing the components of the system, the focal school, at different phases, in order to understand the change process or development. The concept of contradiction which is the driving force for development is given serious consideration in order to more fully understand teacher change. By presenting the focal school as a chronological series of activity systems at the three phases, comparisons of the components, subject, object, outcome, tools, rules,

division of labour and community are studied, using the framework suggested by the Activity Theory. A thorough analysis of the relationships between the components helps to capture a holistic view of the activity system and the change process. Factors that might have facilitated or inhibited the change are identified along the way and interpreted in order to better understand the cultural and historical factors that have caused the present situation. An Activity Theory analysis of the contradictions that have driven development at different phases helps to reveal the change process and factors affecting the implementation.

TABLE OF CONTENTS

CHAPTER 1 INTRODUCTION TO THE STUDY: A STORY ABOUT TEACHER CHANGE USING ICT IN EDUCATION..... 1

1.1. INTRODUCTION TO THE STUDY 1

1.2. IMPLEMENTATION OF EDUCATIONAL CHANGES IN HONG KONG 2

1.3. BACKGROUND OF ICT IN EDUCATION IN HONG KONG..... 4

1.4. PURPOSE OF THE STUDY 6

1.4.1. *The Need for Implementing the Use of ICT in Education*6

1.4.2. *Purposes of This Case Study*6

1.4.3. *Strengths and Weaknesses of a Single Case Study by An Internal Staff*7

1.5. CASE STUDY APPROACH 8

1.6. BACKGROUND OF USING ICT IN TEACHING AND LEARNING IN THE SCHOOL OF THE CASE STUDY..... 9

CHAPTER 2 LITERATURE ON ICT IN EDUCATION AND TEACHER CHANGE: THE MEANING, THE PROCESS AND THE ISSUES 14

2.1. INTRODUCTION 14

2.2. NEEDS OF ICT IN EDUCATION 15

2.2.1. *From the Perspectives of Businesses*16

2.2.2. *From the perspectives of Governments*.....17

2.2.3. *From the Perspectives of Educators*21

2.2.4. *Summary*22

2.3. EDUCATIONAL CHANGE AND TEACHER CHANGE 23

2.3.1. *Introducing ICT in Education as an Educational Change*25

2.3.2. *Understand Teacher Change*.....26

2.3.3. *Teacher Change*.....29

2.3.4. *Professional Development and Teacher Learning*.....34

2.3.5. *Teachers’ Change to Using ICT in Teaching*.....37

2.3.6. *Change in Hong Kong Schools*38

2.3.7. *Factors Affecting Teacher Change*.....39

2.4. RESEARCH OF ICT IN EDUCATION..... 43

2.4.1. *The Need for Research into ‘Success’*.....44

2.4.2. *Trends of Research*.....44

2.4.3. *Research in the 21st Century*.....47

2.4.4. *Case Studies into ICT in Teaching and Learning*53

2.4.5. *Factors Affecting the Implementation of ICT in Education*.....53

2.4.6. *Stages of Implementation & Success Criteria*.....57

2.5. SUMMARY 59

**CHAPTER 3 FRAMEWORK FOR EXPLORING SYSTEM
CHANGE: USING ACTIVITY THEORY62**

3.1. RESEARCH QUESTIONS 62

3.2. THEORETICAL FRAMEWORK FOR ANALYSING CHANGE IN THIS CASE 63

3.3. ACTIVITY THEORY 65

 3.3.1. *Basic Principles of Activity Theory*.....70

 3.3.2. *Examples of Applications of Activity Theory in Research*.....77

 3.3.3. *Studies of ICT in Education using Activity Theory*.....79

 3.3.4. *Reasons for Choosing Activity Theory for This Research*82

 3.3.5. *Components of the Activity System in ICT in Teaching and Learning*84

3.4. SUMMARY 86

**CHAPTER 4 METHODOLOGY: A MULTI-PHASE SINGLE
CASE STUDY.....88**

4.1. INTRODUCTION 88

4.2. RESEARCHING ICT: ISSUES AND APPROACHES 89

4.3. MIXED METHODS RESEARCH 93

 4.3.1. *Mixed Methods Research Strategy*94

 4.3.2. *The Issues of Reliability and Validity*.....96

4.4. DESIGN OF THE STUDY..... 103

 4.4.1. *Multi-phase Mixed Methods Design*104

 4.4.2. *Establishing Validity and Reliability*.....107

 4.4.3. *Application of Grounded Theory*..... 111

4.5. ANALYSIS OF DATA OF THE CASE..... 113

4.6. SUMMARY 115

**CHAPTER 5 DATA COLLECTION PLAN AND STRATEGIES: A
THREE PHASE DESIGN..... 117**

5.1. INTRODUCTION 117

5.2. DESIGN AND STRATEGIES FOR DATA COLLECTION 117

 5.2.1. *Strengths and Weaknesses of Participant Researcher in this Study* 118

 5.2.2. *Design and Schedule for Data Collection*.....121

 5.2.3. *Choice of Research Period*.....127

 5.2.4. *Data Collection Plan and Schedule*129

**CHAPTER 6 ANALYSING AND REPORTING DATA :
GROUNDED THEORY APPROACH..... 140**

6.1. INTRODUCTION 140

6.2. REPRESENTATION OF THE FOCAL SCHOOL AS AN ACTIVITY SYSTEM 141

6.3. DEVELOPMENT OF ICT IN EDUCATION IN HONG KONG FROM GOVERNMENT
DOCUMENTS – CHANGES IN GOVERNMENT POLICIES..... 142

6.4. DEVELOPMENT OF ICT IN EDUCATION IN THE FOCAL SCHOOL 147

6.5. REPORT OF DATA COLLECTED FROM THE CASE STUDY..... 154

CHAPTER 7	ANALYSIS OF PHASE 1 DATA	159
7.1.	INTRODUCTION	159
7.2.	DATA COLLECTED FOR PHASE 1	159
7.2.1.	<i>Key events in Phase 1</i>	<i>160</i>
7.2.2.	<i>Results of the Questionnaire given to Form 1 Students</i>	<i>164</i>
7.2.3.	<i>Results of Questionnaire given to the English Department Head</i>	<i>169</i>
7.3.	ACTIVITY SYSTEM 1 (AS ₁): THE FOCAL SCHOOL AT PHASE 1	170
7.3.1.	<i>The School Context at Phase 1 of the Study</i>	<i>171</i>
7.3.2.	<i>Description of the Components of Activity System 1</i>	<i>173</i>
7.4.	SUMMARY OF PHASE 1 STUDY	179
CHAPTER 8	ANALYSIS OF PHASE 2 DATA	182
8.1.	INTRODUCTION	182
8.2.	DATA COLLECTED FOR PHASE 2	182
8.2.1.	<i>Key Events in Phase 2</i>	<i>183</i>
8.2.2.	<i>Extent of Use of ICT for Teaching and Learning</i>	<i>187</i>
8.2.3.	<i>Written Comments Collected from Teachers on School Self-Evaluation Days</i>	<i>190</i>
8.2.4.	<i>Surveys for broadly collecting views from Teachers</i>	<i>191</i>
8.2.5.	<i>Interview Data Collected from Teachers in the Phase 2 Study</i>	<i>200</i>
8.3.	ACTIVITY SYSTEM 2 (AS ₂): THE FOCAL SCHOOL AT PHASE 2	218
8.3.1.	<i>The School Context at Phase 2 of the Study</i>	<i>219</i>
8.3.2.	<i>Description of the Components of Activity System 2</i>	<i>220</i>
8.4.	SUMMARY OF PHASE 2 STUDY	230
CHAPTER 9	ANALYSIS OF PHASE 3 DATA	232
9.1.	INTRODUCTION	232
9.2.	DATA COLLECTED FOR PHASE 3	232
9.2.1.	<i>Key Events in Phase 3</i>	<i>233</i>
9.2.2.	<i>Overview of Data Collected in Phase 3</i>	<i>234</i>
9.2.3.	<i>Report of Data Collected from Student Questionnaire 5</i>	<i>236</i>
9.2.4.	<i>Results of Student Questionnaire 2 & Student Questionnaire 3</i>	<i>244</i>
9.2.5.	<i>Report of Data Collected from the Teacher Survey 3</i>	<i>248</i>
9.2.6.	<i>Report of the Interviews with the Principal, Teachers and Student Groups</i>	<i>259</i>
9.2.7.	<i>Summary</i>	<i>280</i>
9.3.	ACTIVITY SYSTEM 3 (AS ₃): THE FOCAL SCHOOL AT PHASE 3	284
9.4.	SUMMARY OF PHASE 3 STUDY	288
CHAPTER 10	CAPTURING THE COMPLEXITY OF ICT IMPLEMENTATION AT THE SCHOOL LEVEL: AN EVALUATION OF THE ACTIVITY SYSTEM APPROACH	290
10.1.	INTRODUCTION	290
10.2.	CHRONOLOGICAL FRAME OF ANALYSIS	291
10.3.	CROSS-PHASE ANALYSIS OF ACTIVITY SYSTEMS AS ₁ , AS ₂ AND AS ₃	292
10.3.1.	<i>Components of the Activity Systems</i>	<i>294</i>
10.3.2.	<i>Contradictions: the Driving Force for Development</i>	<i>315</i>

10.4. FACTORS AFFECTING TEACHER CHANGE: SUMMARISED FROM THE CROSS-PHASE ANALYSIS OF THE ACTIVITY SYSTEM..... 318

10.4.1. *Factors Facilitating Teacher Change*318

10.4.2. *Factors Inhibiting Teacher Change*323

10.5. USING THE CHRONOLOGICAL FRAME OF ANALYSIS 324

10.5.1. *A Framework Suitable for Analysing Change*325

10.5.2. *Advantages of Using a Series of Activity Systems*326

10.5.3. *Summary*327

CHAPTER 11 REVIEW OF FINDINGS: CHALLENGE AND SUPPORT FROM SIMILAR RESEARCH330

11.1. INTRODUCTION 330

11.2. USE OF A SERIES OF ACTIVITY SYSTEMS FOR ANALYSING CHANGE..... 331

11.3. FACTORS IDENTIFIED TO HAVE MEDIATED TEACHER CHANGE 335

11.4. FACTORS INHIBITING TEACHER CHANGE 344

11.5. SUMMARY OF FACTORS AFFECTING TEACHER CHANGE..... 347

11.6. STAGE OF IMPLEMENTATION OF THE FOCAL SCHOOL 348

CHAPTER 12 DISCUSSION: ISSUES ADDRESSED AND AREAS TO EXPLORE.....356

12.1. ISSUES ADDRESSED 356

12.1.1. *Case Study Carried Out By An Insider: Strengths and Weaknesses*.....357

12.1.2. *Using a Series of Activity System as a Suitable Framework for Studying Change*.....359

12.1.3. *Limitations of the Proposed Framework for Studying Change*360

12.2. AREAS TO EXPLORE..... 361

12.2.1. *Continuation of the Study in the Focal School*361

12.2.2. *Principal's Leadership for Teacher Change*362

12.2.3. *Concluding Remarks*.....362

BIBLIOGRAPHY364

GLOSSARY OF TERMS & ACRONYMS.....379

LIST OF FIGURES.....382

LIST OF TABLES384

CHAPTER 1 Introduction to the Study: a Story about Teacher Change using ICT in Education

1.1. Introduction to the Study

In Hong Kong, the introduction of ICT into the curriculum started from the early 1980s. Just like most countries, ICT was first introduced as a school subject. With the rapid development of technology, the curriculum has changed from learning about the technology to learning to use the technology. There are both formal and informal curricular for teaching the concepts, techniques as well as the ethics of using ICT in all schools ranging from kindergartens to universities. In 1998, the year after the hand-over of the sovereignty of Hong Kong to China, the Hong Kong Special Administrative Region Government (HKSARG) launched its first 5-year IT in Education Strategy (EMB HKSAR, 1998) and invested a significant amount of money on the implementation. Since its establishment, the HKSARG, with its belief that ‘Education is the key to the future of Hong Kong’ (p.4), has made significant investments in it. A number of reforms, which include the academic system, curricula and assessments, are launched in the follow years.

In the 21st Century, educators around the world are interested in the issue about how ICT can transform the classrooms to prepare our students for the future when ICT has tremendously changed the workplace (Venezky, 2001). Therefore, after the first IT in Education Strategies, the second one on ‘Empowering Learning, Empowering Teaching with Information Technology’ was launched in 2004 (EMB HKSAR, 2004a).

Another large amount of money was spent on improving infrastructure and connectivity. The government had hired the territory's tertiary institutions to do evaluation studies. Territory-wide evaluations were done and comprehensive studies were carried out. Overall, the results were satisfactory and all parties held positive views towards the projects. Some schools were very successful in implementing the policies, have experienced the benefits and were developing their strategies of using the technology in teaching and learning. However, some other schools, perhaps of a larger proportion, still remained at the very early stage of implementation. There was some doubt as to whether the money invested in the implementation of the policies in all schools had been worth it. From another point of view, it would be worthwhile to see what could be done to help those schools to implement the change if it was to be beneficial to students, and consequently beneficial to the society. The study of the change process in individual schools could be a start in the search for more effective solutions. This research attempts to explore methods of understanding the implementation of educational change, using the ICT in teaching and learning as an example.

1.2. Implementation of Educational Changes in Hong Kong

Like other projects or reforms launched by the Hong Kong government in the past years, such as the target oriented curriculum and the language policies, all faced obstacles in the implementation and some were even suspended and had never been fully implemented. Although policies were drawn through well planned procedures, supported with research and had strong theoretical background, they might not guarantee full implementation. Since they all cost a lot in terms of money, time and

manpower for the planning, implementation and evaluation, it will be worthwhile to study why some were not fully implemented.

It is a vision of the HKSARG to transform school education from a largely teacher-centred approach to a more interactive and learner-centred approach (EMB HKSAR, 1998). The 5 year IT in Education Strategy was the first IT policy declared in 1998, the first year after the handover of the sovereignty of Hong Kong to China. This strategy emphasizes the ‘paradigm shift’. After conducting a complete review of the school curriculum, in November 2000, the Hong Kong government launched the reform: ‘Learning to Learn-The way forward in curriculum development’. This reform includes the integration of ICT into the curriculum. ‘IT skills’ is one of the nine generic skills to develop and ‘IT for interactive learning’ is one of the four key tasks in this curriculum reform (CDC HKSAR, 2001a).

Some schools in Hong Kong welcomed challenges at particular times and joined pilot schemes while some preferred to maintain the status quo as long as they can. It is worth studying the factors that facilitate changes and those that are obstacles. The implementation of using ICT in teaching and learning is a good example for the study since the government of Hong Kong has invested huge amounts of public money on it and it is also a world-wide issue.

Fullan (1993) who is a leading educator researching on change said that change is a complex process, not a blue print. It cannot be tested as a scientific experiment, simply by using control variables and measuring the output, such as students’ academic results. It can neither be understood by only interviewing teachers and students. We

can get an understanding of it by following through the process, collecting and looking at any possible evidences of change and listening to the voices of students, teachers and related persons. Research findings on the change process should be used less as instruments of ‘application’ and more as means of helping practitioners and planners ‘make sense’ of planning, implementation strategies, and monitoring (Fullan, 1993).

1.3. Background of ICT in Education in Hong Kong

Hong Kong started its IT in Education in the early 1980s with the introduction of Computer Studies into schools as a senior secondary subject. The curriculum was later extended through Form 1 to Form 7 in the late 80s and early 90s. A certain amount of hardware and software was provided to schools for the implementation of the Computer Studies curriculum. Hardware resources were mainly limited to one or two computer rooms for teaching the subject in the 80s and 90s. The first 5 year IT in Education Strategy, ‘Information Technology for Learning in a New Era’ (EMB HKSAR, 1998), was launched in the first year after the establishment of the Hong Kong Special Administration Region in 1997. Teachers were required to attain the Basic and the Intermediate levels of IT Competencies within five years. A proportion of 25% of teachers in each school should reach the Upper Intermediate level and at least one teacher should reach the Advanced level of IT Competencies by the end of 2003. At the same time, a huge amount of money was invested on the installation of computer systems into schools and further extended to building up networks and Internet connections in 1999. Besides the infrastructure and basic training for teachers, the government invested another amount on the procurement of services of ICT

coordinators and technical support staff to help teachers to solve problems on the technical side and help to promote and coordinate the usage.

It was not until the early 21st century that teaching and learning using IT actually started after Multi-media Learning Centres (MMLC) were gradually set up in schools with funding from the Quality Education Fund (QEF). The Educational and Manpower Bureau (EMB) had organised IT courses for teachers. Schools were encouraged to organise courses catering for the needs of their teachers as well. A preliminary IT in Education (ITEd) review published by the end of 2000 revealed that many schools mainly used multimedia presentations and animations to replace chalk and talk (EMB HKSAR, 2001). The final ITEd review report released in 2005 confirmed the findings (EMB HKSAR, 2005). The second ITEd initiative was launched in July 2004 with the theme ‘Empowering Learning and Teaching with Information Technology’ (EMB HKSAR, 2004a).

Although the government invested a capital of around HK\$ 2,880 million (~£ 220 million) on the development of ICT in education, which was a very big amount compared with what the government used to put on education, both formal and informal reports showed that many schools had not yet fully implemented the policy of using ICT in teaching and learning. There was doubt about the extent of using ICT in teaching and learning.

1.4. Purpose of the Study

As mentioned at the beginning of this chapter, the purpose of the research reported in this thesis is to understand how change is implemented and identify the factors that facilitate and those that inhibit it. It is hoped that with better understanding of change, schools can have better planning for the implementation of any educational change that is to come and successfully implement it for the improvement of school education.

1.4.1. The Need for Implementing the Use of ICT in Education

Encouraging and developing the use of ICT in education is a worldwide issue. In all developed countries over the world, policies have been set up and huge amounts of money are spent on it in order to prepare their younger generations to face the challenges of a global economy and the growth towards a global world. To prepare citizens for life long education using ICT is an irreversible trend. A significant number of researchers have investigated into this issue in order to understand the change.

1.4.2. Purposes of This Case Study

The purpose of this case study in a secondary school in Hong Kong is to have better understanding of the process of change and identify the factors influencing the implementation of ICT in teaching and learning in the school. The study was focused in one school so that deeper investigation into the process of change and the possible factors affecting it could be done. Every school is a unique entity and has its own history, background, expectations, abilities and interests. To conduct a study in a

school for more than two years can help to capture a more holistic picture of the situation and result in a better understanding of change in that particular school. As mentioned above, change is a complex process, the effects of facilitating factors or inhibiting factors on the change process depends on the historical background, the beliefs and attitudes of the stakeholders and the social and cultural environment of the school. Although it cannot be studied as an experiment and the results cannot be transferred to other schools, the findings can benefit the focal school as well as other schools by setting an example of research into the complex process of change, drawing attention to teachers' situation and their needs in the face of educational changes and thus leading to an understanding of why and how teachers change. Findings can therefore help the focal and other schools to nurture an environment that is ready to adopt change on their own initiative or as a result of any other initiatives that are beneficial to students.

1.4.3. Strengths and Weaknesses of a Single Case Study by An Internal Staff

This is a case study done by a senior teacher in the focal school. Both subjectivity and bias due to the position of the researcher at school could be risks to the validity of the study but there are some advantages too. First, since the researcher knew the school well, she was clear about what was actually happening and aware of any changes that emerged. Second, the researcher had the convenience of collecting data both from school documents and stakeholders. Third, it was possible for the researcher to carry out the research over a longer period, more than two years. Since the researcher

was an insider and was there all the time, she could observe the teachers naturally throughout the two years.

Being aware of the possible threats to validity, the researcher had collected all possible types of data through different means. The data collected from different sources using different means could be triangulated with each other to improve reliability. Also, as a senior teacher and being in charge of the ICT development of the school, the researcher should stay alert when she collected and interpreted the data to avoid any bias or subjectivity. Results of case studies, by nature, would not be generalized to other cases. Fullan (2003) said that what works in one situation may not work in another since each individual setting is unique and has its own reasons for change.

1.5. Case Study Approach

In this study, the approach suggested by the Grounded Theory was used for data collection and analysis. Data were collected and immediately analysed throughout the research period. Any area that was found to be unclear would be attended to and supplementary data would be sought to clarify it as far as possible. When there was any piece of data that might be useful for understanding the case, it would be collected and put in the pool of data for analysis. As a senior teacher at the school, the researcher would find it easy to identify and get useful data. However, subjectivity and researcher biases were possible threads to validity in this case study. Measures to avoid or minimize them were designed and steps taken throughout the research period. In

Chapter 4, a description of how data would be collected from different sources and ways to ensure validity would be discussed.

One of the purposes of this study was to identify factors affecting the integration of ICT in teaching and learning. Those factors identified and effects observed or reported would not simply be treated as cause and effect. They would be analysed to see how they related and interacted with each other in order to obtain a whole picture of the situation. Chapter 3 argues that Activity Theory can help to more fully understand change by identifying and organising the factors mediating change, taking into consideration the environment and historical background, different stakeholders and their roles played. By representing the school as activity systems at different time, the process of change can be analysed in detail and thus can help to analyse and understand the process of change.

1.6. Background of Using ICT in Teaching and Learning in the School of the Case Study

This research aims at studying the ‘process’ of implementation of ICT in education policy in the secondary school in which the researcher was working. To understand ‘change to using ICT in teaching and learning’, the history of computer usage in the school would serve as useful background information. The school where the case study was carried out, called focal school hereafter, started Computer Studies as a subject for Form 4 and Form 5 students in the early 80s and it was extended to all levels in the 1990s. With funding from the government for its first 5-year ICT in Education strategies, the school upgraded all the computers and built a local area

network in the school in late 90s. Another amount of money from the Quality Education Fund (QEF) supported the school to acquire extra manpower for its development in using ICT for both teaching and administrative work. The school also hired an ICT coordinator to help in the planning and support the use of ICT in lessons and a technical support staff to help manage the network as well as the hardware and software. According to the First IT in Education (ITEd) Strategy, the school offered courses to its teaching staff. Teachers were also encouraged to join ICT courses offered or supported by the government and tertiary institutions.

In 2000, with the QEF, a Multimedia Learning Centre (MMLC) was set up with 45 computers, all networked together and connected to the Internet through broadband connections. The school piloted using ICT in teaching English Language lessons when the MMLC was ready for use. There was another amount of funding from the government for the installation of computers and LCD projectors in all laboratories, special rooms such as the Art room, Music room, Lecture room, Home Economics room and Design and Technology workshop but not yet in classrooms. Instead, the school acquired 40 notebook computers to be flexibly used anywhere on campus. Teachers could borrow the notebook computers when they needed them. LCD projectors were installed in the laboratories, special rooms and one classroom on each floor. A total of eight computers with two printers and one scanner were set up in a staff computer room next to the staff rooms in 1999.

The school set up plans and got the funding that came with the second ITEd strategy for the improvement of ICT infrastructure of the school in the year 2003/04.

The school upgraded the computers and installed a wireless network so that computers were connected to the school network anywhere and anytime on school premises.

During the school year 2004-05, all the classrooms were installed with LCD projectors with the donation from the alumni association. A new Intranet system was subscribed for internal communication and for developing eLearning. The 2005/06 school year was a vibrant one. The school had big changes since a new principal, Principal B, joined the school after the previous one, Principal A, resigned. The new principal, hereafter referred to as Principal B, purchased notebook computers for all teachers with the school's own funding at the beginning of her principalship and this was thought to be a tool introducing and enabling big changes in teachers' use of ICT for teaching. It became a point of interest to study whether the firm belief of Principal B on the use of ICT to transform the way teachers teach and students learn was a major factor bringing about changes in teachers' teaching and students' learning in the focal school. Detailed information about the development of ICT in education in the focal school from the early 80s to the research period in the 2000s will be given in Chapter 6 from an analysis of government and school documents.

An Overview of This Research Report

The trend of development of education in all countries over the world in these and the coming years will be on the use of ICT. The rapid development of ICT technology has enabled revolutionary changes in ways of life. As a consequence, ways of teaching and learning are to be changed accordingly to prepare youngsters to meet the challenge of the 21st century. However, teachers who received their education ten to twenty or even thirty years before were mostly trained in a totally different way. The

use of ICT tools in teaching and learning was completely new to them and thus much effort was needed to move them onto the right track. Therefore, the study of this process of change would be worthwhile and also full of challenge. The long years of immersion in this context, experiencing its changes in different aspects, confirmed the researcher of the value of studying change in her own school.

To prepare a thorough understanding of the development of ICT in teaching and learning all over the world, an extensive study of literature on IT in education, a review of government policy documents in different countries and a study of related research would be conducted and reported in Chapter 2. Since this study is on educational change, an analysis of what makes teacher change and what makes them reluctant to change is essential. Hence, literature relating to educational change and teacher change are also reviewed. Teacher development is closely related to teacher change and thus would be studied as well.

In search of a suitable framework for studying complex and unpredictable change, Activity Theory has presented itself as a suitable choice. Activity Theory, with its dynamic nature and its capacity to represent a system two-dimensionally enables the analysis of its components by taking into consideration their inter-relations. In Chapter 3, reasons for choosing Activity Theory as the theoretical framework for analysing change in this case will be given. A description on how this framework can be used to study the change in the focal school over time will follow.

In order to conduct an in-depth study of change in the focal school, case study method is most suitable. However, for an insider doing research in his/her own

school, there are both advantages and disadvantages. A review of literature on case study and the use of multi-research method in Chapter 4 will be a guide to the design and help to improve the reliability and establish validity for data collection and analysis. The data collection plan will be presented in Chapter 5.

According to the plan, data will be collected in three phases. The actual data collected will be reported and analysed according to the chronological order of the three phases. An analysis of government and school documents will be done and reported in Chapter 6 to provide background information for the study of the data collected in the three phases. The actual data collected in Phase 1, Phase 2 and Phase 3 will be reported and analysed in Chapters 7, 8 and 9 respectively. The change process will then be analysed and reported from the cross-phase analysis in Chapter 10. The results will be discussed and compared with findings in similar research in Chapter 11. Chapter 12 will be a concluding chapter presenting the contribution of this research and suggesting further research areas.

CHAPTER 2 Literature on ICT in Education and Teacher Change: the Meaning, the Process and the Issues

2.1. *Introduction*

In this literature review, a summary of the literature on educational change and teacher change, the development of ICT in education as well as the trends of research in this area. The main theme of this study is the implementation of ICT in education and the focus is on how teachers change to using ICT in teaching and learning. Factors affecting teacher change are of concern and those found from similar research will be noted and discussed. To understand the level of implementation of the educational change in this study, success criteria or references for measuring the success of implementation will be summarised from other research. Among the many research of similar educational change, case study is popular. A review of literature on this research method will also be given.

The first section is a report of the importance of ICT in education as viewed by business, government and education sectors. The second section is a review of literature on educational change and teacher change starting with the work of the leading authors, Fullan and Hargreaves. Literature on teacher change in general and that specific to the integration of ICT is useful in understanding the current situation and preparing for successful implementation in future. The third section is a summary of the factors affecting teacher change from research such as those given by Buettner (2006), Guskey (2002) and Purnell (2002). Fullan (1993) stresses that all educational changes require

new skills, behaviour and beliefs or understanding. He also points out that professional development is the key to making teachers' reform possible (Fullan, 2001). There is a need for professional development to enable and support teachers to face these changes. Literature on professional development for teachers will therefore be reviewed with an attempt to relate it to teacher change. In the last section, a report on the trends of research on ICT in teaching and learning will be given. Research in the school level, national level and international level will be considered. Similar research on ICT in education and educational changes in different areas of the world, such as the United States of America (U.S.A), the United Kingdom (U.K.), Australia, Singapore and Hong Kong will be reviewed. The trend and shift in focus will shed light and provide guidance for this study.

2.2. Needs of ICT in Education

The 21st century is considered to be an era of globalization, when knowledge and information are growing without bounds with ICT. Education also has to change in order to prepare the younger generation for the challenges of life in the knowledge base society. This should be sponsored by businesses due to the huge amount of expenses incurred.

McCade (2001) claims that computers and networks provide significant opportunities for change in the process of teaching and learning. Students can actively seek out knowledge and engage with a wide range of people from community members to content area experts by these tools. All governments see that ICT has the potential to transform the way that education is delivered and to improve the quality and standard

of education. ICT can also support teachers in their everyday classroom role by reducing the time required for administrative work (McCade, 2001).

2.2.1. From the Perspectives of Businesses

Cogburn (1998), the director of the centre for Information Society Development in Africa points out that *“the era of globalisation has tremendous concomitant implications for knowledge, education and learning”* (p.28). Microsoft, one of the leading companies in software development, has launched a ‘Partners in Learning’ project in a number of countries, working together with the governments, educators and teachers, and other key stakeholders, giving support to the development of teachers and students with the belief and vision that technology in education can be a powerful catalyst to improve education which will in turn change lives, families, communities and ultimately, nations (PIL Microsoft). Microsoft has therefore committed over 10 million US dollars over the past five years to increase technology skills in teachers and improve educational outcomes for students in the project.

Maurizio et al. (2004), in the project of Partnership for 21st Century Skills, stress that students need to be *“competent in ICT literacy by being able to use 21st century tools and learning skills that will allow them to be independent learners in school and throughout their lives”* (n.p.). They also believe that only technology literacy and technology proficiency are not sufficient to assure student success in the 21st century. They emphasize the use of 21st century tool together with essential elements, such as learning skills which include thinking and problem-solving, interpersonal and self-directional skills, for achieving success (Maurizio, et al., 2004).

Abel (2007), from the point of view of a psychologist, addresses the impact of media on cognitive and behavioural psychology and states that media technology has *“caused students’ brains to be wired differently from their teachers’ brains”* (Abel, 2007: p.18). He also points out the need to acquire true computer and literacy skills through the curriculum.

2.2.2. From the perspectives of Governments

Policy-makers around the world envision their society to evolve into a learning society in the 21st century, when people are responsible for their own learning in their lifetime. Government of different countries and cities all over the world respond to the issue by setting up policies for ICT in education and invest a considerable amount of money in the implementation. The government of the U.S.A., the U.K., Singapore and Hong Kong have strong belief that ICT can make a difference to student learning by increasing the opportunity of learning and actively engaging students in learning. They hope that as a result the standard of students will be raised. They have addressed in their policy documents the need and importance of using ICT to change the way of teaching and learning in order to prepare the younger generation to meet the demands of the global society in the 21st century (refer to government documents: ED USA, 2002 & 2004; BECTA, 2005; MOE, 2004; EMB HKSAR, 1998, EC HKSAR, 2000).

The following statement is given as a concluding remark in the National Education Technology Plan of the U.S. Department of Education in 2004.

“Technology ignites opportunities for learning, engages today’s students as active learners and participants in decision-making on their own educational futures and prepares our nation for the demands of a global society in the 21st century” (ED USA, 2004, n.p.).

In the UK, the department for education and skills, DfES, has the belief that ICT can improve the quality of teaching and learning and so raise standards (BECTA, 2005). In Singapore, the government makes the integration of ICT in their education system the blue print in the Master Plan for IT in Education in 1997. The key strategy was to produce a workforce of excellence for the future and the objective was to equip their younger generation with learning skills, creative thinking skills and communication skills in using ICT (MOE, 1997).

The Digital 21 Strategy of the Hong Kong Government shows its commitment in keeping Hong Kong in the forefront of information and communications technology development. The following statement in the year book 2005 shows the determination of the government and its success.

“The Digital 21 Strategy, first issued in 1998 and updated in 2001 and 2004, is the blueprint for ICT development in Hong Kong. Since the launch of the strategy, great strides have been made in putting in place the right environment, infrastructure, skills and culture to encourage the development and adoption of ICT by the whole community” (HKSARG, n.d., n.p.).

The Hong Kong government announced its first 5 year initiative on ICT in Education in 1998 with the target to transform school education from a largely teacher-centred approach to a more interactive and learner-centred approach (EMB HKSAR, 1998). This ‘paradigm shift’ is also being promoted under the curriculum reforms by that time. The aims of this change towards student-centred approach by integrating ICT

in teaching and learning are to achieve higher quality education and prepare the younger generation for the challenges of the 21st century.

Evaluations of the first initiatives of all these countries or cities in the early 21st century show that schools have only changed to some extent in their practice but not yet transformed the learning of students. The governments having recognized the need of systemic change in order to transform school educations put systemic change a target in their next ICT policies.

The U.S. government emphasizes the role of leaders in bringing about systemic change in their public education, saying that:

“For public education to benefit from the rapidly evolving development of information and communication technology, leaders at every level – school, district and state – must not only supervise, but provide informed, creative and ultimately transformative leadership for systemic change” (ED USA, 2004, n.p.).

In the United Kingdom, a review by BECTA (2005), the government agency leading the national drive to ensure the effective and innovative use of technology throughout learning, reports that the foundations for fundamental changes in the education system through the use of ICT had been established in the past five years. However, the full range of opportunities offered by ICT had not been delivered to date. Changes that had taken place were not embedded and not systemic (BECTA, 2005). In their next ICT strategies, the governments shift their focus to emphasize systemic change and to transform education. The U.K. government declares that

“It is now reasonable, and indeed necessary, to expect that by the end of the next five years there will be effective, embedded and systemic ICT practice which has transformed educational opportunities and achievements for all our students and educators” (BECTA, 2005: p.2).

In Singapore, the Master plan II for ICT in Education released in 2004 with the theme of “Connecting educators, communities and resources” claims to adopt

“... a systemic and holistic approach to address all the key pieces including- curriculum, assessment, instruction, professional development, pupil learning and culture of the school” (MOE, 2004, n.p.).

In Hong Kong, the second ICT strategy ‘Empowering learning and teaching with information technology’ announced by the government in July 2004 and implemented starting from the 2004-5 school year has the following aims:

“Students, teachers, schools and other stakeholders will use IT effectively as a tool for enhancing the effectiveness of learning and teaching, with a view to preparing our students for the information age, turning schools into dynamic and interactive learning institutions, and fostering collaboration among schools, parents and the community” (EMB, HKSAR, 2004a: p.10).

The reports from different governments show that they have all recognized that educational change cannot be implemented in classroom level or teacher level if the aim is for the transformation of education. The rapid development of ICT has brought forth big changes in society and the economic world. Not only educators, but all stakeholders including teachers, students, parents and school administrators are facing the change and need to live with it.

2.2.3. From the Perspectives of Educators

ICT is believed to have the potential for changing education from the following four perspectives: First, it is a tool to achieve a shift to learner-centred approach to education; Second, it requires teacher to be a facilitator of learning; Third, it offers greater efficiency and effectiveness of student learning; Fourth, ICTs' growing prevalence in society (Dhanarajan, 2002).

Constructivists and social-constructivists believe that learning involves learner constructing knowledge through active participation (Pearce & Ainley, 2002). Pearce and Ainley (2002), in their search for the kind of motivation triggered by particular learning task with physics software, found that the higher topic interest triggered, the more students become involved in the task, resulting in a higher performance and better learning outcomes. One of the advantages of using ICT in a lesson is its ability to motivate students because the interactivity of ICT is a characteristic to facilitate student learning. However, Pearce and Ainley (2002) conclude that it will be effective only if students are actively engaged in learning. Edwards (2007) also points out that ICT can be used to increase effectiveness of learning only with appropriate amount of activity. Smolin and Lawless (2007) therefore proposes that planning is particularly important for effective introduction of ICT into the curriculum. Teacher training and professional development then become important if the above potentials are to be achieved.

The capability of multimedia resources to allow for self-paced and independent learning facilitates the development towards student-centred approach to education with teachers drawing on a range of information sources as facilitators of learning (Smolin

& Lawless, 2007). Due to ICT's growing prevalence in society, students have increased access to computers at home and their innovative use of ICT's should be tapped. Teachers should be more flexible in their teaching practices as students need more student-centred activities and greater autonomy. Studies also show that technology must be considered as an additional resource that is vital in achieving standards-based learning goals (Maier & Warren, 2000).

2.2.4. Summary

From the perspectives cited above, it is clear that national policy leaders consider ICT to be a 21st century tool that has changed the way students think and learn and that it can improve education and let students become independent and life-long learners. They believe that it can change people's lives, families, societies and even nations. Some worldwide businesses support the change by putting money and launching different programs to prepare teachers and students for the change. Examples are the 'Partners in Learning by Microsoft' (PIL Microsoft, n.d.) and the project of 'Partnership for 21st Century Skills' (Maurizio et al., 2004).

In different countries and cities, governments have their policies for the ICT in education in place in the past decade and invested a large sum of money in the development with the belief that ICT can improve students' learning and help them to be active and life-long learners. Through ICT learning, they have better opportunities to develop their communication skills and nurture their independent, creative and critical thinking skills. Such skills are important in helping students meet the challenges of the global society in the 21st century. These beliefs have prompted governments to put

money on the infrastructure and also target at systemic change of schools and education in order to transform education in their country.

Educators believe that ICTs can help improve the quality of education, enhance lifelong learning and facilitate non-formal education (Dhanarajan, 2002). ICT has the potential to bring about more efficient and effective student learning. Due to the prevalence of ICT in society and students' increase of exposure to ICT outside the school, teachers should be more flexible in their teaching and understand how ICT can inform and enhance pedagogy so that they can help improve student performance with appropriate use of it (Maier & Warren, 2000; Smolin & Lawless, 2007).

The above literature all agree that education has the mission of preparing the younger generation for the challenges of the global society in the 21st century and that ICT can be a catalyst for improving education which can change lives, families, communities, and ultimately nations (PIL Microsoft, n.d.: n.p.).

2.3. Educational Change and Teacher Change

To successfully implement educational change, an understanding of it and how teachers change are important. The concepts and ideas contributed by Michael Fullan (1993, 2001), an authority in this research area, will be discussed. Though his research takes a much broader view than only focusing on change with technology use, implementation of ICT use in schools is given a certain amount of attention and discussion. With his long years of study and deep investigation into the change process

in the educational field, he gives guidelines for understanding changes and the framework for studying them.

Fullan's (1993) eight basic lessons of the 'New Paradigm of Change' can help to understand change. They are (1) you can't mandate what matters; (2) change is a journey not a blueprint; (3) problems are our friends; (4) vision and strategic planning come later; (5) individualism and collectivism must have equal power; (6) neither centralization nor decentralization works; (7) connection with the wider environment is critical for success, and (8) every person is a change agent. Fullan (1993) emphasizes the complexity of the change process saying that

"Dynamic complexity is the real territory of change. ... because other 'unplanned' factors dynamically interfere. ... change in dynamically complex circumstances and is non-linear, we cannot predict or guide the process with any precision ..." (Fullan, 1993: p.20).

Teachers are in the front line are usually thought to be the key persons for educational changes but they are always blamed for having resisted change. Schools are described as slow adapters to change. In order to implement change, to understand how teachers change, why they resist change and why they alter the 'process of change' is very important and calls for the attention of many researchers (Hargreaves, 1994). Richardson (1998) notices the discrepancy between what she read from literature that teachers do not change and what she observed from teachers in different countries that teachers change all the time and inquire into it. Krumsvik (2006) posts the question whether teachers are 'catalysts' or 'inhibitors' of change and whether they are 'innovators' or 'conservator of the status quo'.

2.3.1. Introducing ICT in Education as an Educational Change

The change to using ICT in teaching and learning involves changes in the roles of teachers and their relationship with students. The Hong Kong government has introduced ICT into schools with the belief that it can transform school education from a largely teacher-centred approach to more interactive and learner-centred approach (EMB, HKSAR, 1998). This change emphasized the ‘paradigm shift’ which echoed the requirement for curriculum reform initiated by the Hong Kong government by that time. Fullan’s (1993) new paradigms of change can be a reference and a guide for meeting the change. He points out that the complexity of the change is high and that the process of change is non-linear and cannot be predicted. Reformers and leaders of the change should take note of this and not to blame teachers for reluctance to change when they do not see the progress as they have planned despite the educational change is meaningful and of great importance.

Buettner (2006) summarises factors required to ensure successful implementation in an educational change, particularly with ICT. They include (1) support of principals; (2) time for study and reflection; (3) development of networks and openness about issues among all involved; (4) encouragement and support to teachers for change (Guskey & Huberman, 1995); (5) appropriate learning platforms; (6) teacher’s past experience, willingness, abilities, social conditions and institutional support and (7) ‘need’ and ‘practicality’ as perceived by teachers (Fullan, 2001; Flores, 2003). Overall, the leadership of principals, who are usually the key leaders of change in schools, is most important in moving teachers forward. Teachers would otherwise prefer to stay in their ‘comfort zone’ since any attempts to change are complex and

risky. Fear of failure in trying new ways of teaching which they are not familiar with and are not confident in may deter them from trying (Guskey & Huberman, 1995). Time for study and reflection is another factor for the successful implementation of an educational change. This involves changes in the schedule of the school which the principals have the say. Guskey and Huberman (1995) stresses the need of time for teacher development when he discusses teacher change. Teachers need time to learn, reflect and prepare new materials and it requires the school to put the change in high priority. The factors named above, such as developing networks and learning platforms, teachers' experiences, abilities and willingness as well as their felt need and practicality, can be achieved through teacher development and learning opportunities.

2.3.2. Understand Teacher Change

Clark (1993) believes that an understanding of how teachers change and grow is essential for improving schools. Flores (2003), after considering many reviews of literature on teacher change, claims that it is essential to explore teachers' understanding of change and examine how teachers change, in what way, why and when. A closer look at teacher change could contribute to deeper understanding of the factors that facilitate or hinder the process of change and how these factors interact. Fullan (1993, p.20) considers 'complexity, dynamism, and unpredictability' as normal in the real territory of change.

Reasons for the failure of teacher change

Teachers who are the ‘masters’ in the traditional classrooms, are sometimes blamed for not being willing to change or resist change and schools are criticised as slow in embracing ICT. Mumtaz (2000), after a review of literature on integration of ICT in teaching and learning, summarises the factors that affect teachers’ take-up of ICT as follows: (1) lack of time for teachers ‘to manage and familiarize themselves with ICT’ (p.335), (2) pressures of work and timetabling does not allow time for teacher learning, (3) lack of support for teachers who are not confident enough to take up ICT. She further states that this resistance is based on an unclear understanding of the change and why the change should take place.

Imposed changes

Studies on why teacher change fails emphasize that change cannot be brought about as a top-down policy. Rather, support of all kinds is necessary in implementing changes (Owston, 2006). Teachers are sometimes in a strange position of being simultaneously the subject and the agent of change. Even worse is that changes are usually imposed on them by policy makers who neither know them nor the context in which they work but only instigate change due to economic and political reasons, historical trends or social and cultural developments. Teachers feel that their professional freedom and autonomy have been curtailed in these imposed changes and, in some cases, teachers do not feel the changes appropriate or possible. Besides, the assumptions behind those changes are the fact that teachers do not teach well and students are not receiving the best education. The interpretation and implication may

mean that teachers are lacking in knowledge, skills, competences and even personal qualities for quality education. Therefore, those imposed changes are prone to failure. ‘We cannot mandate what matters’ is the first of Fullan’s eight lessons about change (Fullan, 1993).

Needs and concerns of teachers not attended to

Horn (2000) reviewed the reasons for the failure of his attempt to radically reconstruct the curriculum and instruction in his school with the ‘new philosophy of education’ proposed by the school district in the early seventies. He points out that students and teachers, who often are the objects of change and have the power to implement or resist the change, are overlooked. The possible reasons for failures may include the fact that teachers resist the change because of the disruption of their established routines. Other problems such as scheduling, staffing, differences in philosophy and procedures are also reasons for resisting change (Horn, 2000).

Almost all educational changes require new skills, behaviour, and beliefs or understandings (Fullan, 1993). Weert (2004) says that education is in a continuous process of change. Educational change cannot happen simply because the government or leader sees the need and puts forward the requirement for change. The needs and concerns of teachers and students should be seriously considered. According to the evaluations of the ICT policies by different governments, changes that aim at transforming education require the plan for systemic change and not merely limit it to the change of teachers.

2.3.3. Teacher Change

Fullan (2001) emphasizes that “*educational change is a dynamic process involving interacting variables over time*” (p.71). Factors affecting change cannot be considered in isolation. Besides the characteristics of change discussed above, local roles and external factors also affect the implementation. Local roles refer to district, community, principal and teacher while external factors include government and other agencies (Fullan, 2001). A study by Wilcox and Gray (1996) proves that inspection by government or agencies, such as OFSTED in the U.K., can bring about change though it may only be incidental.

The new meanings, new behaviours, new skills and new beliefs that are necessary for teacher change largely depend on teachers’ working relationship and the support and positive feelings they have towards their work (Fullan, 2001). Their psychological state which is determined by their personality and influenced by their previous experience also leads to whether they will take action and persist in the effort required to bring about successful implementation or not. The different perspectives on the change process suggested by Fullan are (1) change requires some impetus to get started; (2) it requires both pressure and support for the success; (3) it requires careful consideration of the relationship between changes in behaviour and changes in beliefs or understanding. The relationship between change in behaviour and change in beliefs is ‘reciprocal and ongoing’ (Fullan, 2001: p.92).

Fullan (1993) stresses the complexity of change in his works on teacher change. He states that ‘the change process is uncontrollably complex, and in many

circumstances unknowable' (Stacey, 1992 in Fullan, 1993: p.19). Productive change is the constant 'search for understanding, knowing there is no ultimate answer' (ibid: P282 in Fullan, 1993: p.20). The real leverage for change involves 'seeing interrelationships rather than linear cause-effect chains, and seeing processes of change rather than snapshots' (ibid: p.73 in Fullan, 1993: p.20). Fullan and Hargreaves (1998) point out that the implementation of change depends on teachers' beliefs and values as well as their views on education, teaching and the schooling process. It is therefore not possible to change one aspect without affecting the others.

Fullan (2001) points out that change in beliefs and understanding are the foundation of achieving lasting reform. Teachers' beliefs and attitudes are key factors influencing teacher change in practice and they are affected by evidences of students' improvement in learning. Cuban (1988) distinguishes change in the organization as the first-order and change in teachers' beliefs as the second-order. Hopkins et al. (1994) put the process of change in two different levels, namely changes in teachers' beliefs or personal theories as the first level and changes in teachers' professional behaviour or actions as the second level. From the 'vast and scattered' literature on teacher change, Richardson and Placier (2001: p.906) suggest that second-order change, which refers to teachers' beliefs, precedes change in teachers' practices, the first-order change. They all consider teachers' beliefs are important in bringing about change in teachers' practice and even change in the organization. Guskey (1986) states that *"the endurance of any change in teachers' beliefs and attitudes is dependent upon evidence of change in student learning outcomes resulting from changes in teachers' classroom practices"*.

This is based on his idea that change is “*a learning process for teachers that is developmental and primarily experientially based*” (Guskey, 1986: p.7).

In another study on changes in classroom practices and beliefs, Clark and Clark (1993) concludes that changes begins as experiments and whether an activity works out or not is determined by teachers’ personal beliefs. He further points out that teachers’ beliefs and practices are embedded and tied to the broader social and historical context (Clark, 1993). Yuen et al. (2003) also consider the history, culture and background of the school and its general vision and mission as important factors affecting ICT implementation. Therefore, in order to understand how teachers change, it is important to explore teachers’ views, their practices, as well as the school culture and the social and historical factors affecting it. For example, the attitudes of the stakeholders in the school, educational system and the society all have their influences on teachers’ beliefs, attitudes and practices in the classrooms.

A paper by Flores (2003) reporting an empirical study of teacher change in their first two years’ service shows that there is a pattern that most of the teachers, with the exception of only a few, shift from “*a more inductive and student-centred approach to teaching towards a more traditional one*” (Flores, 2003: p.1). Factors contributing to the changes, both positive and negative, are found to include teachers’ past experiences as students, the influence of people such as their former teachers and relatives and “*images of self-as-learner associated with perceptions of school culture and leadership*” (Flores, 2003: p.1). Besides, teachers’ interpretation and the way they deal with the change process as well as the impact change has on teachers’ beliefs and values

also have effects on teacher change (Flores, 2003).

A Model of Teacher Change

Discussions above show that there is a close relationship between professional development and teacher change. Guskey (2002) has defined professional development programs as *“systematic efforts to bring about change in classroom practices of teachers, in their attitudes and beliefs, and in the learning outcomes of students”* (p.381). He stresses the fact that the relationship among these outcomes is highly complex but the efforts to facilitate change can and should consider the order of outcomes most likely to result in desired change and the endurance of that change (Guskey, 2002). He proposes an alternative model of teacher change and it is illustrated in Figure 2-1.

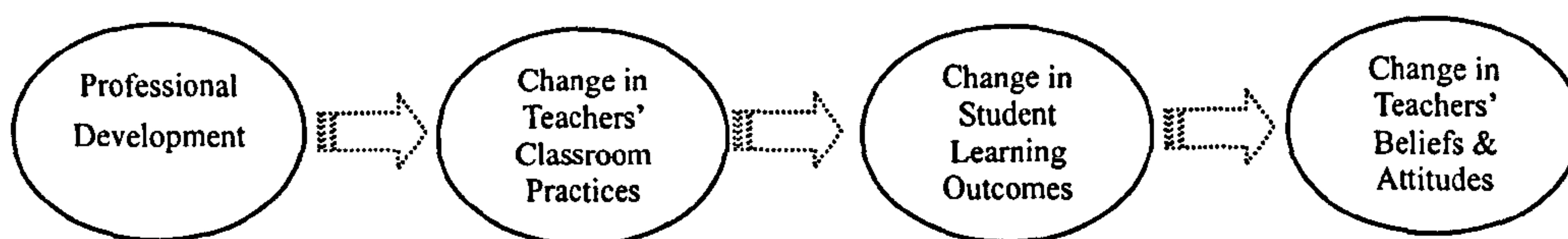


Figure 2-1 A model of teacher change
(Guskey, 2000: p.383)

In this model, the change in teachers' beliefs and attitudes occurs after they gain evidence of the change in student learning outcomes which result from change in teachers' classroom practice. Guskey (2002) stresses the point that it is not professional development but the experience of successful implementation that changes teachers' attitudes and beliefs. Therefore, the clear evidence of improvement in the learning outcomes of their students is a key in changing teachers' attitudes and beliefs. Learning outcome can broadly include student achievements as well as their behaviour and attitudes. Further, he proposes that the process of teacher change mentioned above is

more cyclical than linear. That is, changes in attitudes and beliefs are likely to spur additional changes in practice that bring further changes in student learning and so on. It helps to explain the differences found in the effect of professional development on new and practicing teachers in their research.

Richardson (1996) similarly argues that the chief objective of professional development should be to foster changes in teachers' knowledge, beliefs, and attitudes, because these components of teacher cognition show a strong correlation to teachers' classroom practices. She continues to point out that student performance influences teachers' knowledge, beliefs, and attitudes, mediated through enactment and that it forms a key component of the feedback loop that shapes teachers' beliefs about their students and about their own teaching (Richardson, 1996). Evidence of student performance can therefore play a key role in professional development.

Guskey's (2002) alternative model for teacher change generates new principles for the planning of effective professional development programs for significant and sustained educational improvements. It should be recognized that change is a gradual and difficult process for teachers. It brings a certain amount of anxiety and can be very threatening. Teachers should be provided with continued follow-up, support and pressure for continuing educational improvement. Purnell (2002) also emphasizes the importance of a supportive environment for teacher change. The types of support identified from her research include a supportive management or school principal, adequate technical assistance, time to learn and experiment and appropriate professional development.

2.3.4. Professional Development and Teacher Learning

Fishmana et al. (2003) consider professional development as teacher learning which results in changes of teachers' knowledge, beliefs and attitudes that in turn lead to the acquisition of new skills, new concepts as well as new processes in teaching. There are many studies relating teacher change with teacher learning and professional development. Any change that involves different approaches to teaching and learning or new relationships between pupils and teachers requires teachers' learning and adapting to the new approaches. Kadel-Taras (1996: p.11) claims that *"teacher learning and teacher change are mutually reinforcing: teachers often learn through making changes in their practice, and when teachers act on their desire to learn, they often are led to change"*. Day (1999) considers teacher change as a necessary outcome of effective professional development and he points out that the process of change is complex and unpredictable. Professional development is considered essential in bringing forth teacher changes and time is the basic need for the training and development.

Teacher Learning

Putnam and Borko (2000) describe teacher learning as an experiential process through which knowledge is enacted, constructed and revised. They summarise from a number of research studies different approaches of learning experiences. One of the approaches is to ground teachers' learning experiences in their own practice by conducting activities in school sites and mainly in their own classrooms. Another one is to share teachers' experiences of classroom practices in staff development activities such as workshops which focus on instructional practices. Case-based teaching is an

approach that allows teachers, both pre-service and in-service, to explore the richness and complexity of genuine pedagogical problems in real classroom situations using multiple perspectives and frameworks. It is found that a combination of approaches would be the best for “*fostering powerful, multidimensional changes in teachers’ thinking and practices*” (Putnam & Borko, 2000: p.7).

Professional communities

Putnam and Borko (2000) consider it a challenge for teacher learning to provide ‘conceptual inputs’ which may provide stimulus for different actions, including pedagogical thinking and professional discussions. They point out that professional learning requires vision, capability, motivation, reflection and willingness to participate in a professional community of practice. Professional communities that discuss new teaching materials and strategies, support critical and reflective examination of teaching practices and support risk taking have played central roles in supporting teachers to transform their practice. These communities where inquiry, critique and reflection are the norms can also give impact on experienced teachers’ knowledge, beliefs and practices and facilitate change. However, the existing cultures and discourse communities in many schools may not have these norms. Thus, professional development in schools can play the role to establish new learning communities. Shulman and Shulman (2004: p.259) hold similar views listed above and they use the terms “*Vision, Motivation, Understanding, Practice, Reflection and Community*” to describe the features of accomplished teacher development. In their new model of teacher learning communities, they state that “*an accomplished teacher is a member of a professional community who is ready, willing, and able to teach and to learn from*

his or her teaching” (Shulman & Shulman, 2004: p.259). Professional communities can be most effective in developing teachers and facilitating change.

Teacher Training/Learning for Using ICT in Teaching

An evaluation of ICT teacher training programs in the U.K. to identify the conditions that facilitate effective training and learning shows that improvements in ICT in the classrooms will not happen alone but only when combined with systemic change in the schools (Preston, 2004). Findings from the evaluation suggest that initiatives need to focus on systemic change in schools in order to have an impact on the learning culture of the schools (Preston, 2004). For example, the examination systems will need to be changed if transformational learning is the aim of the innovation since otherwise the professional is unlikely to feel safe to take risks for it if the assessment still measures traditional ways of learning.

Other suggestions given in the review include time for teachers to reflect, to debate and to expand their language of pedagogy as well as time to consider the use of ICT to improve learning. Pedagogy of ICT and the reality of transformational learning are the two issues that are found to need more understanding. Many writers have argued that computers and other new technologies have potential to transform teaching and learning in schools. Teachers need to be trained not only in the basic computer skills for administration and presentation but to connect the potential of ICTs to the subject they are teaching and use related pedagogies in their lessons. Smolin and Lawless (2007) emphasize teachers’ need to understand how educational technology can inform and enhance pedagogy so that they can help improve student performance

with appropriate use. In many teacher training schools, professional communities are established to encourage discussion of new teaching strategies, support critical and reflective examination of teaching practices and support risk taking.

Fullan and Hargreaves (1998), assert that the key to create, sustain, and motivate good teachers throughout their careers is interactive professionalism which requires (1) discretionary judgment as the heart of professionalism; (2) collaborative work cultures; (3) norms of continuous improvement where new ideas are sought inside and outside one's setting; (4) reflection in, on, and about practice in which individual and personal development is honoured, along with collective development and assessment; and (5) greater mastery, efficacy, and satisfaction in the profession of teaching. They further state that in order to encourage teachers to learn and apply new teaching skills, the understanding of the factors that favour changes and factors that are obstacles to change are important. 'Problems are our friends' is one of the lessons given by Fullan (1993, p.21).

2.3.5. Teachers' Change to Using ICT in Teaching

The innovation of change to use ICT in teaching requires teachers to change their classroom practices. They grew up in the traditional education system which was designed for a very different world from the one that their students live in. Findings from research on teacher change suggest that teachers change their practices when they attend to their own needs in terms of learning and professional growth, their intellectual interests, their beliefs about the purposes of their work, their understandings of themselves as individuals and their life priorities (Flores, 2003, Kadel-Taras, 1996).

This change requires teachers to engage in the active learning process. Professional communities are playing central roles in facilitating the adaptation of innovations to transform teaching and learning as mentioned in the previous section. However, there are other factors affecting the implementation and they will be discussed in the sections below. The next section is a brief description of the situations in Hong Kong to prepare for the discussions of the factors affecting teachers change in this context.

2.3.6. Change in Hong Kong Schools

Teachers in Hong Kong schools, like all others in the world, are familiar with change. In the past decade, educational changes mostly came from the government as administrative instructions coming from a combination of factors such as the economic trends, technology development and even political issues. Teachers have long been immersed in an environment where there is ‘a lack of support’ (Li et al., 1999). Therefore, teachers seem to be conservative and resistant to change. From research in educational changes and teacher change in Hong Kong, there are three kinds of fear generally associated with change and transformation. They are (1) the burden of incompetence, (2) the fear of disclosure, and (3) the lack of time and energy (Li et al., 1999). Another study in Hong Kong schools to identify enabling factors and inhibitors of change as perceived by teachers has revealed that even those teachers who were well prepared to face the challenge and technically ready for the change showed little change in practice. The main reasons they expressed include (1) lack of clear and systematic leadership support, (2) inflexibility of the curriculum and assessment processes, (3) time constraints, and (4) limited appropriate professional development (Fox & Henri, 2005).

The Centre for Information Technology in Education (CITE) is an organization established by the Hong Kong University in 1998 for the promotion of the use of ICT for quality education. The centre provides in-service professional development training to teachers and principals and initiates projects for the sharing of research-grounded insights, examples, models, learning architectures as well as pedagogical and assessment activities that support the development and adoption of innovations and practices that improve learning in sustainable and transformative ways (CITE, 2009b). The project of professional development network for knowledge building in schools is an example of a community of teachers for this purpose to enhance learning and teaching that align with the curriculum reforms which emphasize inquiry, teamwork and lifelong learning. In the CITE annual report 2008/09, they have identified “*the greatest educational potential for IT is realized when IT is applied to transform learning in both individual and organizational contexts*” (p.1) after its first 10 years experiences. The centre put ‘empowering communities and transforming learning’ (CITE, 2009a: p.1) as its vision statement after the 10th anniversary and position itself as a focal point for collaboration and innovation by providing a platform for sharing and building new knowledge about learning, transformative uses of technology and improvement of educational practices (CITE, 2009a).

2.3.7. Factors Affecting Teacher Change

Fullan (2001) suggests that there are three components in implementing a new program or policy and these are the possible use of new or revised materials, the use of new teaching approaches and the possible alteration of beliefs.

Fullan points out that successful implementation of an educational change requires an understanding of the process and the factors that determine its success or failure. However, most teachers do not have adequate information, access, time or energy to implement innovations though they are willing to adopt change at the individual classroom level (Fullan, 2001). Findings also show that schools which have established ‘professional learning communities’ always search for new ways of making improvements.

Case studies of innovative uses of ICT in schools around the world show that strategic leadership which includes vision, personal ICT use and ability to manage change is important. Other characteristics include staff professional development, extensive curriculum planning and technical support given by ICT co-ordinators and specialists (Dhanarajan, 2002). Another study has found that the essential components for quality use of ICTs by teachers include prior experience in innovative programmes, support from senior management, a collaborative working environment and a willingness to take risks (Maier & Warren, 2000).

Leadership of the principal

A multiple case studies for the SITE M2 study reports that “*school principal played the critical role of the curriculum leader, engaging staff in the process.*” (Yuen et al., 2003: p.166). In their findings, the most successful integration of ICT into the schools is found in the two schools where the use of ICT in teaching were generally encouraged and supported. Teachers seemed to have voluntarily chosen the pedagogical approaches without the principals’ coercion. Law et al. (2000) point out that the kind

of pedagogical practice used in a particular classroom largely depends on teacher's belief. In those schools, teachers acquired the skills in one way or another for their own use in teaching even when there was no extra demand and no compulsory ICT staff development program. Teachers felt that they were respected and trusted by the school leadership. These schools are labeled as cultural innovation models since they had 'well-established school tradition and culture'. On the other hand, in the schools whose principals used top-down management, teachers were required to learn and use ICT in some ways in their classrooms. Teachers in those schools did exhibit some kind of usage in lessons and demonstrated that they were at the initial stage of innovation. These schools are labeled as technological adoption models in the study. These five schools had a common feature that they were all consciously engaged in the process of curriculum innovation and reform. This model covers the majority of the schools of the SITE M2 study. In these cases, leadership of the principals has played an important part in affecting the change process.

Pressure and Support

Since there are many forces maintaining the status quo, both pressure and support are necessary for success. *"Pressure without support leads to resistance and alienation, support without pressure leads to drift or waste of resources"* (Fullan, 2001: p.92). Professional learning communities are effective in bringing about pressure and support in a 'seamless way' (Fullan, 2001: p.91). A supportive environment for teacher change has been proved important in research like that done by Purnell (2002). Pressure from external sources such as inspection by OFSTED has also been proved effective in implementing change (Wilcox & Gray, 1996).

It has been discussed in the above section that professional development and teacher learning are important in teacher change. Professional development and sharing for teachers both inside and outside the school are essential in bringing about changes in beliefs and practices of teachers (Fullan, 2001). Fullan's eight lessons concerning teacher change include 'Individualism and collectivism must have equal power' and 'Connection with the wider environment is critical for success' (Fullan, 1993: p.21). Professional communities thus play central roles in providing support and creating environments and opportunities for teachers to share and to learn. Besides learning the skills for the change, teachers need support and opportunities to acquire knowledge, change their beliefs and attitudes.

Other factors

In the above discussion, positive learning culture and effective leadership are considered crucial in supporting teachers change to use ICT in teaching (Preston, 2004). The school system, including the curriculum, assessment and time tabling, needs to be flexible enough to accommodate the change. Use of ICT can be barriers or enablers to motivation to learn which in turn may discourage teachers from using or encourage them to use it. Factors such as traditional timetabling and assessments will discourage the use of ICT in school. Pearson and Naylor (2006) point out that the tight timetable of a secondary school day acts as a barrier to extended exploratory sessions. This restriction does not encourage the use of ICT as a tool for personal exploration and development. Further, the government's use of high-stakes test results for measuring school performance also discourages schools from developing the use of ICT to transform teaching and learning (Pearson & Naylor, 2006).

There are many other complex factors affecting the implementation and many of them are inter-related. The three themes used by Pearson & Naylor (2006) for their study in selected schools are some of them. They include the school's determination to 'sell' its innovative practice to a range of stakeholders, to invest in the hardware and software for the development of new technologies and/or new pedagogies and the teachers' readiness to change their roles when ICT is being used to transform teaching and learning. The system, but not personal resistance, may itself have inhibited teacher change. Lack of funding and persistent support from the government or the school management are also factors affecting teacher change.

2.4. Research of ICT in Education

The introduction of ICT in education is an educational change which has invited extensive research worldwide in the past two decades. Watson (2006: p.199) points out that *"understanding the relation between ICT and education means exploring innovation and change"*. The adoption or implementation of this educational change involves changes in practice, in curriculum, in pedagogy and are specifically affected by the change of the technology itself. There is a great demand for the study of ICT in education since it is an issue that governments, educators, schools, teachers, students and all members of society are concerned about and they all have roles to play. The eighth lesson concerning change given by Fullan (2001) says that 'every person is a change agent' (p.39).

2.4.1. The Need for Research into ‘Success’

In the past decade, governments in countries all over the world have invested considerable amounts of money in developing ICT in education. As a consequence, researchers have the interest and see the need to study into the ‘success’ of the initiatives and the related projects or programs. Studies have been carried out to search for the right directions and ways of change to fully exploit the potentials the ICT tool in teaching and learning. To be accountable to the public for allocating the large amount of ‘public money’ in its development, the governments have invited and supported research in this area.

2.4.2. Trends of Research

In the past two decades, there have been rapid changes in ICT technology and the great potential it has in revolutionizing the ways of teaching and learning, in the storage, dissemination and spread of information and knowledge. The way technology is being used in education has changed from instructional delivery devices in the eighties towards greater use of computers and other devices as tools in the learning process (Means et al., 1993). Watson (2006) gives the remark that the focus of research has shifted from teaching to learning and there are substantial debates on the role of the teacher in facilitating learning. Research has changed with the fast changing technology in order to lead or inform this change in education.

In the early eighties, research looked into the relation between the provision of hardware and software which was believed to have contributed to the improvement of motivation in learning and thus directly or indirectly led to improvement of learning

outcomes. In the early 21st century, research interests have shifted to the networked world and ways to exploit the full potential of ICT in teaching and learning. In recent years, the use of ICT tools for lifelong learning has become a focus of research (UNESCO a, n.d.; UNESCO b, n.d.). These changes are reflected in government policies in education almost everywhere over the world.

It was mentioned earlier in this section that research in the nineties inclined towards studying the hardware, infrastructure and access. To report to the public the result of investment for promoting ICT in education, governments tried to present the computer and pupil ratios and/or computer and teacher ratios in their reports and related the effects of computer use in teaching and learning to the provision of hardware and software. The United Nations Educational, Scientific and Cultural Organization (UNESCO), which is an international organization pooling research for the improvement of education, has suggested a list of indicators for assessing the effects. They are policy, infrastructure and access, budget, ICT use in the curriculum, professional development and student outcomes (UNESCO a, n.d.).

Positive and Negative Effects Reported from the Research

Positive effects reported include (1) students are more motivated to learn with the technology, (2) those with special education needs increase time of engagement in learning, (3) students have better understanding with visual effects available, such as animations, photos or videos, (4) students have better self-confidence and higher self-esteem as a result of learning in their own pace and in a safer environment with ICT and consequently leading to better results in assessments (UNESCO a, n.d.).

Besides the many 'evidences' of positive effects of IT in education, there are also studies that draw attention to the rhetoric and false beliefs that the technology can change education. An issue in the British Journal of Educational Technology in 2003 put 'rhetoric and reality' as its main theme and invited discussions and thoughts on the effects of ICT in teaching and learning. Nichol et al. (2003) report that pupils appreciate the increased sense of interaction and control offered by the ICT version of an investigation and they show an increased sense of engagement. However, they also point out that the effects of ICT on raising the standard of learning and teaching in schools are not conclusive since it is not possible to isolate any factors in the study.

A study in Switzerland shows that despite efforts to integrate ICT in teaching for 20 years from the eighties, the use of computers in classrooms is still low in the 21st century (Buettner, 2006). Buettner (2006) points out that even though the schools have sufficient equipment, free access to the Internet, good educational software and educational resources online as well as in-service teacher education throughout Switzerland, the use of ICT in teaching is still not high. She summaries the change in Switzerland schools into 3 stages. They are the keyboarding stage, the integration stage and the communication stage. The reasons for the low use of ICT in classrooms are probably due to the need for teachers to learn new things and to handle new teaching skills roughly every 5 years (Buettner, 2006). Other researchers have similar comments.

Purnell (2002), in her report on a study in Tasmanian schools, states that despite the massive expenditure on technology, the integration of technology into teaching and learning is minimal and schools are struggling to incorporate new technologies into their classroom curricula. She further points out that this educational change requires

changes of teachers' role which demands not only huge amount of teachers' effort, time, and work but more importantly a supportive environment which includes a wide range of conditions.

In the nineties, governments of different countries put forward plans and budgets for the development of ICT in education and evaluative studies on the effects followed. In the U.K., focuses of the studies have been put on proving the causal relationship between ICT and better learning outcomes in national tests (measurable systemic indicators). The Nordic impact approach focuses on the perception of teachers and learners (IMPACT, 2006). There is no conclusive finding that ICT does improve student learning, except some feedback from both teachers and parents seeing the improvement in students' motivation to learn and the increased time on task since it is not possible to isolate any factors affecting student learning.

2.4.3. Research in the 21st Century

In the 21st century, with the rapid changes in technology, drop in what price, rise in speed and connectivity of computers, like the Internet which has been expanding in high speed, there are great potentials, possibilities of and demand for change of the ways 'education' is delivered and the environment for learning.

The changes of the terms from IT to ICT in some government documents and research reports from the late 20th century to the early 21st century, like that used in Master Plan I and Master Plan II of ICT in Education in Singapore, reflect the change of the function and nature of the tool and thus the concept and way of using it in education. Consequently, there is a change in focus of research in this area. In search of good

practice is one of its main themes. Tertiary institutions are offering professional development courses, both for pre-service or in-service teachers, not only to teach the skills of using the ICT tool but to explore suitable pedagogies for using it in the curriculum. They have played an important role in research into pedagogical change, teachers' role change, and search for good practices in classrooms. Such studies are found in the local, national and international levels as well.

Research in the Regional and International Level

Studies in ICT in education are carried out not only in school level or district level, but also in the national level and international level. There are regional, national and international organizations playing important roles in putting together the efforts of teachers and educators. Studies in the international level have invited educators from all over the world to put together their efforts and build up a rich database on the Internet for reference, further investigation and development.

The United Nations Educational, Scientific and Cultural Organization (UNESCO) is one of the international organizations devoted to improve the quality of education and to facilitate policy dialogue, knowledge sharing and capacity building. With the belief that ICTs can contribute to achieving universal education worldwide, it takes a holistic and comprehensive approach to promote ICTs in Education (UNESCO b, n.d.). It hosts a database which contains research findings on ICT in Education in Asia and the Pacific regions. Its vision is to “*empower learners, teachers, educators, managers and leaders to use ICT effectively for expanding learning opportunities, ensuring educational quality and relevance, and achieving Education for All goals*”

(UNESCO c, n.d.). From the UNESCO Bangkok website, information under the five ICT in Education themes, policy, training of teachers, teaching and learning, non-formal education and measuring and monitoring change can be found. A report submitted by European SchoolNet (EUN) examines the impact of ICT use on schools in Europe based on 17 recent studies in schools across Europe. In the report, three types of barriers to ICT use in schools are given and recommendations for making more effective use of ICT in schools are made for governments and researchers to consider (UNESCO c, n.d.).

The Second Information Technology in Education Study (SITES) is a major international research project (Harris, 2002) organised by the International Association for the Evaluation of Educational Achievement (IEA) whose mission is to conduct comparative studies on educational policies and practices within and across education systems (IEA, n.d.). The SITES attempts to answer questions about the effectiveness and impact of technological applications on schooling. It consists of three independent modules, Module 1: the Indicators Module; Module 2: the Innovative Practices Module; and Module 3: the Survey Module. The studies focus primarily on the use of ICT in educational practice from an international comparative perspective. In the first module, a list of indicators were collected and consolidated for references in other research as well as its Module 2 study. In the Module 2 (SITES M2) study, 174 innovative classrooms from twenty eight countries have been identified using the list of indicators given in Module 1. National research teams used a common set of case study methods to collect data on the pedagogical practices of teachers and learners, the role that ICT played, and the contextual factors that supported and influenced them. The International Coordinating Committee (ICC) conducted a cross-case analysis using

qualitative and quantitative methods. Implications are drawn for both improved policy and classroom practice.

The study in 2006 directed by the University of Twente (the Netherlands), the University of Hong Kong, and the IEA Data Processing and Research Centre (Germany) was an international comparative study of pedagogy and ICT use in schools. It focuses on the role of ICT in teaching and learning mathematics and science. The study examines how and the extent to which pedagogical practices are conducive to the development of the 21st century skills, that is, the capacity to engage in lifelong learning and in connectedness. It also examines how the conditions at the system, school, and teacher levels are associated with the different pedagogical practices and different ways of ICT use in teaching and learning (CITE, n.d.).

All these results contribute to inform policy makers and educators, schools and teachers about strategies and practices most suitable for their own nation. The conclusions drawn from the meetings with researchers of these ‘global studies’, such as the criteria for selecting ‘innovative practices’ and ‘indicators for changes using ICT’, are useful in helping schools and teachers to change their practices. Kankaanranta (2005) gives the comment that SITES has aided different countries to evaluate the prevailing status of ICT use and to plan for meeting the trends of its educational use. Motivating and involving teachers in search of good practices and try out strategies for teaching and learning in their subject area as well as doing evaluations can help teachers feel the need and ownership of the development. It takes the lead to initiate and coordinate the efforts from countries all over the world to research into the present role

and development of ICT in teaching and learning and come up with useful guidelines for the future development and research in this area.

BECTA in the UK

BECTA is the British government's key partner in the strategic development and delivery of its ICT and e-learning. Its mission was to lead the national drive to improve learning through technology and its strategic remit was to

“... and promote, identify and map research findings to policy areas in order to support and advise DfES policy” (BECTA, n.d.).

It has carried out or collected thorough studies to report to the government and the public regularly about the most updated situation of use of ICT in education and inform the government about future policies, educators and teachers about teaching strategies being used, good practices found in schools and any other findings and useful information about ICT in teaching and learning. Studies, both quantitative and qualitative, are carried out extensively in the country and among them, case studies are commonly employed.

CITE in Hong Kong

In Hong Kong, CITE is set up to provide support for the education community in promoting the use of information and communication technology (ICT) for quality education. Its strategy is

“... to harness the power of ICT to turn schools into dynamic and innovative learning institutions, where students can become more motivated, inquisitive, creative and independent lifelong learners”
(CITE, n.d.).

With the support from government and sponsored by the Quality Education Fund, the CITES has carried out case studies on good practices in the use of ICT for teaching and learning in Hong Kong and gives a comprehensive report (Law et al., 2000).

From the discussions in the previous sections, supportive environment, rich resources, possibilities for further development and recognition are all important factors in motivating teachers to change. Example of the studies in the regional, national and international levels encourage teachers to research into their own practice and at the same time get support and recognition when they release the results of their research. As mentioned earlier in this chapter, ICT in education is an issue of such importance that not only the education sector but also government and the business sectors put efforts and money into its development. Maurizio et al. (2004) states the need for educators, including higher education leadership, policymakers, and corporate and civic leaders to jointly and expeditiously articulate a broad vision for 21st century education. Partners in Learning by Microsoft in a number of countries with Hong Kong as one participant and the Partnership for 21st Century Skills in the U.S. are examples of such collaboration. Cogburn (1998), in South Africa, has also called for, ‘concrete interdisciplinary, multi-institutional research studies’ to explore examples of applications of ICT in education and learning to meet this new era of globalization.

2.4.4. Case Studies into ICT in Teaching and Learning

From the many studies, case study is one of the most frequently used methods in researching ICT in education (Fullan, 1993). Case study reports are considered powerful means for the dissemination of information (Merriam, 1998). SITES M2 study is one using cross-case comparison in the study and has selected 174 cases from 28 nations. It has laid a foundation and provided examples for case studies in schools though the way of case selection and method used may not be perfect. Nichol et al. (2003) with the intention for filling the gap between what is perceived, claimed and reported, and what actually happens, carried out two case studies in classrooms by integrating ICT into the existing program as an alternative method of teaching and learning into the already established methods.

“Through curriculum research and development using these generic tools, teachers can produce case studies of viable, positive enjoyable and beneficial applications of ICT that are evidentially grounded. Such case studies can provide findings from which to generalise, from which to build a base for successful in-service provision for teachers, with transferable congruent values, beliefs and attitudes and related teaching approaches and resources” (Nichol et al., 2003: p.202).

In a case study, the researcher usually looks closely into the details of an area of his/her study from different perspectives. It is suitable for answering the questions of what factors affect an implementation, how a new practice affects the learning or teaching process. Thus it will be a useful tool for studying ICT in teaching and learning.

2.4.5. Factors Affecting the Implementation of ICT in Education

To more fully understand the change process, it is important to identify the factors, both positive and negative, affecting it. However, it should also be noted that

many factors and conditions are complex and inter-related so they should not be studied individually. To nurture an environment that facilitates the change and remove the obstacles, it is also necessary to investigate into factors and conditions favouring the change and those inhibiting it.

An extended version of the technology acceptance model has been used for identifying the factors that influence a teacher's decision to use ICT or not. Factors found include perceived usefulness, perceived ease of use, subjective norm, computer self-efficacy, professional development and teacher beliefs. Three factors favourable to adoption identified by Pincus (Fullan, 2003) include first, bureaucratic safety which refers to innovations that add resources without behavioural change; second, response to external pressure in which adoption may ease it; and third, approval of peer elites. On the other hand, Sergiovanni (2000) suggested six change forces influencing the implementation of ICT in schools. They are bureaucratic forces, person forces, market forces, professional forces, culture forces and democratic forces. While Pincus talked about bureaucratic safety, Sergiovanni (2000) suggested bureaucratic forces, which refer to rules, mandates and requirements, as conditions influencing change. As stated before, factors affecting changes are complex and need to be studied carefully together. For example, leadership is one of the major factors affecting change in schools as mentioned in many studies. Fullan (2003) expresses that leadership is crucial to foster the conditions for change but he also points out that "*charismatic or savior-type leaders are dangerous to the long-term health of organizations*" (Fullan, 2003: p.37).

The need for technical support is an issue raised by teachers who complain about the problems when they use technology in lessons. A report submitted to the UNESCO website (n.d.) has identified three barriers to ICT uptake in schools. They are poor ICT skills, low motivation and lack of confidence among teachers. Teachers complain about limited equipment, inadequate maintenance, inappropriate educational software and lack of institutional support for ICT use in school. In the early years of research on ICT implementation when the use was mainly in the computer rooms prepared for the purpose, time tabling, hardware management, availability of software and development of teaching and learning materials were the issues that have affected teachers' usage.

Mooij and Smeets (2001) have extensive discussions of ICT implementation in secondary schools on findings from research and literature. Conclusions drawn by Veen (1994, 1995) and Brummelhuis (1995) state that teacher factors affect ICT usage in classrooms. Teachers are believed to be the key persons in the change process (Richardson, 1998). Whether they perceive the innovation relevant to their teaching, whether they are confident and have the expertise to handle the technology determines their usage. Smeets et al. (1999) have also found that the main reason why teachers do not use ICT is that they are not familiar with it or not confident in using it. Teachers' beliefs and skills, as mentioned in the previous sections for educational changes, are important factors in the implementation of ICT and there are research findings showing that teachers' ways of teaching and learning can change drastically when ICT is implemented.

To round up, factors that facilitate the implementation of ICT in teaching and learning include the presence of favourable conditions and change forces. Other

factors influencing change include leadership, time and energy, knowledge and skills, felt need, technical support and availability of resources. The eight favourable conditions for implementing ICT as identified by Ely (1999) can serve as a summary of the above. They are (1) Dissatisfaction of the status quo; (2) Existence of knowledge and skills; (3) Availability of resources; (4) Availability of time; (5) Existence of rewards or incentives; (6) Participation; (7) Commitment and (8) Leadership (Mooij & Smeets, 2001, Melle & Cimellaro, 2003).

On the other hand, there is also a list of barriers to the implementation of ICT from research. After investigating into the issues and questions on whether ICT is suitable for transmitting knowledge to students who are not highly motivated to learn, Carnoy (2004) concludes that teacher's computer skills is the largest barrier to the adoption of ICT-based teaching learning in schools. He points out that despite the *"much greater availability of ICT in schools, ICT seems to play such a minor role in the teaching / learning process in most schools"* (p.14). After his study, he suggests that teachers resist ICT because they do not feel comfortable with it and that they have not been trained in the methods to incorporate ICT into everyday teaching. Richardson (1998) summarises the barriers as (1) resistance from teachers who feel threatened and disempowered by new technologies and the changes they bring to their role; (2) lack of teacher expertise with new technologies; (3) difficulties in transferring teaching and learning processes into technology-based approaches; (4) costs of new technology, particularly as it becomes quickly outdated; (5) costs involved to train teachers in the use of new technologies; (6) lack of technical support in schools; and (7) lack of leadership in IT.

Issues such as access, connectivity, lack of content and technical support continue to act as obstacles to teachers' use of ICT in schools across Canada (Newhouse et al., 2002). From their review of literature, Newhouse et al. conclude that the reason for educators (teachers) to resist the use of technologies is that

"... they are incompatible with their philosophy of teaching and the daily realities of the classroom" (Newhouse et al., 2002: p.44).

To summarise, there are five barriers to change in the implementation of ICT. First, the lack of confidence in using the new technology; Second, the need of time and energy to change teaching and learning processes including materials and teachers' roles; Third, the cost for sufficient hardware, software and training; Fourth, lack of technical support; Fifth, lack of leadership in the change of using ICT in teaching and learning.

2.4.6. Stages of Implementation & Success Criteria

To understand the change process, it is necessary to refer to a set of guidelines for measuring the extent to which the implementation has been achieved. Mooij and Smeets (2001) suggest five successive ICT implementation models with a list of characteristics considering the eight conditions listed in the above section. This serves as a useful guideline for understanding the situation of implementation. The five models are:

- Model 1: *"incidental and isolated use of ICT by one or more teachers"*;
- Model 2: *"awareness of the relevance of ICT for the school and subject-related departments"*;
- Model 3: *"ICT co-ordination and hardware facilities in the entire school"*;
- Model 4: *"didactic innovation and ICT education support"*; and
- Model 5: *"integrated ICT support for learning processes-compare with the actions of Model 4"* (Mooij & Smeets, 2001: p.274, Table 4).

Fullan (2003) points out that schools tend to adopt innovations but do not implement it and it is in fact the predominant pattern.

“... schools tend voluntarily to adopt innovations which promote the schools’ self-image as up-to-date ... efficient ... professional ... responsive...it is relatively easy for schools to adopt complex, vague, inefficient and costly (especially if someone else is paying) innovations as long as they do not have to implement them...” (Fullan, 2003: p.122).

Fullan (2003) then summarises from research with the three broad phases to the change process. These are useful in understanding and checking the ‘success’ of an implementation and avoid falling into the trap of wasting time and money in only adopting an innovation by putting something into practice but not really change the teaching and learning inside the classrooms.

“Phase I – variously labelled initiation, mobilization, or adoption – consists of the process that leads up to and includes a decision to adopt or proceed with a change.

Phase II – implementation or initial use (usually the first two or three years of use) – involves the first experiences of attempting to put an idea or reform into practice.

Phase III – called continuation, incorporation, routinization, or institutionalization – refers to whether the change gets built in as an ongoing part of the system or disappears by way of a decision to discard or through attrition” (Fullan, 2003: p.50).

Hargreaves and Goodson (2006) in their ‘Change Over Time’ project, has found the importance and necessity of taking a historical perspective on the change to see whether the change efforts are ‘sustainable’ or just of ‘transient interest’. When asked ‘what works in schools over long term’ and ‘what works for leveraging deep change in schools’, Sergiovanni (2000) suggest that change forces that are based on views of schools as communities work. They point out that when ‘professional, cultural and

democratic change forces' are successfully used, teachers will willingly adopt change and behave differently in response to the standards and norms. However, the pre-requisite for successful adoption are that teachers have the necessary knowledge and the opportunity to implement the change (Sergiovanni, 2000).

2.5. Summary

In this chapter, I have attempted to draw from literature an understanding of educational change and teacher change, in particular, for the use of ICT in schools. The literature review also tries to explore the trend and current studies on ICT in teaching and learning. From the readings, the conditions and factors that have been found to have facilitated teacher change and those that discouraged it are noted. The following is a summary of what has been found from the literature and how they will guide the development of this research.

ICT in education has become an issue not restricted to the education field but to business, government and society at large. It is widely believed that ICT is a tool with great potential to change the way and the scope people learn and even the form of education to serve the knowledge society in the 21st century (Weert, 2004). To prepare our younger generation for the challenge of living in the global society in this new era, educators and governments from almost every part of the world are calling upon joint efforts from schools, universities, communities, business, etc. for actions to nurture a lifelong learning culture. Therefore, it is important to put resources on research in this area in order to keep the trend and pace of development most beneficial to the younger generation and our society.

Regional, national and international organizations have pooled in efforts in the study of educational change in ICT. The work of UNESCO has helped to build a database of research results which are shared among educators (UNESCO a, n.d.). This culture and norm, as a result, will benefit the educational research community and encourage further development. It also helps to find gaps that need to be filled and are worth studying.

From the readings, teacher change is complex. Teachers are the key persons to implement change but they are also blamed for not willing to change. A reason is that teachers are sometimes required to make changes which they believe to be ‘inappropriate or impossible’ so they respond to the imposed change negatively. Other reasons may include the absence of favourable conditions for change, such as the lack of time for reflection, learning and planning.

What makes teacher adopt change in the context of ICT use in teaching include felt need and practicality of the change, leadership of the principal, encouragement and support, time to learn and to reflect as well as technical support. School conditions that are favourable for change include the readiness of hardware, software, teaching and learning materials, an environment conducive to change and pressure and support from the principal and the government. Examples of good practices, guidelines for changes, targets to achieve and a safe environment to experiment are necessary to guide teachers through the complex change process. Furthermore, sufficient time and resources for teachers to try out new practices, exploring possibilities, sharing difficulties and problems, as well as sharing the joy of success as they journey through the changes also make up favourable conditions for teachers to change. Professional development and

teacher learning are essential in bringing about changes in teachers' beliefs and practices especially for educational changes that require teachers to change not only in their teaching skills but also in pedagogy and aims to transform teaching and learning. Fullan and Hargreaves (1998) emphasize the need of an environment favourable to 'create, sustain and motivate' good teachers throughout their careers. A culture of network and support, openness about issues they are involved in and a norm of continuous improvement are conditions that will facilitate change towards better education for the younger generation. Government policies, school policies and leadership of the principal and support of the school administration are found to have significant influences on this change of using ICT for teaching and learning which requires systemic change to accomplish the aims.

Fullan's (2003) three broad phases of the change process and Weert's (2004) four stages of implementation are useful guidelines for measuring the level of implementation and success. Fullan's (2003) three broad phases of change are (1) initiation, mobilization or adoption; (2) implementation or initial use; and (3) continuation, incorporation, routinization or institutionalization. Weert's (2004) four stages of implementation are the emerging stage, applying stage, integrating stage and transformation stage. These stages refer respectively to being able to apply ICT tools for general functions, learn how to use it in different subjects, choose appropriate IT methods and tools and become an integral part of the professional practice.

With the understanding of educational change from literature, this research is designed and the change process of the focal school and factors affecting teacher change from literature will be compared with those found in this research in later chapters.

CHAPTER 3 Framework for Exploring System Change: using Activity Theory

3.1. *Research Questions*

To meet the challenge of the 21st century, changes in the way of teaching and learning is essential. In this era of information explosion, the perception of education cannot be seen as simply passing on knowledge on the part of the teachers. It needs to be changed from being largely teacher-centred to being student-centred, with the development of life-long learning skills in students as one of its main goals. The use of ICT in teaching and learning is believed to be an effective way to cater to the shift in priorities in education towards this end. However, this change depends heavily on teachers change in their practice and pedagogy which has been believed to be essential but also complex. Therefore, this research is designed to find out how teachers change and how they adopt or implement change in using ICT in teaching and learning as stated in the following:

1. What are the factors that facilitate and those that inhibit teachers' use of ICT in teaching and learning?
2. What factors contribute to 'successful implementation' of using ICT in the classrooms? and
3. What are the success criteria?

The purposes of this study are to

1. more fully understand the process of teacher change to use ICT in teaching and learning within the context of a Hong Kong secondary school;
2. learn from the example of the case, how to better prepare teachers for educational changes.

3.2. Theoretical Framework for Analysing Change in this Case

In the chapter of literature review, discussions on ‘Teacher Change’ show that change is complex and the change to using ICT in teaching and learning is one of it. External factors like hardware, software, staff development programs and technical support all play a part in determining whether teachers will give up their old ways of teaching and try out new strategies. Teachers’ beliefs, their perception for the need to change and their ICT competency are even more important. Other issues, such as the cultural and historical background, as well as psychological factors also influence teachers’ willingness to take the risk to change. Therefore, to fully understand teacher change, the teacher and the school context as well as the social context in which the school is situated should be taken into consideration.

Activity Theory, with its cultural-historical origin and later its concept of community and rules, provides a framework for the study of change mentioned above. There are a number of examples of applying Activity Theory to the analysis of work and learning (Turner et al., 1999). Favorin and Kuutti (1994) suggest that the theoretical concepts of Activity Theory are useful in analysing how learning could be amplified by working through information technology. Benson et al. (2008) consider Activity

Theory as a powerful tool for investigating how technologies interrelate with their context.

This paper argues that Activity Theory is a framework suitable for analysing the process of change from the traditional way of teaching to the use of ICT. Activity Theory is considered to be a socio-cultural, socio-historical lens for analysing activity systems by focusing on the interaction of human activity and consciousness within its relevant environmental context (Jonassen & Rohrer-Murphy, 1999). This study attempts to understand the change process by exploring the factors influencing the change and analysing how they affect teachers in using ICT in lessons in the focal school. In order to have a holistic view, at both the macro and micro levels of this change process, and a more comprehensive understanding of why and how teachers change, the framework suggested by Activity Theory can be a useful guide.

According to Activity Theory, the basic unit of analysis is the human activity. This includes those who carry out the activity, the tools and concepts used, the objects, the community in which it takes place and the rules governing the conduct of the community (Turner et al., 1999). In the focal school, teachers using ICT in lessons are considered to be the human activity system. Its components include the following: the subjects are made up of teachers who teach using ICT; the tools include the ICT equipment such as notebook computers, LCD projectors as well as the teaching strategies and concepts used; the objects are teachers' teaching and students' learning. The community refers to the school, the Hong Kong education system and the Hong Kong society while the rules include the school policies, government policies and

expectations of the stakeholders.

Another aim of this study is to learn from this case how to prepare teachers for educational change. Further development of the use of ICT in teaching and learning is of course a desired outcome. From the literature on Activity Theory, there is a claim that the study and change of the entire collective activity system, their objects and motives, not just isolated actions and skills can help to understand and even facilitate development (CHAT, n.d.). Furthermore, the idea of contradictions as the driving force of change and development in activity systems can serve as a guide to study the change process in this research (CHAT, n.d.).

Before applying the theoretical framework of Activity Theory to this study, a description of the basic concept, the principles and why and how it can be applied to similar situations will be discussed in the following.

3.3. Activity Theory

Activity Theory originates from the cultural-historical theory of activity and was developed by a group of revolutionary Russian psychologists in the 1920s and 1930s. Its basic concept was formulated by Lev Vygotsky (1896-1934), the founder of cultural historical psychology, and developed into the conceptual framework known as Activity Theory by his student, Alexey Leontiev (Bannon, 1997). Leontiev's version is often associated with a three-level scheme describing the hierarchical structure of activity:

“Activities, which are driven by motives, are performed through certain actions which are directed at goals and which, in turn, are implemented through certain operations” (Bannon, 1997: p.4).

Engström (1999) suggested the evolution of cultural-historical Activity Theory be distinguished in three generations (CHAT, n.d.). Vygotsky and his colleagues A.R. Luria and A. N. Leont'ev, formulated a theoretical concept centred around artefact-mediated and object-oriented action (Vygotsky, 1978). They argue that the relationship between human agent and objects of environment is mediated by cultural means, tools and signs (Vygotsky, 1978; Engeström, 1999; Kuutti, 1996). Figure 3-1 is an illustration of the first generation of the Activity Theory which is centred around ‘Lev Vygotsky’s concept of mediation and crystallized in Vygotsky’s triangular model of artefact-mediated and object-oriented action’ (Daniels, 2001: p.85).

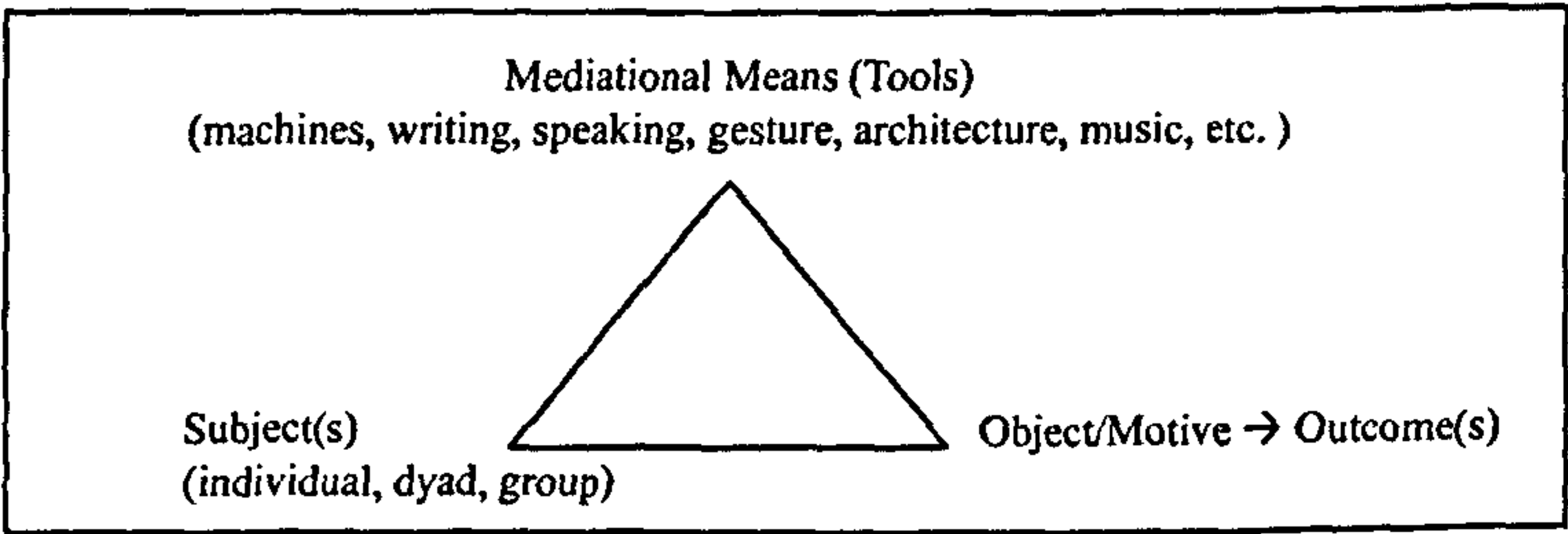


Figure 3–1 First generation Activity Theory model (Daniels, 2001: p.86)

At a later stage, Engeström expanded the triangular representation of activity systems in the first generation and established the second generation Activity Theory model as shown in Figure 3-2.

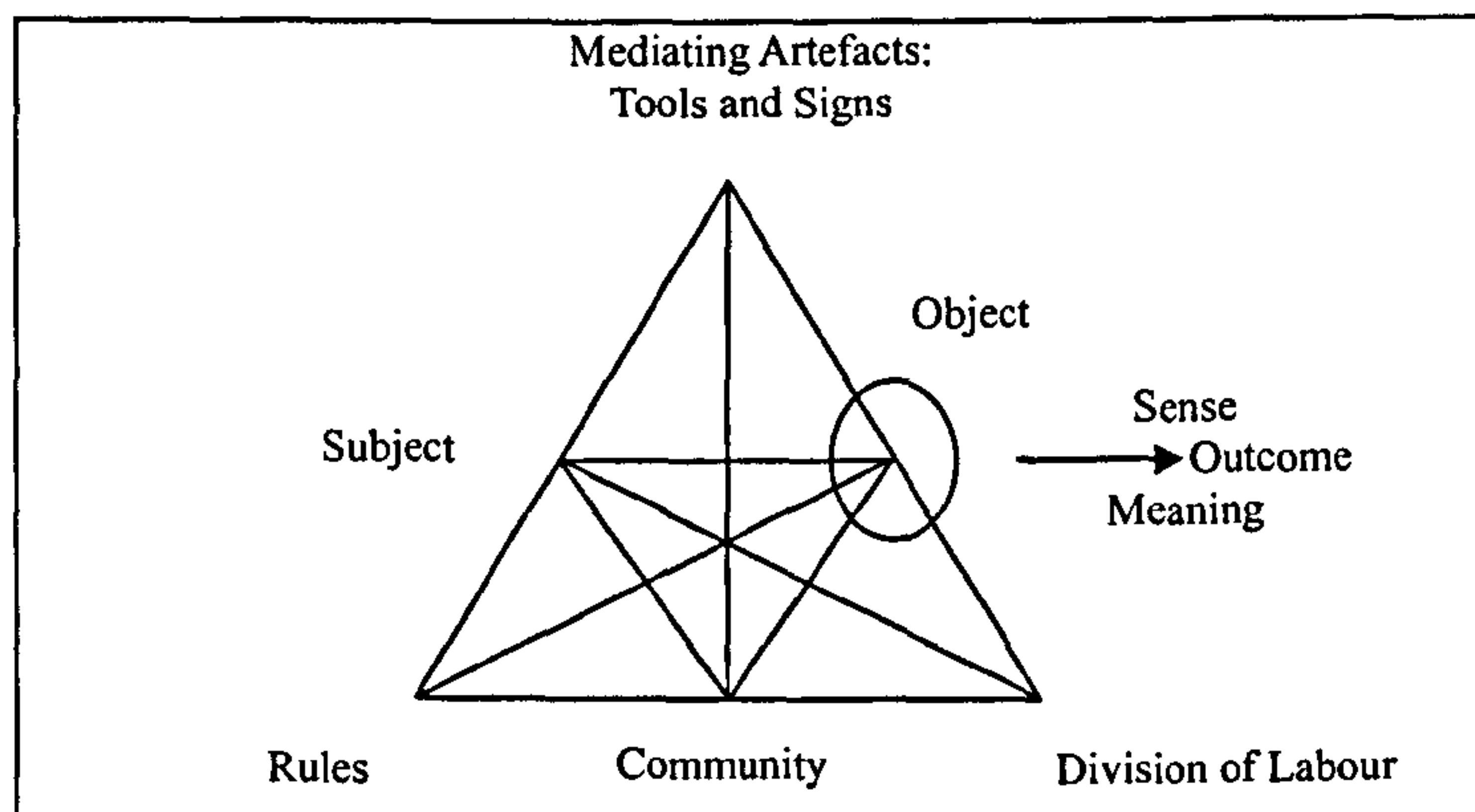


Figure 3-2 Second generation Activity Theory model
(The structure of a human activity system, Engeström, 1987: p.78 in Daniels, 2001: p.89)

This expansion aims to represent the social/collective elements in an activity system, through the addition of the elements of community, rules and division of labour whilst emphasizing the importance of analysing their interactions (Daniels, 2001). The concept of activity in the second generation has its focus on complex interrelations between the individual subject and his or her community (Engeström, 1999). Kuutti (1996) describes the components in the model and the relations between them in words in the following:

“The relationship between ‘subject’ and ‘object’ is mediated by ‘tools’, the relationship between subject and community is mediated by rules, and the relationship between object and community is mediated by the ‘division of labour. ... A ‘tool’ can be anything which is used in the transformation process, including both material tools and tools for thinking. ‘Rules’ cover both explicit and implicit norms, conventions and social relations within a community. ‘Division of labour’ refers to the explicit and implicit organization of a community as related to the transformation process of the object into the outcome. Each of the mediating tools is historically formed and open to further development” (Kuutti, 1996: p.28).

Jonassen and Rohrer-Murphy (1999) hold the similar view that activity cannot be understood or analysed outside the context in which it occurs. They further

explain that when human activities are analysed, both the people who engage in it and the community in which the activity occurs need to be examined. In addition, the goals and intentions of the people; the objects or products of the activity and even the rules and norms circumscribing this activity and the larger community all need to be considered (Jonassen & Rohrer-Murphy, 1999).

This second generation model was further expanded by Engeström and developed into the model for the third generation of Activity Theory which “*needs to develop conceptual tools to understand dialogues, multiple perspectives and networks of interacting activity systems*” (Engeström, 2001: p.135). The basic model is now expanded to include at least two interacting activity systems as shown in Figure 3-3.

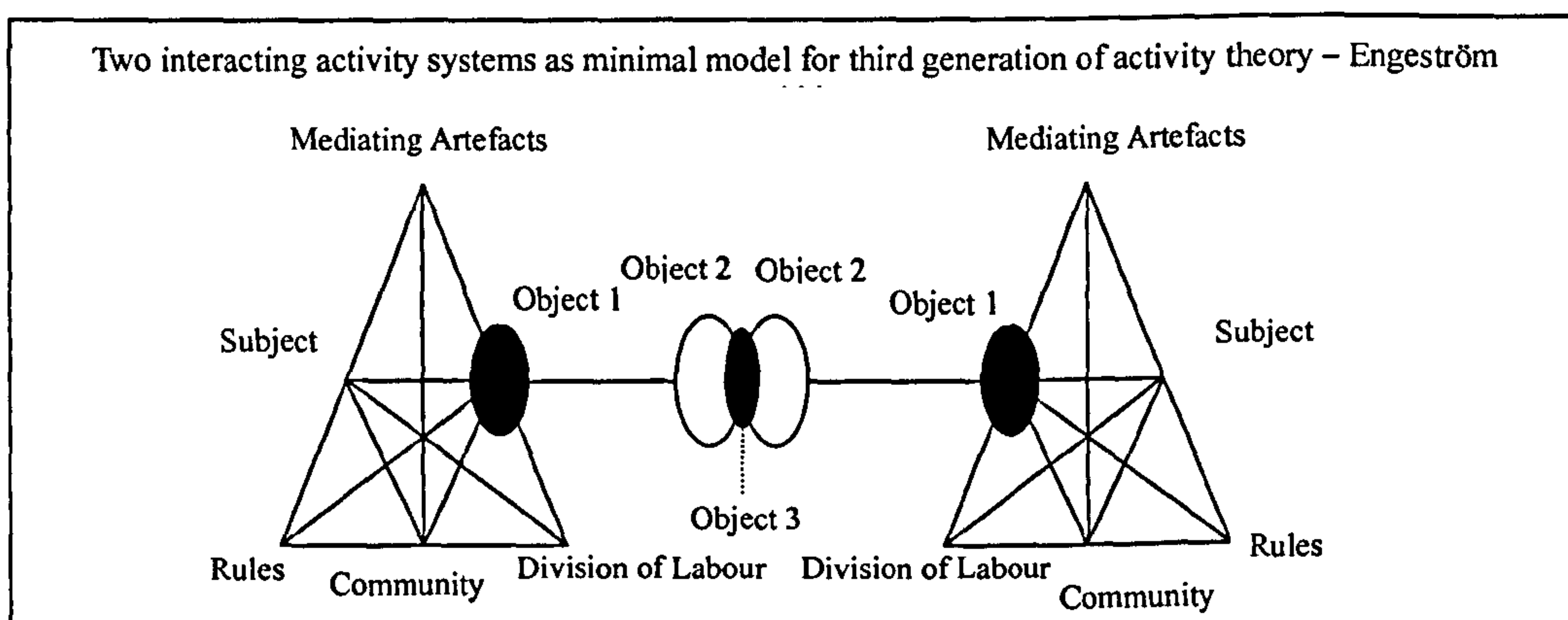


Figure 3-3 Third generation Activity Theory model (adopted from Engeström, 2001: p.136)

Researchers further develop the structure of Activity Theory into networks by considering the contradictions and struggles that take place in the definition of the motives and objects of the activity (Daniels, 2001). By slightly modifying Engeström’s framework for the study of work development, Korpela (1999) developed it into networks of activities. He points out that activities do not exist just for their own sake but to contribute to other activities. He has devised a checklist to identify the main

constituents of the ‘central activity’ and a checklist to identify other activities that are benefit from and contribute to the ‘central activity’. Figure 3-4 is a diagram used by Jonassen & Rohrer-Murphy (1999) to show the nested nature of Activity Theory dynamics.

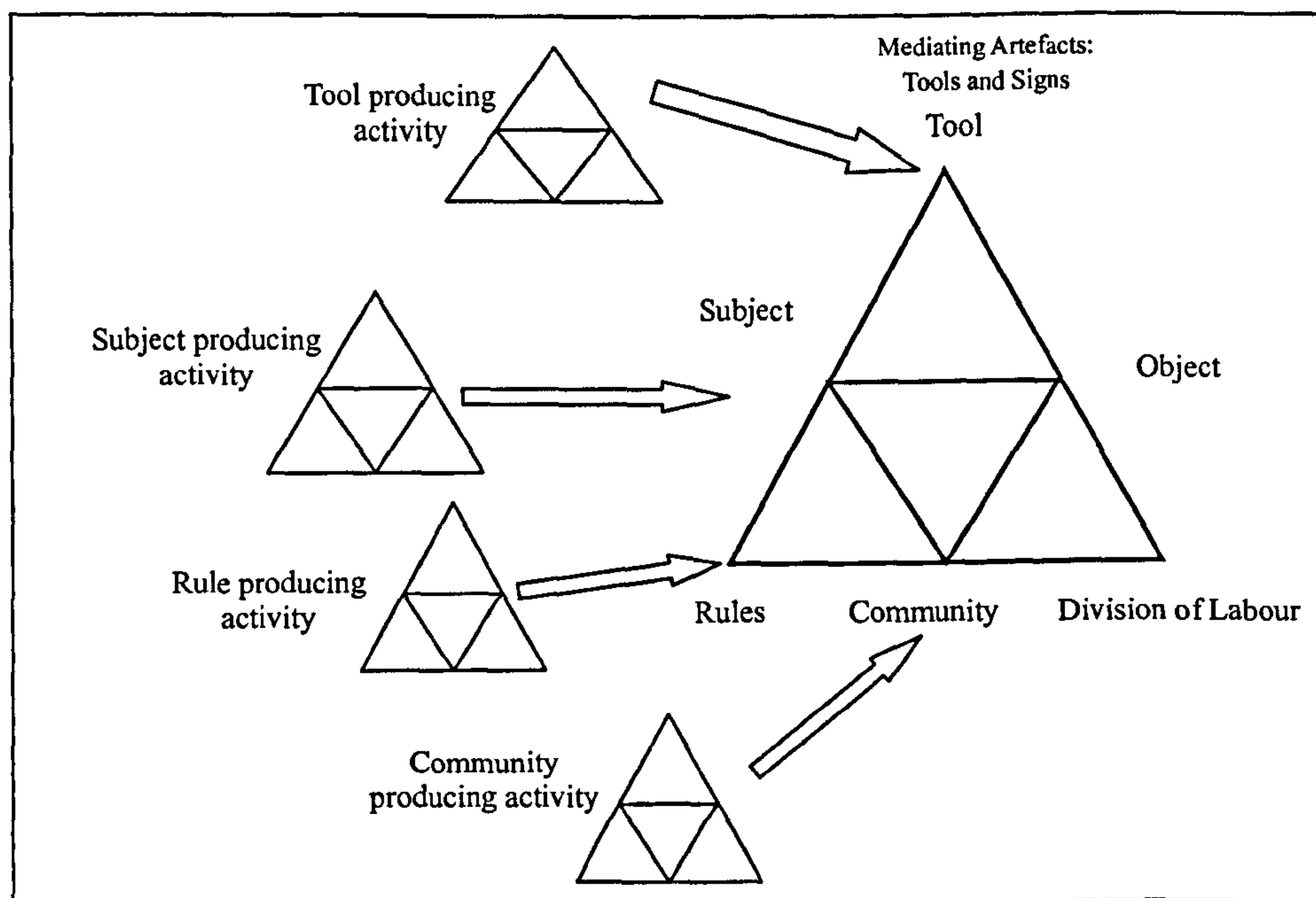


Figure 3-4 Nested nature of Activity Theory dynamics (Jonassen & Rohrer-Murphy, 1999: p.67)

Engeström has summarised the characteristics of Activity Theory as in the following:

First, it is “*contextual and oriented at understanding historically specific local practices, their objects, mediating artefacts, and social organization*”;

Second, it is “*based on a dialectical theory of knowledge and thinking, focused on the creative potential in human cognition*”; and,

Third, it is “*a developmental theory that seeks to explain and influence qualitative changes in human practices over time*” (Engeström, 1999: p.378 in Daniels, 2001: p.92).

The basic principles of Activity Theory and how they are applied in research will be discussed in the following sections.

3.3.1. Basic Principles of Activity Theory

Turner et al. (1999) describe Activity Theory as a dynamic and evolving body of thought which has been found relevant not only to psychology and education but also to the understanding of work in organizations and other fields. The ideas have been extended to include a model of human activity and methods for analysing activity and bringing about change. Nelson and Kim (2001) emphasize that it is a dynamic system in which *“elements reciprocally and dynamically influence each other so that the system is continually adjusting, adapting, and changing”* (p.3).

Human activity is taken as the basic unit of analysis. It is a system that includes those who carry out the activity, the tools and concepts used, the object, the community in which it takes place and the rules governing the conduct of that community. Changes to activities, including the formation of new activities and cessation or transformation of existing ones, are driven by contradictions which can exist within and between activities in the form of incompatibilities, conflicts or opportunities (Turner et al., 1999).

Bannon (1997) points out that Activity Theory is not a ‘theory’ but rather consists of a foundation on which more specific theories can show out of its basic principles. He considers the principle of tool mediation playing a central role in the activity. He thinks that tools are created and transformed during the development of the activity itself. While Activity Theory emphasizes on social factors and interaction between agents and their environments, tools shape the way human beings interact with reality. Tools influence not only human behaviour but also the mental functioning of individuals. According to Vygotsky, there are two kinds of tools: technical ones,

which are intended to manipulate physical objects, and psychological ones, which are used to influence other people or themselves (Bannon, 1997). The basic principles of Activity Theory proposed by Bannon (1997) include object-orientedness, the dual concepts of internalization/externalization, tool mediation, hierarchical structure of activity and continuous development (Ryder, n.d., Bannon, 1997). Kuutti (1996) states that ‘Activities as basic units of analysis’, ‘Hierarchical structure of Activity’ and ‘Internalization and Externalization’ are the three key principles. Engeström (2001) considers ‘activity system as unit of analysis’, ‘multi-voicedness of activity’, ‘historicity of activity’, ‘contradictions as driving force of change in activity’ and ‘expansive cycles as possible forms of transformation in activity’ as five central principles of Activity Theory. Although they state the key or central principles differently, most of them are the same or overlapping. To have a clearer picture of the principles and prepare for the application of Activity Theory for this study, six of them are summarised in the following.

Activity as basic unit of analysis

The basic unit of analysis in the framework of Activity Theory is considered to be an activity. According to the second generation of Activity Theory, the components of activity consist of a subject, an object or motive, artefacts and socio-cultural rules. Nelson and Kim (2001) emphasize that activity systems are not static but dynamic. The constituents of an activity system is dynamically affecting each other and continually changing. Leont’ev (1974) describes an activity as a unit composing of subject, object, actions and operations. His concept of the hierarchical structure of activity will be discussed further in the following (Nardi, 1996; Ryder, n.d.).

Hierarchical Structure of Activity

The Hierarchical Structure of Activity is often associated with Leont'ev's version of Activity Theory which states that activity is a collective system driven by an object and motive and is realized through individual actions driven by goals. In turn, actions are realized by means of routinized operations which are dependent on the conditions of the action. There are different descriptions of the hierarchical structure approaching the same concept with slightly different emphasis. One of them is to describe activities as goal-directed actions undertaken to satisfy the object. According to Jonassen and Rohrer-Murphy (1999), actions are conscious and are implemented through chains of automatic operations. They emphasize on the dynamic relations between operations with the following description:

“With practice and internalization, activities collapse into actions and eventually into operations, as they become more automatic, requiring less conscious effort. The reverse dynamic is also possible: operations can be disrupted and become actions” (Jonassen & Rohrer-Murphy, 1999: p.63).

The three-level structure of activity with the idea of dynamic relations between them is depicted in Figure 3-5. The bi-directional arrows are intended to show the dynamic relationships between the levels (Jonassen & Rohrer-Murphy, 1999; Kaptelinin et al., 1999).

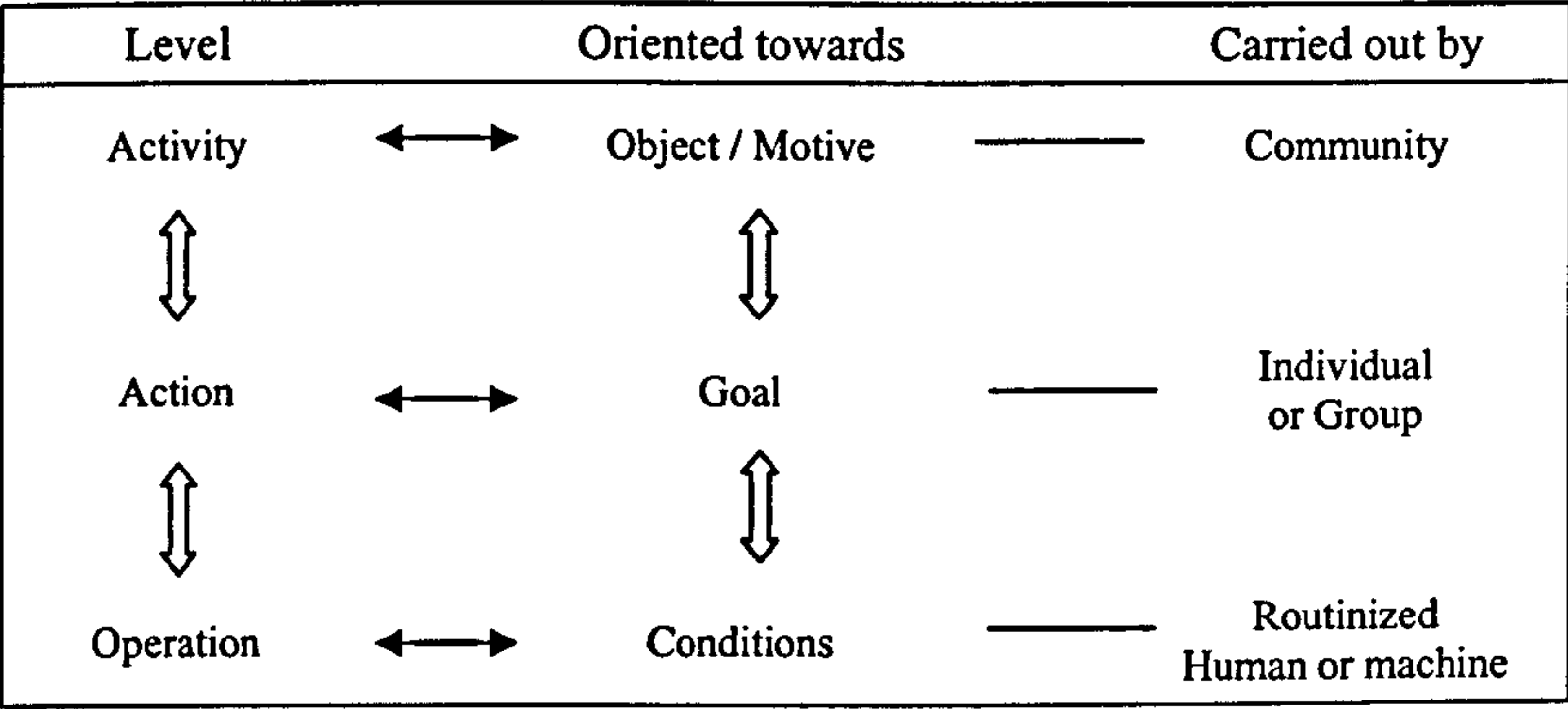


Figure 3-5 The hierarchical structure of activity (adopted from Leont'ev, 1974)

This framework helps to understand activities, actions and operations by revealing the motives, goals and instrumental conditions of the participants (Freire, 1998). In the model, the uppermost level of collective activity is driven by an object-related motive; the middle level of individual (or group) action is driven by a conscious goal; and the bottom level of automatic operations is driven by the conditions and tools of the action at hand (CHAT, n.d.). In words, Kaptelinin et al. (1999), describe the relationships in the following way:

“Activities are undertaken in order to fulfill motives, which may or may not be aware by people. Behind a motive, there is always a need or a desire. ... Actions are goal-directed processes that must be carried out to fulfill a motive. Actions are conscious and people are aware of their goals. Actions transform into operations when they become routinized and unconscious with practice and conversely operation can become an action” (Kaptelinin et al., 1999: p.29).

Internalization and Externalization

Nelson and Kim (2001) point out that *“changes in activity systems come about through the reciprocal and unified processes of internalization and externalization”* (n.p.). Internalization relates to the human being’s ability to imagine, consider alternative approaches to a problem and perform mental simulations. It provides a

means for people to try potential interactions with reality without performing actual manipulation with real objects and thus can help identify optional actions before actually performing an action externally. Externalization can be considered as the manifesting of internal processes externally and the creating of new artefacts and social practices. Externalization is necessary when an internalized action needs to be 'repaired or scaled' and when collaboration between several people is required (Kaptelinin et al., 1999; Nelson & Kim, 2001; Ryder, n.d.).

There is a close relation between internalization and externalization. Externalization transforms an internalized action into an external one while internalization is the transformation of external activities into internal ones. This constant switch from external to internal activities and back is the very basis of human cognition and activity.

Mediation

In Activity Theory, human activities are object-oriented, driven by certain needs and usually mediated by one or more instruments or tools (Kaptelinin et al., 1999; Ryder, n.d.). The first generation of Activity Theory is centred around artefact-mediated and object-oriented actions. Artefacts or tools, both internal and external, shape the way human beings interact with reality. They can be signs, languages, instruments or machines and are invented or modified by people when they try to effect control over behaviour or solve problems more efficiently. Artefacts or tools have an associated culture and history and permanence that exist across time and space. The use of tools is an evolutionary accumulation and transmission of social knowledge, which

influences both external behaviour and the mental functioning of individuals (Kaptelinin et al., 1999; Ryder, n.d.).

Bannon (1997) points out that the emphasis on social factors and interaction between people and their environments explains why the principle of tool mediation plays a central role in Activity Theory. Nelson and Kim (2001) in their study of student learning have considered the concept that knowledge is socio-historically mediated. That is, people's ways of thinking and learning are developed through and shaped by the activities in which they participate. These activities are social in nature and have historically developed tools, structures, and settings (Nelson & Kim, 2001).

Contradictions and Development

Activity Theory emphasizes the importance of developmental transformations of actions into operations. It sees all practices as a result of chronological development under certain conditions in a continuously reforming and developing process. Therefore, it requires human interaction with reality be analysed in the context of development (Bannon, 1997; Kaptelinin et al., 1999; Nelson & Kim, 2001; Ryder, n.d.). Favorin and Kuutti (1994) point out that historicity and constructivity are the two most important features of Activity Theory. To understand the recent state of affairs, the driving forces behind each step of development which has produced it needs to be considered. They also emphasize that changes of all parts of the activity, such as the division of labour, tools in use and the working community should be studied as well.

Activity system is constantly working through contradictions within and between its elements. Contradictions can be incompatibilities, conflicts and opportunities. To resolve or transform the contradictions results in a change, and thus development of the activity system. Therefore, contradictions are considered the driving forces for change and development in activity systems (CHAT, n.d.; Turner et al., 1999; Nelson and Kim, 2001; Hardman, 2005). In studies of student learning, such process is called by Engeström (2001) as learning by expanding. Since contradiction is such an important concept for change, and thus development, a brief description of it is drawn from literature and research using Activity Theory.

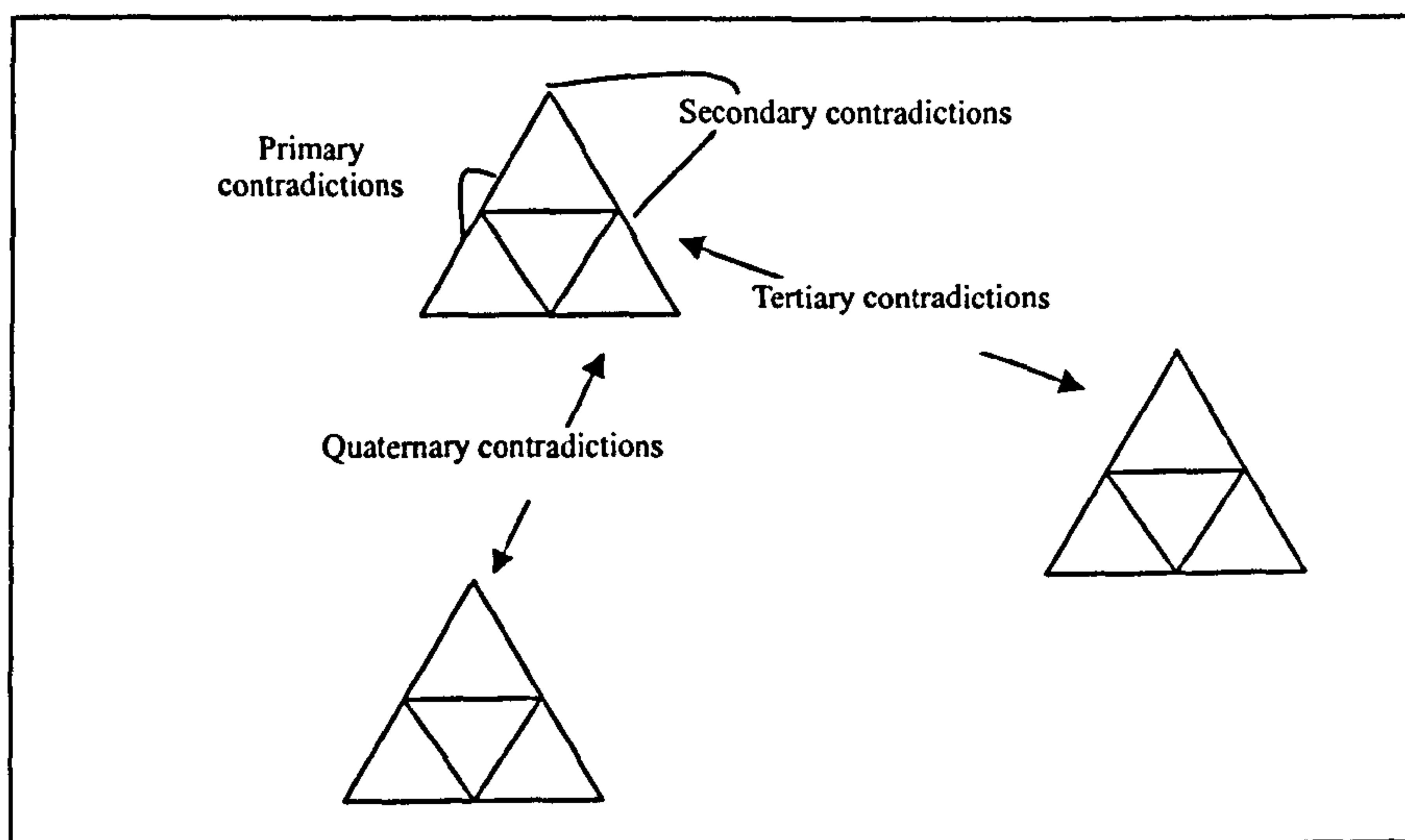


Figure 3–6 The four levels of contradiction (adopted from Turner et al., 1999: p.287)

Engeström (1987) has classified contradictions into four levels as presented in Figure 3-6: Primary contradictions are found within a single node; Secondary contradictions refer to those between nodes; Tertiary contradictions are those that occur between an activity and a new form of that activity with a culturally more advanced object; and Quaternary contradictions are those that occur between different activities (Turner et al., 1999).

Nelson and Kim (2001) state that development can be driven by contradictions and tensions: (1) between individuals and the socio-cultural context; (2) between two or more elements of an activity system or (3) between different activity systems. They further describe that to ‘develop’ means to resolve or transform contradictions, thus resulting in a change in the activity system. Development is a cyclical and spiral process of internalization and externalization which Engeström (1987) called ‘learning by expanding’. Engeström (1999) points out that the process of expansive learning should be understood as “*construction and resolution of successively evolving contradictions in the activity system*”. Fisher (2006) states that identification and removal of ‘internal contradictions’ are necessary for expansive learning to occur. The idea of internal contradictions as the driving force of change and development in activity systems has become a guiding principle of empirical research.

3.3.2. Examples of Applications of Activity Theory in Research

Activity Theory, which is originated from the cultural-historical school of psychology in the USSR, has been found not only relevant for psychology and education, but also for understanding work in other fields (Turner et al., 1999). Besides the modelling of work such as Computer-Supported Cooperative Work (CSCW) and Human Computer Interface (HCI), tremendous diversity of applications of Activity Theory has emerged. There are numerous examples of the application of Activity Theory to the analysis of work, play and a wide variety of processes. The following are some of them.

Kaptelinin et al. (1999) compiled activity checklists by applying the five basic principles and resulted in four sections corresponding to four main perspectives on the use of the 'target technology' to be evaluated or designed. The advantage of using the checklist is to be more effective in applying the already established methods and techniques. Macaulay and Cree (1999) describes the checklist as a tool for thinking and it has helped her in relating experiences in the field of study to Activity Theory concepts and to think about the kind of data to collect and the kind of questions to ask. It also gives her extra view points on reviewing the notes and transcripts of fieldwork. She summarises it as 'a valuable aide memoir and a tool for reflexivity' (p.31).

Korpela et al. (2002) use the framework in their study of Information System and concludes that the concepts, the framework and the treatment can help practitioners to understand their own practice and researchers to study Information System Development (ISD) practice in empirical settings. They give the comment that Activity Theory provides an exceptionally comprehensive basis for understanding the human, technological, temporal and organizational aspects of work as a systemic whole. They further point out the approach has a very strong tendency for not just describing how things are, but for becoming an evaluation tool for practitioners to identify needs for improvement in their practice and to proceed into work development (Korpela et al., 2002).

Worthen (2004) considers that Activity Theory is useful for researchers to breakdown a complex event into manageable elements, analyse the relationships between elements, have a holistic view of the system but not a part, understand the internal contradictions that drive the development of the system and analyse the

system from different perspectives and with different expectations. Jonassen and Rohrer-Murphy (1999) argue that the Activity Theory is an appropriate framework for designing constructivist learning environments. It provides a socio-cultural, socio-historical lens for analysing human activity systems. Its focus on the interaction of human activity and human mind as whole within its relevant environmental context is suitable for understanding not only the kind of activity people engage in but also the people, their goals and intentions, the rules and norms and the larger community circumscribing the activity. (Jonassen and Rohrer-Murphy, 1999)

The Activity Theory operationalized in the form of Kaptelinin et al.'s activity checklists (1999) or Mwanza's eight-step model (2001) are found to be useful and important for research (Benson et al., 2008). They serve as guidelines for researchers or practitioners to more fully understand the activity system. After their study of e-learning design, Benson et al. (2008) gave the comment that context sensitivity provided by a micro-level theory like Activity Theory helped to reveal the fine detail of a system which will otherwise be missed while the comparative study helped to examine the macro-level context in which the activity systems function. Their study proves Activity Theory to be a methodology flexible enough to assist in both the ante- and post-implementation phases of e-learning design.

3.3.3. Studies of ICT in Education using Activity Theory

Watson (2006) asserts that Activity Theory has become popular in studies on learning as a social activity and also the use of ICT for learning. The following are some examples of application of the theoretical framework in studying ICT in schools.

Lim (2002) points out that many studies in ICT in schools “*lack detailed investigation of what actually takes place in an activity system and its socio-cultural context*” (p.411). Arguing that ICT does not exist in isolation but is interwoven with other tools and participants in the learning environment, Lim proposes a socio-cultural approach for studying ICT in education and uses this theory to research into ICT use in Singapore schools (Lim, 2002, Lim & Chai, 2004). He emphasizes the need to consider “*the whole configuration of events, activities, contents and interpersonal processes taking place in the context that ICT is used*” (Lim, 2002: p.411).

In response to the suggestion that teachers are responsible for the failure of schools to embrace ICT, Lloyd and Albion (2005) have used the framework of Activity Theory to reassess the review data and field notes and revealed some insights into the beliefs and perceptions of the ‘level 0 teachers’ who have unwittingly or purposefully rejected ‘change’ (Lloyd & Albion, 2005).

Evolutionary Transformations in a Chronological Frame of Analysis

In an attempt to study how transformation can take place from traditional to constructivist epistemologies in relation to collective and individual perspectives, Hung et al. (2006), adopted Activity Theory to illustrate ‘the evolutionary transformations in a historical frame of analysis’ (p.44). Figure 3-7 illustrates the historical frame of analysis adopted.

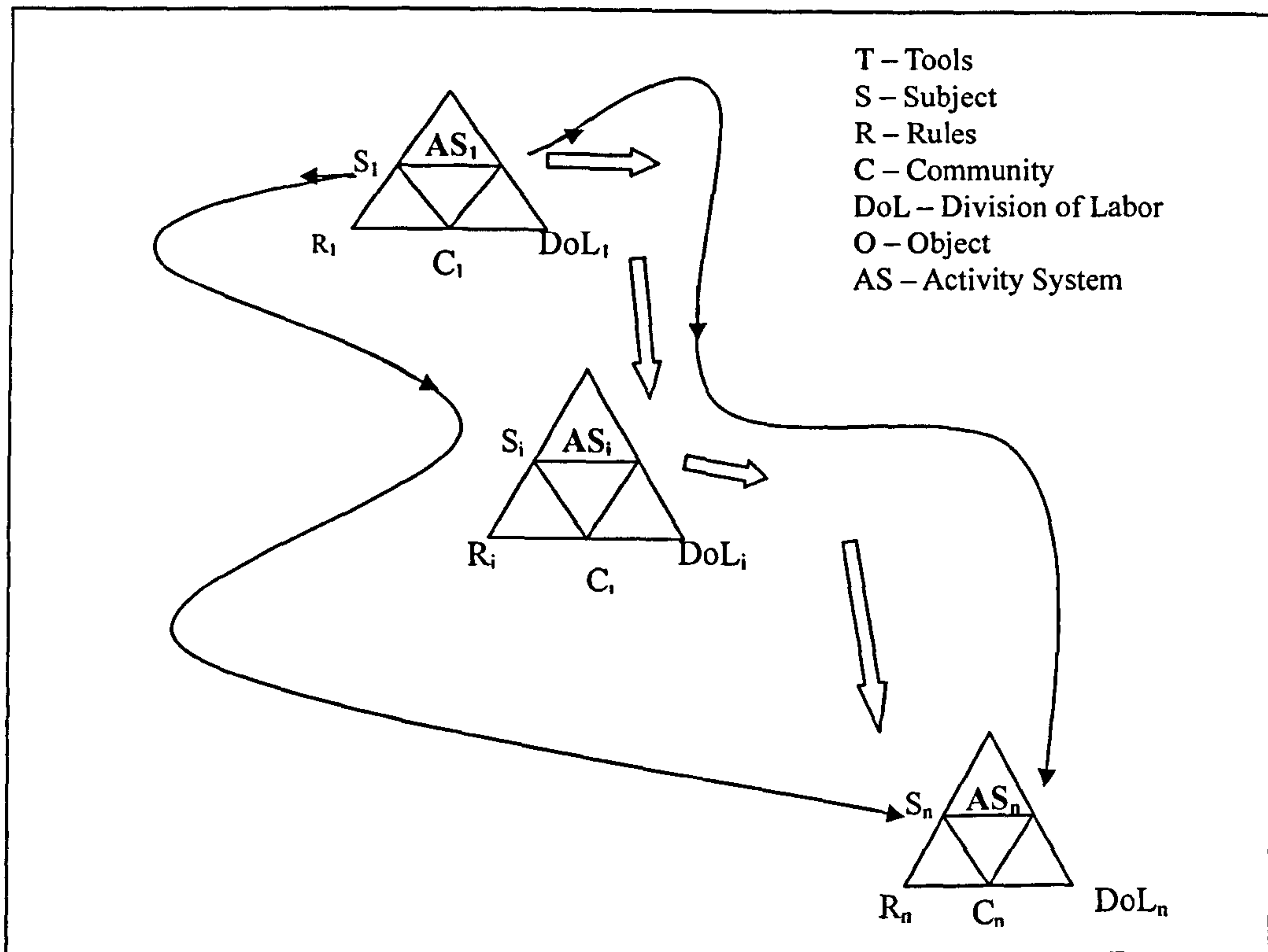


Figure 3-7 The evolving nature of learning communities where various instances of the history of the system (AS_i) are depicted. Each AS_i represents an instance of the state of the system at a particular instant in time (Modified from Hung et al., 2006: p.44).

Contradictions as Dynamic Forces for Development

In the research by Joanne Hardman, Activity Theory was used as a methodological tool to analyse change within and between activity systems of the classroom and computer laboratory (Hardman, 2005). She focused on contradictions as dynamic forces for her study on how the introduction of computer led to transformation within an activity system, in her case, a mathematics classroom. Demiraslan and Usluel (2008) used Activity Theory to examine complex pedagogical, social and technological issues in ICT integration process at the classroom level by identifying and analysing the contradictions within the activity system. They discussed the potential effects of ‘expansive learning’ resulting from the contradictions.

3.3.4. Reasons for Choosing Activity Theory for This Research

The literature and studies summarised in the above sections shed light on and suggest ways of using Activity Theory as the theoretical framework or analytical lens for analysing the process of learning, transformation and development of a system. The rich pool of examples from the above demonstrate the application of Activity Theory to micro-level analysis into the details of activity systems, how the components interact and transform contributing to the development of the system.

This research aims at analysing the change process that occurs when implementing the use of ICT in teaching and learning in a school. The results can be a tool to review the evolving development of using ICT for teaching and learning in the context of a rapidly changing society facing the challenge of the 21st century. Activity Theory has its very nature suitable for studying the change process of implementing technologies into a school context which is largely influenced by tools, rules and roles. From the example of the comparative study by Benson et al. (2008), Activity Theory can be operationalized to develop context-sensitive insights in this multi-phase case study. Reasons for using Activity Theory as the theoretical framework for this study are summarised in the following.

This paper is a report of a study on teacher change in using ICT in teaching and learning in a secondary school in Hong Kong. The purposes of this study are to more fully understand the process of change or development and to identify the factors facilitating or inhibiting the implementation. The characteristics of Activity Theory as a theoretical framework and analytical lens for studying the development of activity

systems described above seem to match these purposes. Activity Theory is chosen as the theoretical framework for this study for the following reasons.

First, Activity Theory suggests a framework which breaks down a complex event or a system into manageable components and guides the analysis of the relationships and interactions between them by considering the activity system as the basic unit of analysis (Worthen, 2004). Its emphasis on analysing the activity system as a whole considering the subject, object, tools, rules, roles as well as its socio-historical and socio-cultural background of the community in which the activity is situated facilitates a comprehensive analysis with every detail of the system in the micro-level.

Second, the key concept of mediation and its dynamic nature is important in helping to understand the inter-relationships between the components and how they lead to the transformation process. The concept that a system's elements reciprocally and dynamically influence each other sheds light on how the system is continually adjusting, adapting, and changing and thus making it a suitable tool for studying change in practices, such as change to using ICT in teaching (Nelson & Kim, 2001).

Third, Activity Theory considers contradictions as driving forces for change and development in activity systems. The concept that activity systems are continuously resolving and transforming contradictions which thus result in change and development helps to understand how and why teachers change in this case study.

Fourth, Activity Theory is viewed as a developmental theory that helps to explain changes in human practices over time (Engeström, 1999). The rapid

development of the ICT tools leads to rapid changes of the potential of ICT tools to innovate and revolutionize teaching and learning. How teachers change in this rapidly changing context is an aim of this study. The concept that the components of the activity system is dynamically changing and repositioning throughout the development can help in understanding the continuously reforming and developing process of implementing the use of ICT in teaching throughout the research period. Snap shots of the system at different phases will be taken for a cross-phase analysis. A comparative study of different phases helps assess the relative influence of tools, rules and roles and hence lead to an understanding of the change in the macro-organization level.

3.3.5. Components of the Activity System in ICT in Teaching and Learning

In this study, the theoretical framework suggested by the second generation of the Activity Theory will be applied to the study of the use of ICT in teaching and learning. The components of the activity system consist of the subject, object, tools, rules, roles and community. Mwanza's eight-step model (2001) which poses the following questions to guide the analysis is an example of using Activity Theory as theoretical lens and analytical tool. The questions help to identify the components of the system for the study (Benson et al., 2008: p.460).

1. What sort of activity am I interested in? → **Activity**
2. Why is this activity taking place? → **Object(ive)**
3. Who is involved in carrying out this activity? → **Subjects**

4. By what means are the subjects carrying out this activity? → **Tools**
5. Are there any cultural norms, rules or regulations governing the performance of this activity? → **Rules**
6. Who is responsible for what, when carrying out this activity, and how are these roles organised? → **Divisions of labour or roles**
7. What is the environment in which this activity is carried out? → **Community**
8. What is the desired outcome of the activity? → **Outcome**

The very first step to start applying Activity Theory for analysing this case is to identify the activity system and its components. An attempt to answer the questions above results in the following description. The **activity** is teachers' teaching using ICT in classrooms. The **objective** for this activity is to bring about more effective teaching and learning. The **subjects** of the activity are the teachers of the focal school. As mentioned in the previous sections, a **tool** can be anything which is used in the transformation process. Tools can be signs, languages, instruments or machines that effect control over the activity. They can be external and internal, material or mental. To name some possible tools in this activity, hardware and software are examples of external ones and technical support, staff development, teachers' beliefs and confidence are examples of internal ones. The **rules** governing the performance of this activity include the policies of the school and that of the government. Roles or **division of labour** include the parts played by the stakeholders such as teachers themselves, students, the principal, the Education Department, the government and the business.

The immediate **community** where the activity is situated is the school and the wider community is the Hong Kong Education System and the Hong Kong Society. The stakeholders of the school include board members, teachers, students, parents and the alumni. In a broader sense, community members include the government and citizens of Hong Kong. All these members have some expectations on the outcome of teaching and learning in schools.

3.4. Summary

Activity Theory is chosen as the theoretical framework for analysing the change process of teachers by identifying the factors, both physical and psychological, facilitating or inhibiting the adoption of ICT in classroom teaching and investigating how they affect the process from a cultural-historical perspective in order to answer the research questions. It is expected that through this theoretical lens and analytical tool, how teachers adopt and adapt to using ICT in their lessons and how they are influenced by the tools introduced, the rules and norms of the school and the society, as well as division of labour among the stakeholders can be revealed.

The emphasis on the detailed investigation of the components of the activity system and their interrelationships taking into consideration the historical and cultural background and analysing the contradictions that come into existence and how they can be resolved throughout the process can help to fully understand the complex process of change. Therefore, I argue that Activity Theory is a suitable theoretical framework and an analytical lens for understanding teacher change in this case study.

The attempt to identify the components of the activity system of this study by answering the eight questions suggested by Mwanza (2001) is an initial step for the analysis. However, it should be noted that the constituents of activity systems are dynamically changing with new elements adding, existing elements changing or repositioning or removing while the system itself is developing. This process of change or development is driven by primary, secondary, tertiary or quaternary contradictions as described earlier in this chapter. A study of the interrelations between the components and the contradictions that drive the development is the main theme. The next chapter will describe how data are collected for the study of this activity system in order to answer the research questions stated in the beginning of this chapter.

CHAPTER 4 Methodology: A Multi-phase Single Case Study

4.1. Introduction

In this chapter, I am going to describe the methodology to be used in this study and explain the reasons for choosing it. This research is carried out as a multi-phase single case study in a secondary school in Hong Kong. Activity Theory is chosen as the theoretical framework for this study with the reasons stated in Chapter 3. It is carried out as a mixed methods research with the focal school as a case. Reasons for choosing case study as the method of study and mixed methods research for collecting, analysing and reporting data will be presented. The issues related to adopting a case study approach to researching ICT in teaching and learning and the reasons why it is chosen for this study will be explained.

The focal school will be taken as a unit of analysis in the framework using Activity Theory as described in Chapter 3. The different components of the activity system will be analysed taking into consideration the socio-historical background. The contradictions between and within the components will be identified with Activity Theory as a guide and a lens. Attempts will be made to answer the research question, how teachers change, and identify the factors that have facilitated or inhibited it.

To study how and why teachers change to use ICT in teaching and learning using Activity Theory, the research will be designed to consist of three phases and extend over two years. Mixed-methods design with concurrent quantitative and

qualitative data collection throughout the research period will be adopted. The reasons and the way of using mixed-methods in the research will be discussed in this chapter as well. Bearing in mind that the researcher is an insider and at a senior position of the focal school, measures will be taken to minimize subjectivity and biases. Issues of trustworthiness, data validity and reliability are also important and will be addressed.

4.2. Researching ICT: Issues and Approaches

It has been found in the Literature Review in Chapter 2 that the research on ICT in Education conducted in the past two decades varied extensively. The trend changed from the largely quantitative type of analysis into the ratio of computers for students, hours and style of usage in relation to the exam results, to the more qualitative type of analysis on the influence of ICT in the attitudes and motivation of students towards learning as well as the attitudes of teachers' use of ICT in their teaching.

In the eighties, schools in Hong Kong just started to offer Computer Studies as a subject in senior secondary level. The government began to invest money on the development. Later in the nineties, further investment was made to widely extend the use of computers in teaching and learning in all subject areas. Studies were done to research on the relation between the provision of hardware and software and the improvement of students' performance. Education sectors, such as universities and tertiary institutions, received funding to conduct territory-wide research on ICT for teaching and learning with the purpose of designing appropriate courses for both teachers and students. Since that time, teachers have been encouraged to do research in schools in trying out ways of teaching and learning using ICT and study its effects on

students and teachers. It has been reported in Chapter 2 that UNESCO for the Asia Pacific region and CITE in Hong Kong are set up to encourage collaboration of efforts and pooling of research results for the educational community. There are good models for educators to learn from develop new ideas and practices based on research findings.

Case study is one of the most commonly used research methods in international, national and local research and is designed to bring out the details from the viewpoint of the participants using multiple sources of data. The method for data collection and analysis used in recent years has been a mixture of quantitative and qualitative type. Collective case study is popular for governments to study how ICT is used in their countries such as Singapore, the U.K. and Hong Kong (Lim and Chai, 2004; BECTA, 2005; Law et al., 2000). The SITE M2 study called for case studies from the member countries in the Asian-Pacific region (SITE M2, n.d.). Innovative practices satisfying a list of criteria set up by the international research committee are selected and submitted to the pool of exemplars and shared with member schools. Reports from the case studies are put together for cross case study analysis both within country and across countries. This rich pool of cases is available for researchers to be used or referenced in their future studies. Within a country, the reports of these studies are presented to the government as an account of how the public money has been spent and as evidence for the successful implementation of government policies. They will be used as references for future development as well. The data are useful for identifying factors that have influenced the implementation of ICT usage in teaching and learning and their effects. These findings will provide governments and educators ideas to plan for further development in their own countries.

The change of focus and interest in recent years can be found from research in different areas of the world. For example, Altun (2002) has carried out a study on how teachers adopt technology in classrooms in schools in Turkey. Purnell (2002) carried out a case study in a Tasmanian school to look at the changing role of teachers in managing learning in a technology-rich classroom. Most of the research has employed the case study strategy.

The purposes of this research are to more fully understand the complex process of teacher change and to identify the factors which facilitate and those that obstructed the implementation of ICT usage in teaching and learning. That is, the main theme of the research is how teachers implement or adopt change in using ICT in teaching and learning. The case study is carried out in a secondary school in Hong Kong by a single researcher who is an insider.

Characteristics of Case Study Approach

The term 'case study' can be interpreted as a strategy used for the inquiry (Yin, 1994) or a choice of what is to be studied (Stake, 2000). Fullan (1993) points out that case study method has been widely used in studies of educational change at institutional levels. Stake, Yin and Tellis, the most widely cited authors on this topic, describe the characteristics of case study as follows. It is an ideal methodology when a holistic, in-depth investigation is needed (Stake, 2000; Tellis, 1997). It is also a multi-perspectival analysis which considers not only the voice and perspective of the actors but also that of the relevant groups of actors and the interaction between them, hence bringing out the details from the viewpoint of participants (Tellis, 1997; Yin, 1994). Case study is an

interpretive, inductive form of research which explores the details and meanings of experience but not to test a priori hypotheses (TESOL, 2007).

Yin (2003) points out that case study is suitable for the 'how' and 'why' form of research questions and it does not require control of behavioural events but focuses on contemporary events. He also points out that the multiple realities in qualitative case studies reviewed from different perspectives of the researcher, the participant, and others, may or may not converge (TESOL, 2007; Yin, 1994). Tellis (1997) states that case study is a triangulated research strategy and that triangulation is necessary according to the ethical need to ensure validity of the process. The design of a case study is to optimize understanding of the case and for refining theory and suggesting complexities for further investigation with limited generalizability (Stake, 2000; TESOL, 2007).

The objectives of this study are to understand why and how teachers change to the use of ICT in teaching. The research intends to conduct a holistic and in-depth investigation into the process of teacher change. This is both explanatory and exploratory in nature. The process of and reasons for teacher change are to be approached from different perspectives. It will be carried out as an 'intrinsic case' as organised by Stake (2000). This study will not make enquiries into theory building nor make generalizations in other situations. However, better and deeper understanding of how and why teachers change, in particular in the use of ICT for teaching and learning, can contribute to the planning and implementation of educational policies in this and similar schools.

Role of the Researcher

According to Stake (2000) and Yin (2000), the role of the researcher of a case study is to (1) bind the case and conceptualize the object of the study; (2) select themes or issues, that is, the research questions; (3) seek pattern from the data to develop the issues; (4) triangulate key observations and bases for interpretation and (5) select alternative interpretations to pursue. In this study, the case is bound to the school and the object of the study is teachers using ICT in teaching. The research questions defined are to fully understand why and how teachers change to using ICT in teaching in the focal school and to identify the factors affecting it. The research will adopt mixed methods to collect and analyse the data in order to seek the pattern and develop the issues. These data collected by different means and from different sources will triangulate with each other for more accurate interpretations. An important role of the researcher is to take measures to minimize subjectivity and biases so as to improve reliability and validity.

4.3. Mixed Methods Research

Mixed methods research paradigm is used for the collection, analysis and interpretation of data in this case study. Quantitative methods such as surveys and questionnaires and qualitative methods with examples of interviews and document analysis are designed in line with the mixed method research strategy.

4.3.1. Mixed Methods Research Strategy

Mixed methods research, named mixed research in short in the following, is a research strategy employing more than one type of research methods (Greene et al., 1989). It is usually a combination of quantitative and qualitative methods, approaches, and concepts that have complementary strengths and non-overlapping weaknesses (Johnson & Onwuegbuzie, 2004). The methods may be a mix of qualitative and quantitative methods, a mix of quantitative methods or a mix of qualitative methods. It also means working with different types of data (Brannen, 2005; Bryman, 2001). Mixed research, can be a combination of quantitative or qualitative research in a concurrent, sequential, conversion, parallel or fully mixed manner (Onwuegbuzie & Johnson, 2006). It is often referred to as *“multi-strategy research implying the application of a number of research strategies related to a complex range of research questions and a complex research design”* (Brannen, 2005: p.4).

Greene et al. (1989), from an analytic review of first theoretical and then empirical literature on mixed-method inquiry, conclude with valuable information on mixed-method purposes and design characteristics. Among the purposes they suggest, triangulation and complementarity are two characteristics that are suitable for the design of this study. After seeing its divert and frequent usage in research, Tashakkori and Teddlie (2003) define ‘triangulation’ broadly as *“the combinations and comparisons of multiple data sources, data collection and analysis procedures, research methods, and/or inferences that occur at the end of a study”* (p.671). How it can strengthen the validity of inquiry results will be further discussed in the section for the issues of reliability and validity. Greene et al. (1989) consider complementarity as the use of

different methods to assess different study components or phenomena, or to assess the plausibility of identified threats to validity so as to enhance the interpretability of assessment of a single phenomenon.

Both quantitative and qualitative data are collected from various sources with the intention of seeking elaboration, enhancement, illustration, clarification of the results from one method with the results from another method. This is one of the characteristic of mixed method named complementarities. As the research progresses, data from the quantitative methods inform the design and analysis of qualitative data, and vice versa. The characteristics of each of them will be described briefly in the following.

Quantitative Research

Quantitative research refers to the study based on a large sample of data. Questionnaires are common instruments for collecting the data and statistical methods are used for analysing the data in quantitative research. Stratified random sampling is one of the common sampling methods used for better management of the collection and analysis of data while maintaining the representativeness of the group to the whole population. In mixed research method, data collected through quantitative methods such as surveys and questionnaires provide background information that can be generalized to the study of the whole population.

Qualitative Research

Denzin and Lincoln (2000) point out that qualitative research stresses on the socially constructed nature of reality and the intimate relationship between the researcher and what is studied as well as the situational constraints that shape the inquiry. It emphasizes the qualities of entities and on processes and meanings. Qualitative researchers usually use more than one interpretive practice to get a better understanding of the subject matter. These practices can transform the world and turn it into a series of representations such as field notes, interviews, conversations, recordings and memos (Denzin & Lincoln, 2000). Qualitative research has an elastic quality and that the design is adapted, changed and redesigned along the research period (Janesick, 2000, p.395).

4.3.2. The Issues of Reliability and Validity

Onwuegbuzie and Leech (2007) warn that threats to internal and external validity exist throughout the research stages of data collection, data analysis and data interpretation in both quantitative and qualitative study. The situation in qualitative study is even more complicated and the issues are summarised as problems of representation, integration and legitimation by Onwuegbuzie and Leech (2007). Constructivists use the terms trustworthiness and authenticity to evaluate qualitative research (Denzin and Lincoln, 1998). These issues will be discussed in the following section with attempts to identify the potential areas under threat in this study and suggest appropriate strategies to counter them.

While researchers are thinking about complementing one method with another to address the complex research questions, the problems that arise from the non-overlapping weaknesses of mixed research could not be overlooked. Onwuegbuzie and Johnson (2006) summarised them as problems of representation, integration and legitimation. He refers the problem of representation to the difficulty in capturing lived experiences using text and legitimation to the difficulty in obtaining findings and making inferences accurately. In mixed research, these problems in its qualitative and quantitative components, could become additive or multiplication threats leading to the problem of integration (Onwuegbuzie & Johnson, 2006). Therefore, when mixed method strategy is applied to a study, not only will its strengths be considered, the issues of reliability and validity must also be carefully handled. In the following section, the issues of reliability and validity relating to case studies and mixed method research will be discussed.

Lincoln and Guba (1985) refer 'reliability' to the rigour, consistency and most importantly, the trustworthiness of the research. Reliability, is therefore the 'precondition for validity' (Evans, 2008b). 'Validity' is referred to the degree to which a study measures what it claims to measure (Evans, 2008b). Fraenkel and Wallen (2008) state that validity is considered as the appropriateness, meaningfulness, correctness, and usefulness of the inferences a researcher makes. Both reliability and validity are important concepts to consider when selecting and designing instruments for the study (Fraenkel & Wallen, 2008).

Yin (2003) emphasizes the need for case study investigators to try hard to report all evidence fairly. He gives a warning to case study investigators in the following:

“too many times, the case study investigator has been sloppy, has not followed systematic procedures, or has allowed equivocal evidence or biased views to influence the direction of the findings and conclusions” (Yin, 2003: p.10).

Yin (1998) in his earlier publication, states four tests to establish the quality of any empirical social research of which case study is one of them. They are construct validity, internal validity, external validity and reliability (Yin, 1998). It is recognized that there are threats to internal and external validity in the three major stages of the research process, namely the research design and data collection, data and data interpretation (Onwuegbuzie, 2003). From a review of literature on the issues concerning the reliability and validity of qualitative, quantitative as well as mixed research, the following areas are identified to have potential threats to reliability and validity that are relevant to this study and need to be identified and addressed as early as in the planning stage.

External Validity

The external validity of a study depends on the extent to which the results of the study can be generalized (Fraenkel and Wallen, 2008). The sampling method used in the study is therefore important in determining representativeness of the population so it must be carefully chosen. ‘Random sampling’ of questionnaires is considered to be a useful tool to collect data from the whole school population of around 1000 students. However, when ease of administration is also considered, ‘strategic sampling’ of classes was finally adopted. For example, when questionnaires are to be given out to two of

the four classes in each form, one of the two academically weaker classes and one of the other two will be chosen for the junior forms. For the senior secondary level, one of the two Science classes and one of the other two will be chosen.

In order to collect data about the overall situation and the trend of development of the whole group of about 50 teachers, surveys can be administered to the whole population. One of the limitations of this method is that some of the respondents may not give their feedback. For in-depth study with a small number of selected teachers from about 50 teachers in the school, stratified sampling can be adopted. However, it should be noted that data collected in this way are not to be generalized to the whole population.

Internal Validity

Internal validity is highly applicable to the qualitative context of a research. It refers to the extent to which a study ‘actually investigates what it purports to investigate’. Fraenkel and Wallen (2008) state that internal validity means “*any relationship observed between two or more variables should be unambiguous as to what it means rather than being due to something else*” (p.166). Examples are “*the age or ability of the subjects, the conditions under which the study is conducted, or the type of materials used*” (p.166). These threats should be identified early in the planning stage so that ways to eliminate or minimize them can be prepared.

Amongst the many possible threats, characteristics and biases of the data collector, who is the researcher in this case, may exist. Other threats including loss of subjects, maturation and hawthorn effect also require special attention while data are collected and analysed. Measures must be taken to minimize the threats due to different kinds of biases and subjectivity.

Researcher bias

Researcher bias is considered to be an extremely serious threat to validity in qualitative research. Miles and Huberman (1994) state that one source of researcher bias is the effects of the researcher on the participant(s) and the others are the effects of the participant(s) on the researcher. Researcher bias may be subconsciously transferred to the participants and it may even affect their behaviour, attitude and experience.

The sources of researcher bias can be active or passive. Passive sources include the personality, characteristic or attribute of the researcher while active sources include his or her mannerism and statements made. The researcher, himself or herself, can affect the study procedure and the data collection techniques, for example, the type of questions asked in the interview or the way he/she phrases them may lead to biases. The researcher bias can extend throughout the three stages, from data collection, data analysis to data interpretation. Evans (2008b) states that one way to eliminate the possibility of unreliability due to researcher bias is to hold the research as a constant variable and substitute the researcher and repeat the research. However, he also points out that an exact repetition of a qualitative study in the same context is normally impossible. In this case study, it is impossible to repeat the research nor to

substitute the researcher since the development of the use of ICT in schools cannot be made constant. The environment of the school and the context in which it is situated has also been changing making it impossible to hold the research as a constant.

Construct Validity

Yin (1998) states that construct validity is especially problematic in case study research. He comments that a case study investigator is often criticized to have failed to develop a 'sufficiently operational' set of measures for collecting data but 'subjective' judgements are used instead. He further suggests that an investigator must be sure to cover the following two steps in order to test construct validity. First, to select the specific types of changes that are to be studied and second, to demonstrate that the selected measures of these changes do indeed reflect the specific types of change that have been selected in the first step (Yin 1998). The tactics suggested by Yin to increase construct validity include the use of multiple sources of evidence, and the establishment of a chain of evidences in the data collection stage. The following questions: *"Is the inference correct? Have all the rival explanations and possibilities been considered? Is the evidence convergent? Does it appear to be airtight?"* (p.34) may be answered by the investigator when he/she infers that a particular event resulted from some earlier occurrences, based on interview and documentary evidence as part of the case study.

Triangulation

Triangulation is considered to be an ethical need to confirm the validity of the processes (Tellis, 1997). It is a strategy widely used for strengthening the internal

validity of qualitative research through the use of multiple sources of data (Yin, 1994; Tellis, 1997).

“The key aspect of the strategy is threats to the validity of the conclusions, caused by the particular biases of any one source, method or agent of research, and which will be lessened by employing a variety of type” (Evans, 2008b: p.120).

Triangulation is based on the principle of confirming findings through the use of multiple perspectives. More specifically, Greene and McClintock (1985) state that ‘Triangulation’ seeks convergence of findings from different methods, offsetting or counteracting biases in order to strengthen the validity of inquiry results when these methods are used to assess or evaluate the same situation.

“Triangulation has been generally considered a process of using multiple perceptions to clarify meaning, verifying the repeatability of an observation or interpretation. But, acknowledging that no observations or interpretations are perfectly repeatable, triangulation serves also to clarify meaning by identifying different ways the phenomenon is being seen” (Stake, 2000: p.443).

Different data-collection instruments including interviews, questionnaires, document analysis will be used. The merit of counterbalancing the threats inherent to any one method will be weighed against the possible additive or multiplicative effects of their weaknesses. For example, the ‘Hawthorne effect’ which is likely to occur during an interview of a colleague can be balanced by the surveys given to the larger group of teachers, and the weakness of questionnaires having less freedom to give answers can be complemented with answers to the open ended questions in an interview. Although writers emphasize that comparing results from different angles is not possible to strengthen a common finding, it is possible to draw on the multiple sources of evidence

and analysis in support of the validity of the main focus (Evans, 2008b). The case study method used is known 'triangulated research strategy' (Tellis, 1997).

Reliability

Evans (2008b) states that the reliability of a study depends on the degree of transparency of research rationale and the decisions guiding the selection of the research sample. The researcher of this case can make clear the aims and objectives of the research and declare the use of the research results.

Reliability also depends on the accessibility of data collection and analysis procedures. This will involve keeping transcripts of interviews and records of lesson observation and other fieldwork notes in this case study. The questions to be asked at interviews need to be justified in relation to the aims of the specific study.

4.4. Design of the Study

The research is designed to be a case study using mixed methods research paradigm for the collection, analysis and reporting of data. The research period will consist of three phases. Each phase uses a mixed methods approach and provides conceptual and/or methodological grounds for the next phase (Tashakkori & Teddlie, 1998). Data are collected across the three phases using mainly sequential mixed methods. Measures are taken to establish reliability and validity of the research.

Special care is taken to minimize researcher bias and subjectivity and establish internal and external reliability. The researcher who is an insider in a senior position

is at an advantageous position to have prolonged engagement and persistent observations, and these help to establish trustworthiness and credibility. Triangulation is a method suitable for improving reliability and validity. Data of different nature collected through different means and from different sources will be triangulated with each other to achieve higher level of reliability. Grounded Theory methodology will be used to guide the analysis of data, from coding to reporting.

4.4.1. Multi-phase Mixed Methods Design

This study of mixed-methods design used multiple methods for studying different aspects of the case so that the results complement each other to approach the research questions more accurately and achieve a richer description of the situation (Greene & McClintock, 1985). The paradigm attributes are logically independent and therefore can be mixed and matched to make one most appropriate for the inquiry problem (Reichardt & Cook, 1979). Complementarity is described by Greene et al. (1989) as an intent of mixed methods to seek elaboration, enhancement, illustration, clarification of the results from one method with the results from the other.

In the first phase of this study, data were reported from policy documents of the school and the government to provide a rich description of the background of the provision of ICT equipment to schools and the related policies. Informed by these policy documents and findings from other research of the same area, questionnaires were designed to collect data about the use of ICT in lessons from all the Form 1 students. A questionnaire with open ended questions was designed to collect views from the English department head on the issue and the situation in the school. Both

were selected using purposive sampling. These two sets of independent data were analysed separately. They were analysed to see if they converged and complemented with each other in describing the situation or not. Information included teachers' usage of ICT in teaching and the students' attitudes towards it. The results informed the design of the data collection in the next two phases. Based on these results, questions to be asked in interviews and questionnaires for the Phase 2 were designed.

In the second phase, a survey was given to all teachers to collect data about their usage of ICT in teaching. Two sets of questionnaires were administered to students, one to collect general information about their experience of using ICT in teaching and learning and the other to collect information about students' usage of ICT both inside and outside school for learning and for entertainment. The focus of the research was on teachers' use of ICT in teaching and learning, so the results from the student questionnaires provided background information to help understand students' skills of and attitudes towards using ICT. Literature review on teacher change suggested that students' response to teachers' use of ICT in lessons would have positive or negative impacts on the teacher's continued use of ICT. To substantiate this, a teacher survey was designed to collect data concerning teachers' usage and attitudes towards the use of ICT in teaching around the same period. These results could both be triangulating and complementing each other to produce a clearer picture of the situation and would lead to better understanding of how and why teacher changed in this case.

A group of six teachers were chosen using stratified sampling method in order to have sufficient representation of the teacher population in the focal school, though generalization of the results was not the purpose of the study. The selection was

based on their gender, years of service and subjects they taught. They were invited to join voluntarily. The views of these teachers were collected to determine where the school was in the process of implementation of using ICT in teaching and learning. Semi-structure interviews with the selected teachers were designed with reference to the results obtained from the questionnaires aiming at clarifying and elaborating the findings. In the interviews, the situation of usage of ICT in teaching, their views on this issue, their reasons for using or not using it and the problems they face were explored.

In the third phase, a teacher survey similar to the previous one but with slight modifications was administered to collect data about teachers' views on their usage of ICT in teaching, their perceived changes in practices and their reasons. An interview was conducted with the principal who was the key person in leading the school, setting up school policies, and determining the provision of resources which include hardware, software and man power. She could provide first-hand information about the school policy and direction which very much determined teachers' practice in teaching. A second round of interviews was conducted with selected teachers to trace any change in practices, perceptions, beliefs and attitudes. Two teachers among the six who had participated in Phase 2 of this study were invited for further investigation. Each of them had one lesson observed and a group of 3 to 5 students from the class were interviewed after the lesson. This selection was based on their change of usage reported and observed. Data collected from the lesson observations, student group interviews and the teacher interviews were triangulated with each other and with the data from student questionnaires and teacher surveys.

Since the researcher was part of the research project and an intellectual critic throughout the study, issues of biases and subjectivity which may negatively influence the result of the research would be a major concern (Janesick, 2000). The challenges to the reliability and validity of the research are given in the following section and means to eliminate the threats will be discussed.

4.4.2. Establishing Validity and Reliability

Since the case study was carried out in the researcher's own school, subjectivity and researcher bias seem to be unavoidable and issues of reliability and validity should be considered seriously. In this case study, the researcher was a teacher of the school and was in charge of the team overseeing ICT in education of the school when the research was carried out. There were both strengths and potential dangers to validity of the result as described in the previous sections. Issues of reliability and validity were addressed and handled appropriately.

The following were the steps to maximize internal and external validity in the design of the data collection stage as described in the previous section. Sampling strategies were carefully chosen to maximize the representativeness of the data collected. In this mixed methods research design, data were collected in different phases by different means taking the strength that results could complement with each other and be triangulated to achieve higher level of reliability.

Since the data collector was the researcher who was also a teacher of the school, the responses and behaviour of the teachers and students being interviewed or observed

might have consciously or subconsciously been influenced. With careful consideration of the possible causes of biases, various ways were employed to handle the problem of biases and subjectivity and improve the quality of the study. Hawthorne effect was one of the possible threats that needed to be addressed. For instance, teachers might be prone to giving more positive comments and used more ICT in their lessons when they were being observed. Care had been taken for the design of the setting and leading questions for the interviews.

Interpretation of the data by the researcher and even the data themselves might contain some bias and could not be free of subjectivity. The researcher might have been preoccupied with a list of comments, a set of reasons why teachers use or not use ICT in teaching. Though bias and subjectivity might not be completely avoided, they could be minimized with the possible ways to check and improve the validity and reliability as mentioned in previous sections. Researcher bias could be a threat to validity and reliability in this case so the following measures were taken to prevent it as far as possible. First, the interviewing questions were designed carefully in advance so as to reduce the chance of using leading questions to get answers that might contain biases. Second, the researcher explained clearly the aims of the research and built up a trustworthy relationship with the respondents. Third, the interviewing data, after translation, were made accessible to the respondents while keeping them confidential.

Triangulation of data collected from different sources using various methods is a means improving reliability of the analysis and interpretation of data. Three types of triangulation are suitable for this study. They are triangulation of different sources, of methods and of investigators. In this case, the use of ICT in teaching and learning

involved both teachers and students and could be reviewed through lesson observations. Student group interview data, teacher interview data and quantitative data collected from questionnaire surveys are complementing and triangulating with each other. For instance, data from questionnaires were used to complement and triangulate with interview data. Questionnaire data collected from a wider population were used to guide the design of leading questions for interviews to clarify concepts, describe facts and situations. Data collected from interviews also informed the design of surveys and questionnaires. Though the researcher was the one who analysed the data, the multi-phase design allowed her to conduct interviews with the key informants at least two times throughout the research period. This was also a strategy to improve reliability. The multiple sources of evidences, the chain evidences from lesson observations and focus group discussions could help to increase the construct validity of the study to a reasonably high level.

Since all the information was collected for reviewing and understanding the teaching of teachers by an insider of the focal school, the ethical considerations were essential. The informants had to be carefully and truthfully informed about the research and ensured that their privacy would be protected (Fontana & Frey, 1998). Teachers were informed of the purposes of collecting the data and their names would be kept anonymous. A trustful relationship between the researcher and the participants was very important. Trustworthiness of the researcher and a relaxing environment could make the respondents feel safe and be open during the interviews. The interviews were recorded with the permission of the respondents and the researcher noted down the key points of their conversation and the nonverbal responses. The records of the

interviews were transcribed and translated carefully by referring to the record several times to ensure accuracy. Special care had to be taken to handle the words and terms used in order not to generalise findings. Rather, they were used to obtain insights.

Besides the potential biases that might have been introduced, there were strengths with the researcher being the insider. Both prolonged engagement and persistent observation which were methods for assessing the truth value of qualitative research suggested by Onwuegbuzie and Johnson (2006) could be achieved. 'Persistent observation' enabled proactive planning and 'long-term engagement' could have helped the researcher to develop a clearer research focus. Prolonged engagement refers to a study being carried out in a time period long enough for an adequate representation of the 'voice' under study. It includes understanding the culture and building trusts with the participants. Long-term involvement is a strategy where this researcher is at an advantage over the external researcher. The weaknesses or errors of judgment and patchy knowledge of the field due to the status of the researcher as an outsider can be minimized and thus will enhance the credibility of the study's findings. In this case study, the researcher was a member of the focal school, so the research could be carried out for more than two years. The researcher was also familiar with and had certain levels of understanding of the subjects, the data and research process and there was sufficient time for checking misinformation, thus strengthening the validity of the findings.

Yin (1998) says that reliability test is to ensure that if the same study is conducted all over again, following exactly the same procedures, the same findings and conclusions can be arrived. However, Janesick (2000) points out that the value of

case study is its uniqueness and this traditional sense of replicability is pointless. Since the present research was carried out as a case study, the reliability test of repeating the same study was not suitable due to the above reasons.

4.4.3. Application of Grounded Theory

Grounded Theory approach is adopted for collecting and analysing data in this research. Its basic concept that theories are drawn from data which offer insight and enhance understanding will be used to guide the collection and analysis of the data. Grounded Theory was originally put forward by Glaser and Strauss. They state that generating Grounded Theory is a way of arriving at theory suited to its supposed uses (Glaser & Strauss, 1967).

“Grounded Theory methodology is a specific, highly developed, rigorous set of procedures for producing formal, substantive theory of social phenomena ... As tentative answers to questions are developed and concepts are constructed, these constructions are verified through further data collection” (Schwandt, 2001: p.110).

In Grounded Theory, data analysis does not follow data collection in a distinct stage. It begins as soon as data are collected. The result informs decisions about further data collection, such as what to observe, who to talk to next and what questions to be asked and so on until any theory emerges from the data. An iterative process of coding with several stages will be used for breaking down data into manageable chunks (Evans, 2008a).

In this study, both quantitative and qualitative data were collected to enable thorough analysis of the data and triangulation of results. Data collected included government and school policy documents, questionnaires, surveys and interviews.

Data were collected in three phases with careful design but also allowed the inclusion of any useful and appropriate data not yet planned in the original design. Data were analysed immediately after they were collected and the results informed the design of data collection instrument in the next stage. For example, semi-structured interviews were conducted with open ended questions designed to clarify concepts, investigate into the classroom context, understand teachers' reasons for using or not using ICT, encourage them to express their feelings, beliefs and give any comments and opinions freely.

“By creating open-ended, non-judgmental questions, you encourage unanticipated statements and stories to emerge. The combination of how you construct the questions and conduct the interview shapes how well you achieve a balance between making the interview open-ended and focusing on significant statements” (Charmaz, 2006:p.25).

Guiding questions for interviews were designed with reference to the results from the survey and questionnaire data while the surveys and questionnaires were modified with reference to the information collected in interviews.

Initial and Focused Coding

Charmaz (2006) proposes that Grounded Theory coding consists of at least two phases; namely, initial and focused coding. During the initial coding stage, the data will be analysed by studying fragments of data-words, lines, segments and incidents. In the focused coding stage, the most useful initial codes will be tested against extensive data. Throughout the process, data will be compared with other data and with the initial codes. These codes may be elaborated or moved to extent theoretical codes when themes emerge from analysis (Charmaz, 2006).

In the first phase of data coding, the interviews were transcribed and translated into English. The transcripts of the interviews were then examined line by line and word by word and a list of words or terms used by the informants were recorded. Though the English version was used in this research report, telling terms used by participants in Chinese were also noted as *vivo* codes as suggested by Charmaz (2006). With the aid of the software, NVivo, the original records of the interviews and their transcribed data were stored together in the same project for easy reference. Bishop et al. (2005) suggest that in this first stage of coding, concepts, arguments, feelings and the like can be identified, forming codes for analysis. The software helped in highlighting the data codes, adding categories and subcategories whenever they were found to have emerged from the data codes. These codes were not limited to what the researcher predefined at the beginning but were added freely during the process of analysis. Besides the qualitative data, quantitative data were also collected at different phases of the research period. Findings from the quantitative data which were collected from the bigger pool of respondents illuminated the identification and formation of themes, categories and subcategories as well.

4.5. Analysis of Data of the Case

Stake (1995) refers to doing analyses as a matter of giving meaning to first impressions as well as to final compilation. He suggests two methods for analysing the case study data.

“Two strategic ways that researchers reach new meanings about cases are through direct interpretation of the individual instance and through aggregation of instances until something can be said about them as a class” (Stake, 1995: p.74).

He describes the detailed analysis of data saying that the qualitative researcher

“... concentrates on the instance, trying to pull it apart and put it back together again more meaningfully”(Stake, 1995: p.75).

Patton (2002) also suggests that the strategies for analysis of unique cases are inductive analysis and creative synthesis, holistic perspective and context sensitivity. Janesick (2000) says that there is almost no ‘correct’ interpretation and there are multiple ways of interpreting an event in qualitative analysis. The data collected would be read thoroughly by coding the contents and making nodes with the help of the software Nvivo. The data will then be revisited, grouping similar codes together and adding relations between them. Interpretation of data comes after the coding and grouping. To establish basic validity, it needs to consider whether or not the explanation fits the description.

Since most of the interviews were done in Cantonese, the very first step to analyse the data was to transcribe and translate them into English before coding. Ryan and Bernard (2000) point out that ‘coding is the heart and soul of whole-text analysis’ (p.780). The first stage of analysing the qualitative data collected through interviews and field notes of lesson observations, school and government documents for this research was to find themes. As suggested by grounded theorists, Ryan and Bernard (2000), a careful line-by-line reading of the text while looking for processes, actions, assumptions and consequences to be carried out immediately after the data were

collected, transcribed and translated. In this case study, certain recurrent words or phases used were noted and coded to guide the investigator in carrying out the data collection and the writing of report as suggested by Yin (2003). He considers the protocol as a major way of increasing the reliability of case study research.

4.6. Summary

There is a long list of related literature on case study and mixed methods research. They provide comprehensive, thorough and critical discussions on case studies and mixed methods of study and analysis. From the books and other papers, articles and web materials, the rationale and methodology of doing case study using mixed methods research have been discussed in this chapter. Details of the data collection and analysis of this case study will be given in the next few chapters.

In this study, quantitative data such as teacher surveys and student questionnaires, qualitative data including interviews with the principal, teachers and focus group students as well as school and government documents were collected for analysis. Issues of validity and reliability were of concern and special care had been taken since the researcher was an insider of the case. Data collected from different sources and by different means triangulated with each other to help minimize subjectivity and biases. The researcher was aware of the tendency of generalizing findings rather than utilizing the qualitative data to obtain insights into particular underlying processes and practices, that is, to avoid the error of population generalizability (Connolly & James, 1998).

Since a large part of data for this study were collected through semi-structured interviews with selected teachers and student groups by the researcher who was a senior teacher at the school, researcher bias and subjectivity could have been problems to validity. The use of mixed methods, taking advantage of its strength of triangulation and complementarities, were means employed to address those issues of reliability and validity. The researcher was alert to those issues throughout the three stages including data collecting, data analysis and data interpretation. For instance, the researcher was careful about her choice of words in the interviews and designed the guiding questions before the interviews in such a way as to avoid biases. The strategies suggested by Grounded Theory for the collection and analysis of data were employed with the help of the software, Nvivo. Bearing in mind that *“the purpose of a case report is not to represent the world, but to represent the case”* (Stake, 2000: p.448), generalization of the case is not an ultimate purpose. Rather, the case research can be utilized by practitioners and policy makers as an extension of experience (Stake, 2000).

Stake (1995) suggests that a case report will be a valuable resource for researchers who are interested in collective case study where a number of cases will be studied in order to investigate a phenomenon, population, or general condition. The SITE M2 study mentioned in the literature review is an example of collective case study in researching ICT in education over the Asian-Pacific region (SITE M2, n.d.). Though this case study is not intended to make generalizations in other situations as mentioned above, the results can contribute to the pool of cases to be studied collectively.

CHAPTER 5 Data Collection Plan and Strategies: a Three Phase Design

5.1. Introduction

In the previous two chapters, I have stated the purposes of this study and the theoretical framework to be used. To portray the school at different phases of the study, data of different nature were collected from different sources to approach it from different perspectives. The sources of data included government and school policy papers, minutes, plans and evaluation reports of the focal school, teacher and student interviews, student questionnaires, teacher surveys and school self-evaluation (SSE) data. In the next section of this chapter, the strategies of data collection will be discussed, followed by the plan for data collection and analysis. The actual data collected and results of analysis of the three phases will be reported respectively in chapters 7, 8 and 9. A cross phase analysis will be given in Chapter 10.

5.2. Design and Strategies for Data Collection

This research was designed to study how teachers adopt the educational change to using ICT in their teaching in the focal school. There was no research-based intervention although we must accept that the research procedures themselves would have impacted on the participants' lives to some extent. The researcher acted as a participant observer, observing and tracking the changes and investigating the factors affecting the change process. As mentioned in the beginning of this report, the researcher was in a senior teaching position at the school by the time the research

was carried out. With the permission of the school head, she was able to obtain the documents of the school for the study and arrange for interviews with any personnel, collect comments and opinions from teachers and students on school self-evaluation (SSE) days and observe lesson with the consent of the teachers involved. She could also collect data using questionnaires and surveys on the school Intranet.

5.2.1. Strengths and Weaknesses of Participant Researcher in this Study

There are strengths and weaknesses related to the fact that the researcher was in a senior position of the school during the research period. These were taken account of throughout the stages of planning, collection and interpretation of data. The following are some of the concerns and the ways the researcher undertook to maximize the reliability and validity of the data collected and interpreted.

The fact that the teachers who agreed to participate when they were invited might have been affected by the authority of the researcher and not out of their willingness must be accepted as a factor which might affect the validity of data. Though this might have been seen as an advantage, there was the danger that some of their answers to the questions might have been given to please the researcher and might not be genuine. On the contrary, without the push by a figure in authority, teachers might not have agreed to participate and thus it would have become impossible for teacher data to be collected. In this case, the researcher has established good relationship with the teachers over a number of years. One example was that the researcher had been elected by the whole staff as a member of a committee which was a channel for teachers to express their concerns, grievances, comments or criticisms of

school policies to the management board of the school body. Besides, the researcher took careful steps to select teachers for the research. Teachers selected were those with more than 5 years' service at the school which is a period long enough to ensure any change of practice came from and were related to the conditions and policies of the focal school. It was also long enough for some trust to be established between the teachers involved and the researcher. Finally, questions asked throughout the interviews were open-ended. Teachers were invited to talk freely about anything related to their usage of ICT in teaching and learning at the school.

Another potential advantage was the fact that the researcher was the one who started computer education at the school. She was clear about the development and way able to get all the related documents for the study. However, this advantage could also be a disadvantage, in that the design of the questions for the interviews, questionnaires and interpretations to the answers given might contain biases. For example, the researcher might consider the ICT equipment as well designed for teaching and learning and the training given to the teachers were sufficient. Care had been taken to minimize any bias that might occur. For example, questions posed in the interviews were mainly open-ended and teachers were encouraged to freely describe their situations and give comments and suggestions. They were also assured that their views would be considered seriously for the improvement of the school and not only for the research.

Furthermore, the researcher acknowledged that teachers might have tended to avoid criticism and show support for the ICT policies which were mostly drafted by the researcher. The researcher herself might also be inclined to look at the positive side of the policies since celebrating the success would be much easier than admitting

failures. In fact, the design of the research was not to judge the success or failure of the ICT policies but to understand the process of change. With this aim clearly stated, the bias could be minimized, though it could not be totally eliminated. The researcher explained it clearly to the teachers before the interviews and emphasized that the more accurately and clearly they described the situation, the better the result of the research could be represented. She also encouraged the interviewees treat the meeting like a chat rather than a formal interview, though their conversations would be recorded.

Last but not the least, the advantage of the researcher being a senior teacher of the school was the fact that she could identify any piece of data that would help to understand the case. Many conditions of the case were changing throughout the research period so the data collection plan should be modified according to any needs that had arisen. For example, there was a change in principal just before the start of the Phase 2 study and there was the External School Review towards the end of this phase. Several teachers had left the school and a number of new teachers had joined during the research period. One of the teachers selected to participate in this research left before Phase 2 too. As a case study, the data collection plan could be changed according to the situation. For example, additional data could be collected whenever there was the chance while some planned data could not be collected as scheduled due to change of personnel. In such case, the researcher had taken the opportunity whenever appropriate to collect data related to the study.

Any measures to improve the validity and reliability of the data collected were also considered. For example, to avoid bias and subjectivity, the data collected from different sources would triangulate with each other. Although the subject of the

study was the teachers and the main source of data came from the teachers, data from school documents, the principal and students were also collected. The school documents served mainly as background information for the case in addition to providing the main source of data describing the school policy as well as the change process this case intended to study. The principal and student data could help to describe the school situation at different phases and triangulate with the teacher data concerning the change process.

5.2.2. Design and Schedule for Data Collection

The following is an explanation of the design of data collection and the schedule. As mentioned before, since the researcher was at a senior position of the school, it was easier for her to capture any signs of change and gave her flexibility to modify the data collection plan whenever there was a good chance. ‘Refining theory and suggesting complexities for further investigation’ is an advantage a case study offers to this research (Stake, 2000).

Overview of the Data Collection Plan

For data collection, Yin (1994) has suggested the design of data collection as in Figure 5-1:

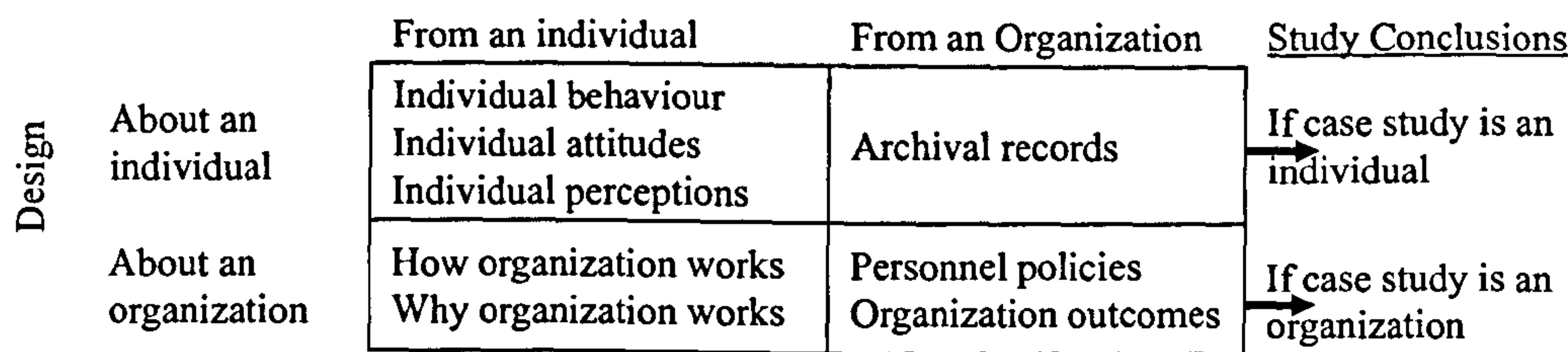


Figure 5-1 Design versus data collection: Different units of analysis
Source: COSMOS Corporation (adopted from Yin, 1994: p72)

This research is a case study designed to see how teachers adopt an educational change in a secondary school. It is a study of an organization but it involves the case study of individual teachers as well. Yin’s suggestion as represented in Figure 5-1 above is helpful in guiding the design of the data collection. In this research, all the four main sources and types of data were collected for the purposes of understanding the organization, that is, the school, and the individuals, that is, the teachers.

Data to collect from documents

This case aims to study how teachers adapt their practice to use ICT in teaching and learning in the school context situated in the Hong Kong educational system. Therefore the policy documents of the government and that of the school are important sources of information. Archival records were downloaded from the government website and retrieved from the school server. They include the government policies, school policies, school plans and school notices that could help to describe the school situation and the Hong Kong educational system and hence would provide a more accurate interpretation of the case.

Data to be collected from students

The main purpose of any school system is the education of students. Any practices, policies and even furniture and equipment in the school are all designed to achieve this purpose. Without doubt, educational changes are carried out for the improvement of the quality of education for students. The change for using ICT in teaching and learning of this study is to benefit students' learning. What, when, why and how teachers do in their teaching largely depends on the needs of and feedback from students. Therefore, students make up a major source of information in this study.

For this case study, student questionnaires were designed to collect information from the whole population and selected groups that could represent the target group of students. Three sets of questionnaires were designed for students. The first questionnaire was given to the Form 1 students in Phase 1, the pilot stage, to collect their opinions on using computers for learning. The questions asked and answers given by them would be used in the design of the questionnaires for students in the research period. The analysis of the results could also provide information for the description of the situation before the research period.

In Phase 1, student questionnaires were drafted and given out to different classes of Form 1 students to gather general information about their usage, their experience of learning using ICT and their opinions on teachers' ICT usage in teaching. Another way of collecting their opinions concerning the ICT environment of the school and how teachers were using them were collected through class discussions and free writing on comment sheets on SSE days.

After reviewing the data above, further data concerning the response of students to teachers teaching using ICT were collected through lesson observations followed by semi-structured group interviews with selected subgroup of students from the classes. Students' responses during lessons and their feedback to the lessons served as validation tools. They helped to cross check the data collected from student questionnaires, teacher surveys and interviews. They also helped to clarify areas that were overlooked in the questionnaires and confirmed key findings.

Data to collect from teachers

The main purpose of this study was to understand how teachers adopt and implement the educational change of using ICT in teaching. Therefore, teachers made up the target group of the study. Data about their behaviour, attitude and perception related to the usage of ICT in teaching were within the scope of the study. This data was collected through teacher surveys, free writing on opinion collection forms and semi-structured interviews supplemented by lesson observations.

A preliminary study was carried out through a question and answer form given to the English Department head who was also a Form 1 English teacher who piloted the use of ICT in teaching during Phase 1 of this study. The teachers were invited to elaborate and freely wrote their comments on the questionnaire. The aim was to probe and explore how teachers felt about the use of ICT in teaching, their attitudes towards and the different perceptions to this new practice. With reference to the responses, teacher surveys were designed for Phases 2 and 3. The teacher surveys were given out on the school Intranet, eClass, and teachers were free to choose whether to give their

answer or not. It was not given on paper in order to minimize the pressure of being asked to do the survey as a favour to the researcher who was a senior teacher. However, it also had the risk that teachers might have overlooked it. After considering the pros and cons, it was decided that the original plan be kept. Results of the surveys would then be used to prepare for the semi-structured interviews for the selected teachers.

The main purpose of the study was to investigate how teachers change to using ICT in their teaching. Therefore, teachers were selected for close investigation on their change process. In order to represent as wide as possible the range of teachers who were the subject of the study, they were selected according to the plan in Figure 5-2.

Table 5-1 Plan for choosing teachers to be interviewed and lessons to be observed

Level of ICT Usage	Years of Service	Sex	Subjects taught
High	Less than 15	F	Language, Science, Humanities or Cultural
High	Less than 15	M	
High	15 or above	F	
High	15 or above	M	
Medium	Less than 15	F	
Medium	Less than 15	M	
Medium	15 or above	F	
Medium	15 or above	M	
Low	Less than 15	F	
Low	Less than 15	M	
Low	15 or above	F	
Low	15 or above	M	
At least 2 from each level of usage	At least 3 with more than 15 service years	At least 2 each sex	At least one from each subject group

It was planned that at least 6 teachers be chosen for further investigations. The criteria for selection included the level of ICT usage, the number of years of service, the subjects they were teaching (Sciences, Arts or Cultural) and their genders. The wider the range of teachers selected, the more fully the situation could be represented. Since the majority of teachers in the school had more than 10 years of teaching experience,

the teaching experience of the teachers selected ranged from 10 to 25 years. Of the three major subject groups, Arts, Science and Cultural, at least one teacher was selected from each. Since the number of male and female teachers at the school was about the same, almost equal numbers of male and female teachers were selected to participate in the interviews.

Like that a case study cannot be generalised, the study of each individual teacher could not be generalized to represent all other teachers of the school. However, the selection tended to include teachers ranging from the less experienced to the more experienced and from those who were more prone to using technologies to those with more resistance to using technologies, in order to get a description of the situation as close to the true picture as possible.

Data to collect from the principal

Though the study was about teacher change, the role of the principal could never be ignored. The principal is the key person in the school to lead educational changes. Usually he/she is the one who makes decisions, gets funding and sets up policies for the school. Therefore, his/her belief, attitude and perception have a significant effect on the pace of adoption and implementation of an educational change.

An interview was arranged with the principal to capture his/her views on the educational change and his/her plan as well as the strategies for achieving it. Data collected would also help to better describe the situation of the school from the point of view of the principal. His/her attitude towards the development and policies would

mean a lot to teachers' determination to change and how they worked for it. The data could also triangulate with those collected from the teachers.

Quantitative and Qualitative Data Supplementing Each Other

Quantitative data collected through questionnaires and surveys from larger groups of people would provide descriptions of the wider environment and the context of innovation. The results could help to prepare for the interviews. They would also be used for triangulating with the key observations and data collected from interviews (Yin, 2000). In this case study, the student questionnaires and teacher surveys would be collected before interviews so that questions could be prepared with reference to the results of the surveys. Some questions or observations could be designed to confirm or clarify points raised in the questionnaires and surveys. The results could also be triangulated with each other to increase the reliability and enrich the description of the situation.

5.2.3. Choice of Research Period

The aim of the research is to study how an educational change, which involves the change of role and practices of teachers, has been adopted and implemented. The introduction of the change could be traced back to the 1980s when hardware was first provided to the school for piloting the new Computer Studies curriculum in the senior secondary level. The network of the school was first built in the late 20th and early 21st century when the Hong Kong government declared its first initiative of ICT in education. The school started training teachers in 1998 and piloting the use of ICT in junior form English lessons in 1999. Gradual improvement of the infrastructure with

government funding and the school's own funds were underway but no breakthrough was observed until end of the school year 2004-05. Therefore, the first cut off point was put at September 2005 and the period before this point was named Phase 1 of the study. The whole research period was divided into 3 phases with the cut off lines marking the different phases of data collection while changes continued throughout.

The period before September 2005 was taken as Phase 1 when a pilot study was carried out in 2003 and observation continued until significant changes were found in 2005. The main research period extended over two school years from September 2005 to August 2007. It was further divided into two phases with Phase 2 covering the period September 2005 to August 2006 and Phase 3 from September 2006 to August 2007.

The major changes in the provision of hardware and school policies in the three phases would be identified and presented as background information for the investigation of questionnaire, survey and interview data. It should be borne in mind that there was no clear cut boundary between the different phases and the development was a continuum. The schedule of data collection and the key events throughout the research period were presented in Table 5-2.

Table 5-2 Key events and schedule of data collection in the 3 phases.

	Time	Key events / Data collected
Phase 1	1999-2000	All computers connected together into a LAN / provision of funding for hiring a technical support staff / A staff computer room with 8 computers systems / 6 LCD projectors purchased for teachers to use during lessons on request
	2000	Multimedia Learning Centre (MMLC) was opened
	2000-2006	Starting from 2000, each Form 1 class was allocated a double lesson, that is, each group a double lesson per alternate week, in the MMLC. It was gradually extended to Form 2 and Form 3.
	2003	Pilot study with Form 1 English lessons. Questionnaires given to Form 1 students – to collect their views on using ICT for learning based on their English lessons in the MMLC. Interview with the English Department Head
	2003-2004	Lesson observation in the computer room – a Form 1 English lesson using CAL Some classrooms were installed with LCD projectors so that teachers can borrow these rooms for lessons using IT
	Sept., 2004	LCD projectors were installed in all classrooms + 10 visualizers
	1998-2004	Review of government documents- ICT strategies and review of 5 year ICT plan
Phase 2	Sept., 2005	Change of principal of the focal school
	Nov., 2005	Notebook computers for all the teaching staff
	Jan.-Feb. 2006	Online survey for teachers (26 teachers responded)
	<i>Feb. 2006</i>	<i>SSE comments- written comments were collected from teachers and analysed.</i>
	Jan.-April 2006	Lesson observations / video recording of lessons Comments (optional) from students in special meetings for school self evaluation
	May 2006	External School Review
	July 2006	Online survey for teachers Questionnaires 2 & 3 to students (F3, F.4 and F.5)
	July 2006	Interviews with selected teachers
Phase 3	2005-2006	Review of school policy documents, school plans, announcements and notices
	Dec. 2006	Interview with Principal B
	Jan.-Feb. 2007	Lesson observations / video recording of lessons with selected teachers Group interviews with students immediately after the observed lessons
	Feb. 2007	Follow-up interviews (with 4 teachers)
	Feb. 2007	Student questionnaires 2 & 3 (F.3, F.4 & F.5) same as the one in July 2006 Student questionnaire 5 (F.1-F.5) – about using ICT in lessons
	Feb. 2007	All classrooms are equipped with a desktop computer and a connection point to a visualizer
	April 2007	SSE comments- written comments were collected from students and analysed
	May 2007	Interviews with the selected teachers
	July 2007	Online survey for teachers

Legend: **Items highlighted bold** are the events that were unexpected at the start of the research but they had significant effects on the change;

Items highlighted in italic are the data that were not planned to collect but they are found to be useful in understanding the situation.

5.2.4. Data Collection Plan and Schedule

Table 5-2 describes the data collection schedule with the key events included to mark the possible catalysts for change. Data were analysed as soon as they were

collected so that the results could inform the data collection and analysis in the next stage. The schedule had been modified throughout the research period to allow capture points for the change process be added or deleted. The following paragraphs describe and explain how data were collected from each source.

Government and School Documents

Archival records of the government policy documents were retrieved from the government website. School policy documents, notices and minutes of meetings were retrieved from the school server for analysis.

Government policy papers

In Hong Kong, government policies on formal education are drafted and implemented by the Education Bureau (EDB), which was named the Education and Manpower Bureau (EMB) in the years before 2008. The EDB is also responsible for supervising schools to ensure the quality of education delivered, getting funds from the government and granting funds to schools. The EDB documents are useful in understanding the education policies so that the documents relating to ICT in education throughout the research period were collected from the government website. They provide information about the direction, targets and budget of the government for ICT in education in Hong Kong. Documents retrieved included:

1. Information Technology for Learning in a New Era Five-Year Strategy 1998/99 to 2002/03 (EMB HKSAR, 1998).

2. Review of "Information Technology for Learning in a New Era Five-Year Strategy 1998/99 to 2002/03"
 - Preliminary Study on Reviewing the Progress and Evaluating the Information Technology in Education (ITEd) Projects (December 2000 - August 2001) (EMB HKSAR 2001).
 - Overall Study on Reviewing the Progress and Evaluating the Information Technology in Education (ITEd) Projects 1998/2003 (EMB HKSAR 2005).
3. Empowering Learning and Teaching with ICT (July 2004) (EMB HKSAR, 2004a)
4. Review of "Empowering Learning and Teaching with ICT (July 2004)"
 - Phase (I) Study on Evaluating the Effectiveness of the "Empowering Learning and Teaching with IT" Strategy (2004/2007) (EMB HKSAR, 2007).
 - Phase (II) Study on Evaluating the Effectiveness of the 'Empowering Learning and Teaching with Information Technology' Strategy (2004/2007) (EDB HKSAR, 2007).

The purpose of analysing these documents was to understand the situation of Hong Kong schools and locate factors that might have facilitated or inhibited the use of ICT in teaching and learning. The review of the EDB policies shed light on the situation of the wider school population. Since the review reports were released during the research period, the results could be compared with what was found in this case study, though each school should be considered unique. The school's history, socio-economic background, people and environment built up the characteristics and

determined the work style and its adoption to different changes. Though this study does not aim to look into the background of the focal school in details, it does go as far back as the nineties in order to plot the development of ICT in education.

The factors and conditions reviewed in the reports were taken as a reference to the design of the surveys, questionnaires and interviews thereafter. They also serve as a reference for discussions of the findings of this research.

School Documents

School documents such as school plans, school reports, minutes of meetings related to ICT in education, etc. were retrieved from the school server and the school Intranet. The following is a list of the documents retrieved:

1. School plan 2005/06, 2006/07 (Appendices D1 & D2).
2. ICT plans of the focal school 2003/04, 2004/05, 2005/06 and 2004/07 (Appendix D4).
3. Summary of Departmental ICT plans 2005/06 (Appendix D6).
4. Minutes of the ICT Seed Teachers meeting (Appendix D7).
5. ICT plans of different departments submitted by ICT Seed Teachers, January 2006.
6. e-Notices on the school Intranet (Appendix D10).

The school plans and IT plans of the focal school and different departments would help to understand the situation and intention of using ICT for teaching and learning of the school. The 'IT Seed Teachers' group was set up after notebook

computers were distributed to teachers near the end of 2005 for the purpose of promoting the use of ICT in teaching. Therefore, the current practice as well as the planning for using ICT could be found in the plans and the minutes of the IT seed teachers meeting. School policies towards the use of ICT in teaching and learning could also be found in the school plans. The 'e-Notice' on the school Intranet was a platform for giving instructions, reminding teachers of planned actions and deadlines as well as calling for actions. It was usually used by the principal or senior teachers. This would be a source for understanding how the school policies were implemented.

Other Documents and Archival Records Available

Other documents available including e-Notices, teachers' and students' comments collected on school self-evaluation (SSE) days on the ICT equipment, ICT support, ICT training and the usage of ICT in teaching and learning were retrieved and analysed together with the qualitative data collected from interviews. Since teachers and students were free to write their comments concerning the use of ICT in teaching and learning, these data helped to describe the situation more accurately and the result in a better understanding of both teachers' and students' attitudes towards the issue.

Teacher Surveys and Student Questionnaires

The teacher surveys and student questionnaires were designed for collecting information about the actual practices and the opinions of these two groups of people concerning the advantages and disadvantages of using ICT in teaching and learning. Both students and teachers were invited to report on their ways and frequencies of usage

as well as the perceived increase in usage of ICT in teaching and learning.

Strategies for designing the teacher surveys

Three online surveys were designed for collecting data from teachers about the situation of using ICT in teaching and learning as well as their attitudes and opinions on this issue. The first one was given out between January and February in 2006, in the middle of Phase 2. The second one was carried out in July 2006, towards the end of Phase 2. The third one was given out in August 2007, the end of Phase 3. The surveys were posted on the school Intranet for teachers to take but it was not compulsory. Teachers could opt whether they join the research or not and their names would not be recorded. The three surveys, though not answered by all the teachers, were designed to collect basic information about the situation of ICT usage for teaching and learning at the school and the teachers' views and attitudes at different phases of the study. The same survey with only slight modifications was used for the following surveys in order to keep track of any changes in teachers' responses.

In the survey, three questions asked about the amount of ICT usage in teaching, the kinds of software they were using and the reasons for using them. Another three questions asked whether they had increased ICT usage in their teaching in the second term and the reasons for this increase as well as those that discourage them from using it. They were also asked to rank order the reasons in both cases. Some suggestions from other sources and from informal chat with teachers were given as choices in the surveys. Teachers were invited to freely add to the list of factors according to their own experiences.

As mentioned earlier in this chapter, the data collected were analysed immediately so that the results could inform the data collection in the following phases. The three surveys, though being of the same design, consisted of questions that are modified with reference to the findings in the previous survey or were otherwise designed to suit the stage of development at the phase.

Strategies for the Design of Student Questionnaires

Three sets of student questionnaires were designed for this study. The first one, labelled S1(a, b& c) in the appendices, was designated to Form 1 students when the school piloted its use of ICT in the English lessons. It was given out to all Form 1 students near the end of the school year 2002-03 and it served as a pilot to this study. Students' comments on the use of ICT in their English lessons and their perceived change in learning style when ICT was used were collected from the questionnaire. This served as basic information about students' perception on the use of ICT in teaching and learning in the earlier stage of adoption of the educational change. It helped in locating points that were worth further investigation and exploration. It is worth noting that this group of students was in Form 4 in the school year 2005/06, that is, Phase 2 of the study and Form 5 in the school year 2006/07, Phase 3 of the study.

The second one was modified from that used for the ImpaCT2 study in the U.K. The purpose was to collect information about students' usage of ICT both inside and outside classrooms. The results would contribute to the understanding of students' usage of ICT not only in learning but also in other areas. This questionnaire was well developed by the group of scholars in the U.K. and was a reliable tool to measure

the students' usage of ICT. It would be worthwhile to put this in the Hong Kong situation and look at the same category of questions in order to explore and compare the ICT usage of Hong Kong students with that in the U.K. This second set of questionnaires was modified and developed into two similar sets to suit the different subject combinations in Form 3 and Form 4 & 5 of the focal school. Though the results were not to be compared with the U.K. study due to the different time frames and difference in the education systems, the results could reflect the situation of ICT usage of students in learning. Student Questionnaire 2 (Appendices S2a, S2b) was for Form 3 students while the Student Questionnaire 3 (Appendices S3a, S3b) was for Form 4 and Form 5 students.

The Student Questionnaire 5 (S5a, S5b), was designed specifically for this case study. It would ask students to report on the frequentness of teachers' usage of ICT in lessons and their comments on it. Data collected would be useful for triangulation with teachers' report. Students' comments on whether they liked the use of ICT in learning or not and the advantages and disadvantages they perceived were also collected. This would help to understand how and why this educational change was adopted and implemented in the way it was in this school. Both Questionnaires 5 (Appendices S5a, S5b) and 2 (Appendices S2a, S2b) & 3 (Appendices S3a, S3b) were administered in the end of the school year 2006/07.

Interviews with the principal, teachers and students

Interviewing was a key method for collecting the core data in this case study. Using Grounded Theory methods for conducting interviews, 'open-ended yet

directed, shaped yet emergent, and paced yet unrestricted' approach was used to collect interview data (Charmaz, 2006). All the interviews were recorded, transcribed and translated into English. The interview data was analysed together with the survey or questionnaire results and related documents or field notes of lesson observations.

Interviews were taken with the principal, selected teachers and student groups during the research period. Choice of teachers to participate in this case study was important. Stake (2000) point out that the researcher needed to seek good samples to assure variety but are representativeness or typicality. He also stresses that stronger consideration has to be put on access. In this case study, accessibility did affect the choice of research period, choice of teachers and students for interviews, and even the choice of lessons to be observed and choice of documents to be studied.

Design for the Interview with selected teachers

The teachers selected according to the plan described in Figure 5-2 were interviewed two times, once in Phase 2 and the other in Phase 3. The interviews were semi-structured with some questions prepared with reference to the data collected in the teacher surveys and student questionnaires. It was mentioned earlier in this chapter that the researcher was at a senior position of the school. Bearing in mind that teachers might tend to give favourable comments on policies and positive answers to the usage and effects of using ICT, probing questions were used to elicit true feelings and verify the answers as far as possible. Also, the interview environment was arranged so that it was more like an informal chat than an interview. The purpose of the interviews would be made clear to the teachers to relieve them from any worries.

Two of the teachers were invited for deeper investigation. One lesson of each teacher was observed with their consent. After the lesson, they were asked to select 3 to 5 students from that class for a focus group interview. These two teachers were interviewed one more time. These would be used to confirm the actual practice inside the classrooms and triangulated with the data from the teacher interviews.

Design for the Group Interview with students after lesson observations

Two student focus group interviews were conducted after the lesson observations. Students were invited to give feedback on the lesson focusing on the use of ICT during the lesson as well as their views on ICT usage for teaching and learning. The purposes of the meetings were to check the points observed from the lessons observed and collect information about students' attitudes towards teachers' use of ICT in lessons as well as the advantages and disadvantages they perceived.

Questions asked mainly focused on their views on teachers' use of ICT in lessons, whether they liked teachers using ICT for teaching or not and what were the reasons. Comments on the way the teacher used ICT in the lesson observed and suggestions to the teacher were also included. They were also asked to comment on the amount and way of ICT usage in teachers' teaching and their learning. The data collected were then used to check against teachers' views and the data collected from student questionnaires. These results would triangulate with the amount and way of usage teachers reported. Any discrepancies between the answers would be studied carefully for the reasons. It would be helpful in understanding why teachers used or did

not use ICT in their teaching and thus facilitate the understanding of the change process.

Design for the Interview with Principal B

Principal B joined the school at the start of the school year 2005 to 2006 after Principal A resigned. An interview was designed to be carried out in Phase 3. One of the purposes was to collect information about how she felt about the situation of ICT usage of this school compared with that in schools where she used to serve. Another purpose was to get some information about her attitudes on the use of ICT in teaching and learning. The third purpose was to understand how she drafted the new ICT policies for this school and how they were implemented.

As a new comer to the school from between Phase 1 and Phase 2 of the study, Principal B would be the most appropriate person for objectively describing the ICT environment of the school and the situation of the use of ICT in teaching and learning in the focal school. Open-ended questions were asked to elicit her views on the development of ICT in education in this school. Other questions were asked in order to understand Principal B's beliefs and her attitudes on the use of ICT. She was invited to state her preferred policies and strategies for the implementation of the educational change. Since principals are considered as the key leaders of change in schools, data about Principal B's beliefs and attitudes towards the use of ICT and her leadership style would help to understand how and why teachers change in this school.

CHAPTER 6 Analysing and Reporting Data : Grounded Theory Approach

6.1. Introduction

This chapter aims to give a brief description of the ways that the data would be reported and analysed in the following chapters. As stated in Chapter 4, the Activity Theory will be employed as the framework for presenting and analysing the changes in the school system.

The quantitative data collected through questionnaires and surveys will be organised and analysed with the help of spreadsheet software while the qualitative data will be analysed in the light of Grounded Theory. Employing Grounded Theory methods, the interview data, field notes and document reviews were coded line by line at its initial stage and emerging themes were identified and organised in the following stages (Charmaz, 2006). The program, Nvivo, would be used to help in organising, coding and categorizing the qualitative data. The actual data collected will be reported and analysed under the framework suggested by the Activity Theory according to the three phases defined in Chapter 5.

The focal school will be represented as activity systems at different phases for analysing the change process of using ICT in teaching and learning. In the activity systems, teachers were the subjects and teachers' teaching using ICT and students' learning using ICT were the objects. The outcomes will be the extensiveness of usage

and the effectiveness of using ICT in teaching and learning.

6.2. Representation of the Focal School as an Activity System

In this case study of the educational change of ICT in education, the effectiveness of teaching and learning was the major concern and more effective teaching and learning was the target outcome of the change. With the help of the framework of Activity Theory, the focal school system will be represented in 2-dimensions (see Figure 6-1). The mediating tools, the rules that might have driven the changes, the culture and the division of labour of stakeholders of the school contributing to the change process will be identified from both the quantitative and qualitative data collected. This framework could also help to study the relations between the data collected, compare and contrast them to track the changes and identify the factors affecting the changes.

Within the school system, the principal, board of management, the alumni, parents, students and teachers were the stakeholders that had significant roles to play. The EDB, which was the government department that set up policies and make sure schools implement them, also played important roles in this educational change. It was also in control of the main resources by allocating funds to schools so that it might have significant influences on the change process. Therefore, hardware and software provision, teaching and learning resources and policies of EDB and the focal school would have been the mediating tools in the development. As the activity triangle could represent, these factors were explored and carefully studied in each phase in order to fully understand the change process in the focal school. Any other factors that

might have come into being were also captured and studied. A diagrammatic representation of the activity system is given in Figure 6-1.

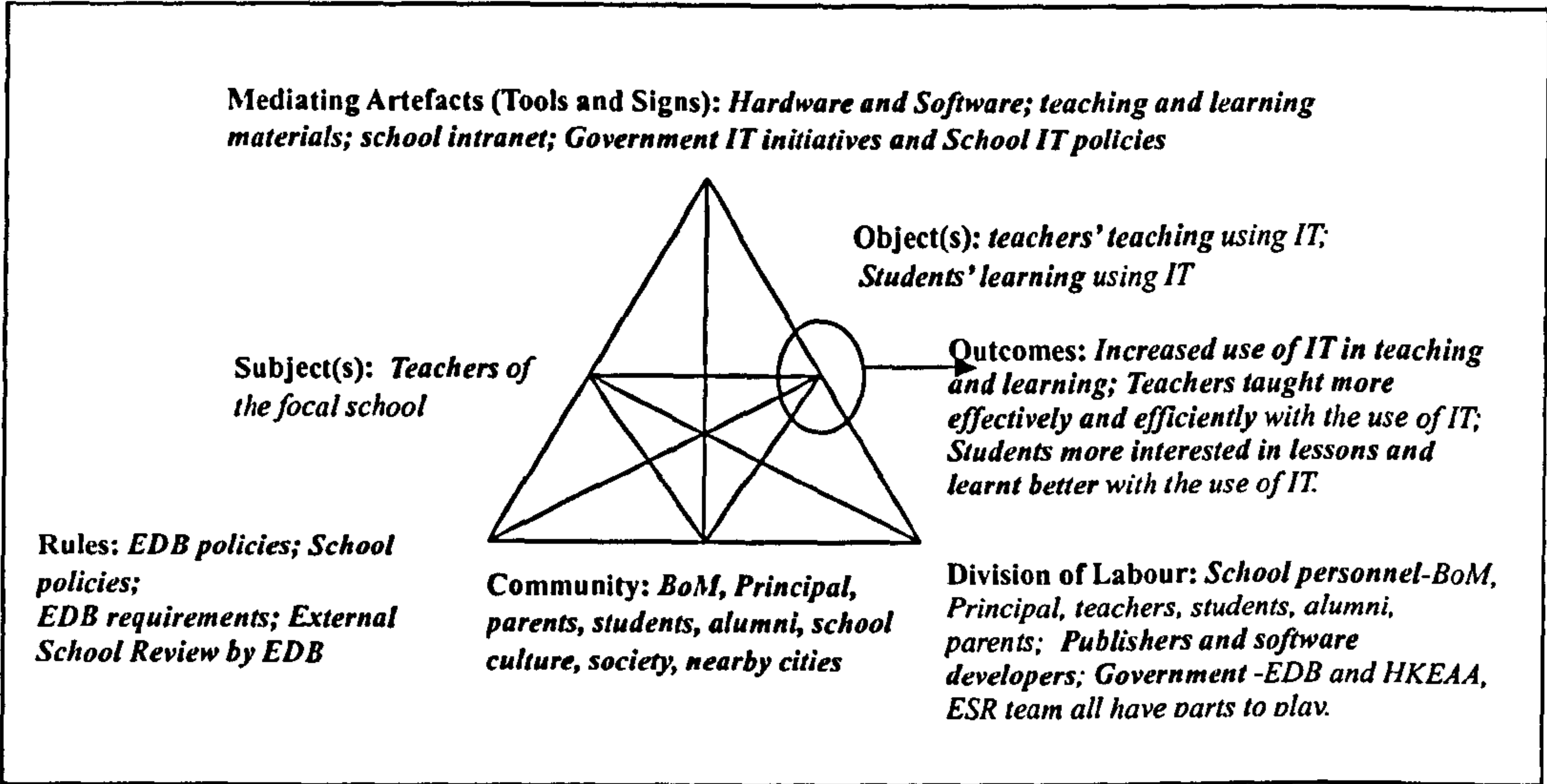


Figure 6-1: First representation of the activity system – the focal school

Both quantitative data and qualitative data collected at different phases through various means would be analysed, cross-referenced and compared with each other in order to portray the school situation as accurately as possible.

6.3. Development of ICT in Education in Hong Kong from Government documents – Changes in Government Policies

The first and second ICT in Education Strategies declared by the Government were the main factors leading to changes in schools in Hong Kong. These policies and their review reports from the archive on the EDB website contain background information of the ICT environment of most schools, including the school of the study. Before the school year 2004-05, the EDB implemented a centralized scheme in the provision of hardware, software and manpower to schools. Procurements were done

by EDB and distributed to schools according to the class sizes of the schools so most schools were of almost the same standard.

ICT in Education initiatives of the Hong Kong Government and their reviews

The first ITed strategy : “Information Technology for Learning in a New Era: Five-Year Strategy” (1997/98-2003/04) (EMB HKSAR, 1998)

The Hong Kong Government announced the first five-year ICT strategies in 1998 with an amount of HK\$ 2,880 million (~ £ 220 million) in capital cost and HK\$260 million (~£ 20 million) in annual recurrent cost for its implementation in about 400 secondary schools and 600 primary schools. It was followed by a series of strategies and investments for supporting the implementation of the policy which incurred an additional capital cost of HK\$334 million (~£ 25.7 million) and annual recurrent cost of HK\$294.5 million (~£ 22.7 million) for the recruitment of ICT coordinators and support for facilities for students use in afterschool hours. The emphases were ‘access and connectivity’, ‘teacher enablement’ and ‘curriculum and resource support’ (EMB HKSAR, 1998).

In this first ITed strategy, teachers were not expected to become computer experts but they were required to reach the ‘comfortable level’ which meant that they were capable of using ICT tools and resources available on the Internet and the Intranet for teaching and learning. Schools were also required to have at least 25% of teachers reaching the ‘competent level’ which means that they could handle computer networking, resolve simple hardware and software problems, make more advanced use

of authorware for lesson preparation and so on. It also required each school to have one to three teachers at the ‘creative level’, that is, the teachers could design, manage and evaluate the school’s ICT system and the instructional materials with the use of ICT. As stated in the document, their responsibilities included choosing appropriate ICT equipment to meet a school's needs, giving advice to teachers on matters relating to the use of ICT in teaching and promote the ICT culture in the school.

The report of the reviews conducted by tertiary institutions gives the remark that the 5-year strategy had successfully provided the necessary infrastructure for ICT in education to take-off (EMB HKSAR, 2004b).

Situation of ICT Usage in Hong Kong Secondary Schools in Early 21st Century

From surveys of the overall study, student-computer ratio of Hong Kong secondary schools was 7.6 by 2004. Data collected in mid-2003 by the Census and Statistics Department showed that 91.3% of students aged 10 or over had computer at home and among them 92.6% had their computers connected to the Internet. With the additional funding from the EMB, all students can have access to the Internet outside school hours.

In the Education Reform proposed by the Education Commission in 2000, ‘The use of Information Technology for interactive learning’ was given as one of the 4 key tasks to promote learning to learn in order to achieve the seven learning goals for the short-term targets of curriculum reforms 2001-06 (CDC HKSAR, 2001a: p.7). IT skill is one of the 9 generic skills to develop. The Curriculum Reform document

published in 2001 reinforced the role of ICT as a tool to support the reforms which had an emphasis on interactive learning. Though the reports showed quite high percentage of teachers used ICT in teaching across all key learning areas, it was realised that the teaching strategy largely remained teacher-centred (EMB HKSAR, 2004a).

It is also reported that some professional networks to collaborate efforts of schools, such as the 'Centres of Excellence on IT in Education' (CoE), were set up during these early years of development. These professional networks also advised on teacher training and promotion of ICT activities, suggested ways to integrate ICT into curriculum and piloted new technology and pedagogy. During the same period of time, HKEdCity, a professional educational portal in Hong Kong, was set up with the QEF to provide teachers with rich learning resources and platforms for communication. It also became the most popular education portals for teachers and then developed into an e-learning and e-business platform for teachers, parents and students. Besides, there were hundreds of activities organised by professional bodies as well as private companies to promote ICT in education (EMB HKSAR, 2004a).

From various studies to evaluate the pedagogical and other impact of ICT in Education, the development in infrastructure and training was confirmed to be a success in the first 5 years. However, reports also pointed out that it needed more development in pedagogical practices (EMB HKSAR, 2004a).

The second ITEd strategy: “Empowering Learning and Teaching with Information Technology” Strategy (2004/2007) (EMB HKSAR, 2004a)

Based on the reviews of the first IT strategy, the second ITEd Strategy was announced in 2004 with the following goals: ‘To empower learners with IT’; ‘To empower teachers with IT’; ‘To enhance the Leadership Capacity of Schools for the Knowledge Age’, ‘Enriching Digital Resources for Learning’, ‘Improving IT Infrastructure and Pioneering Pedagogy Using IT’, ‘Providing Continuous Research and Development’ and ‘Promoting Community-wide Support and Community Building’ (EMB HKSAR, 2004a: p.12).

It was emphasized that for successful implementation of ICT in education, the leadership and direction of the government were important in building the necessary culture, organising activities and providing resources and support of school heads as visionary leaders as well as teachers as practitioner of appropriate pedagogies. Professional development was emphasized for empowering teachers to use ICT for curriculum and pedagogical innovations. The government would support the development of online and off-line platforms for teachers to exchange experiences and good practices as well as undertake action-oriented research in order to achieve the aims (EMB HKSAR, 2004a).

In this second ICT in Education strategy, the Education and Manpower Bureau of the Hong Kong SAR government had the vision that

“Students, teachers, schools and other stakeholders will use IT effectively as a tool for enhancing the effectiveness of learning and teaching, with a view to preparing our students for the information age, turning schools into dynamic and interactive learning institutions, and fostering collaboration among schools, parents and the community” (EMB HKSAR, 2004a: p.10).

Together with this strategy was another large investment to upgrade the networks and computer systems in schools. Different parties of the communities were involved to support the development. The importance of ICT in teaching and learning as perceived by the Hong Kong government was reflected in the curriculum reform documents: ‘Using information technology for interactive learning’ was one of the four key tasks to promote effective learning and teaching and ‘IT skill’ was considered to be one of the nine generic skills to acquire and construct knowledge (CDC HKSAR, 2001a: p.7). Schools were required to include ICT in Education in their annual plans as well.

6.4. Development of ICT in Education in the Focal School

Before 2004, the government mainly employed a centralised scheme in enforcing its policies including the ICT in education policies. The government was responsible for the procurement of equipment and services and allocate to schools according to the number of classes of the schools. Therefore, all the schools, with the exception of a few with strong support from their stake-holders or the private sector, were almost the same in terms of hardware and software provision and ICT support services. Any differences came from the teachers’ adoption and usage of ICT in teaching and learning. The focal school was among schools with a common ICT provisions. The following is a description of its development from a review of the minutes of staff meetings and circulars about the provision of hardware and software. It is important to present

these data because they provide more comprehensive information about the context in which the focal school of this study was situated.

Introduction of ICT in Education in the Focal School

Computer Studies was formally introduced into the focal school as a senior secondary subject in the early eighties. About twenty stand-alone computers were installed with government funding for piloting the Computer Studies curriculum. Gradually, the Computer Studies curriculum was extended to Form 7 and the junior secondary levels in the nineties. In the early nineties, there were around 50 stand-alone computers in two computer rooms mainly for teaching computer subjects and a few more in the general office for administrative work. The school started using computers for recording students' personal data, attendance and other performances, as well as generating student reports and timetabling in the late eighties. The School Administration and Management System (SAMS) was set up by the government in early nineties to support schools in doing administrative work.

Improvement of ICT Infrastructure and Its Usage for Teaching and Learning

As soon as the first 5-year ICT strategy was launched by the government in 1998, the school upgraded all the computer systems and improved the infrastructure and connectivity with the funding provided. In the late nineties, the school had a total of 104 computers with a student-computer ratio of about 10 to 1 and 10 LCD projectors. The desktop computers and LCD projectors were installed in laboratories and special rooms such as the Design and Technology Workshop, Home Economics Room and Lecture Room. Besides, eight desktop computers were installed in a teacher

computer-room for sharing among fifty teachers. All computers were connected in a local area network and to the Internet.

In 2000, twenty four notebook computers and three extra portable LCD projectors were available for teachers to use in classrooms. Teachers needed to book the notebooks and LCD projectors in advance and a technician would help to set them up in the classrooms if they requested for it. Principal A allocated a small amount of school fund to install network nodes on all teachers' desks to enable teachers to use notebooks on their own desks in order to encourage them to use ICT for administrative work, lesson preparation as well as teaching and learning. Later in 2004, one classroom on each floor was installed with a LCD projector so teachers could connect it to their notebook computer and this could encourage more ICT usage in teaching. However, since those rooms were homerooms of some classes, teachers could only use them when students were attending lessons elsewhere in the school. Due to the inconvenience, the use was still rather low.

The school successfully applied for the setting up of the MMLC with the QEF in 1999. According to government specification, 45 desktop computers and related equipment were installed in the MMLC which was specially designed for use as a language laboratory. The school started piloting the use of ICT in teaching while the school was preparing for the setup of the MMLC. The time table of a computer room which could accommodate only 20 students was modified to allow for double lessons per alternate weeks for Form 1 English lessons. School funds were allocated for the purchase of software packages. As soon as the MMLC was ready for use in 2000, the pilot scheme extended to Form 2 and gradually to Form 3. It then became a policy

of the school to set aside a double lesson per week for learning English in the MMLC. The pilot scheme could start earlier than the completion of the MMLC because the Form 1 English classes were split up into groups of twenty students each, and could be accommodated in the sub-standard computer-room.

Starting with a small group of English teachers, Principal A strategically planned for the implementation of ICT in teaching and learning. Training workshops were given by the software provider to the English teachers to prepare them for using it in their lessons. The technical skills of using the software, the rationale of the design and the pedagogy were explained to the teachers. Together with the computers in the MMLC, the student-computer ratio went up to 7 to 1 while the average for the secondary schools by that time was 7.4 to 1. Furthermore, Principal A had successfully appealed for donation from former students for the installation of LCD projectors in all classrooms and the project was finished near the end of the school year 2004-05 which is also the end of Phase 1 of this study.

The focal school joined a program launched by a university in Hong Kong for setting up a school Intranet system in the early 2000s. All teachers and students were given accounts to use the system since 2003. However, teachers were not active in using the system. Neither teachers nor students used the system voluntarily until Hong Kong schools were forced to close schools for one or two weeks due to the outbreak of the Severe Acute Respiratory Syndrome (SARS). Many schools began using the Intranet systems for teaching and learning during the suspension period so students would not miss too many lessons. The focal school also reconsidered the use of the system which the school had subscribed free of charge. By the end of the school

year 2004-05, the school subscribed for another Intranet System, eClass, which was more popular and provided more online facilities. Though the school encountered a change of principal by the end of the same school year, the new principal, Principal B, welcomed the new system and proceeded with the installation. The system was ready for use at the start of the school year 2005/06. Principal B got the school funding to provide all teachers with notebook computers near the end of 2005 and installed workstations in all classrooms in the school year 2006/07.

Teacher Training and Support for Using ICT in Teaching and Learning

The government recognized the need for support for the development of using ICT in teaching, a number of funding were available for schools to apply for the recruitment of technical support staff and ICT coordinators. The focal school also successfully applied for the funding to acquire the Technical Support Service (TSS) from a company and hired an extra teacher to release the work load of one or two teachers who had taken up administrative work due to the extended use of ICT (Appendix D4a). Teachers could then get technical support from these additional staff for using ICT at school. The school started planning for its development for using ICT in teaching and learning and gave training to teachers. The school also required department heads to include the use of ICT for teaching in their subject year plans (Appendix D4a).

The first 5-year IT strategies introduced in 1998 provided funding for school based training and courses organised by the government. Schools were encouraged to organise training for their teachers with the aim of achieving the IT competency

levels required by the government. According to the policy, all teachers had to reach the basic IT skills (BIT) level, 25% teachers to reach the Intermediate IT skills level (IIT level) and two teachers reaching the advanced IT (AIT) level before the end of the school year 2003 (EMB, HKSAR, 1998). The focal school satisfied all these requirements by the end of the school year 2003-04. It was considered as a strength of the school in the IT plan (Appendix D4a) that teachers, after attending the training courses, were willing to try to use IT for teaching. The school had required all subject panel heads to include some usage of ICT in their lessons in their subject plan and put ‘Using IT in teaching and learning’ as one of the major concerns of the school year 2004-05. The policies of both the government and the school had shown their determination to implement the use of ICT in teaching and learning. Table 6-1 is a summary of the government and school policies concerning ICT in Education and the key events relating to the infrastructure and provision of software and hardware.

Table 6-1: Policies and events related to the development of ICT in Education in the focal school

Phase	Time	Government	Focal school	Remarks
	1998	First 5-Year ITed Strategy announced;	- Computers upgraded and connected in a LAN and to the Internet; Student-computer ratio was 10:1;	- teachers participated in both government organised and school based trainings;
	1999	- Required teachers in schools to meet different levels of ICT competencies;	- ICT skills training given to teachers;	
		- Required schools to set up ICT in Education plans;	- Installed 10 LCD projectors in Labs & special rooms;	
		- Grants to schools for ICT infrastructure and connectivity;	- A few portable LCD and notebook computers for use in classrooms;	
		- Trainings organised in connection with tertiary institutions;	- Recruitment of ITC & TSS	
	2000	- QEF for the recruitment of Technical Support Staff (TSS) and IT coordinator (ITC);	- Started the pilot scheme of using ICT in Junior Form English Lessons in Form 1;	
		- QEF for setting up MMLC in schools;	- Set up the MMLC;	
		- Professional development programs supported by tertiary institutions.	- Pilot scheme extended to Form 1 to 3 in the MMLC;	
			- Student-computer ratio went up to 7:1	
1	2003	- Invited universities and private sector to develop Intranet systems;	- Subscribed to an Intranet system;	- Outbreak of SARS and schools closed for few weeks;
		- Set up an Intranet system for teachers, HKedCity.	- Teachers learnt to use the Intranet system during closure of school;	
		- Review of the first ITed Strategy;	- Notebook computers and LCD projectors available for teachers to borrow for use in classrooms;	
		- Consultation for the 2 nd ITed Strategy.	- Some teachers used ICT for teaching in Laboratories but very few used ICT in classrooms.	
			- All teachers satisfied the basic requirement of the government;	
			- Subject departments included use of ICT in their annual plans.	
	2004	Second ITed Strategy announced	- Improved ICT infrastructure of the school including a wireless network;	
	2005	- Matching Grant for the improvement of ICT infrastructure as well as the setting up wireless network;	- LCD projectors installed in all classrooms with donations from the alumni;	
2	2005		- Change of principal;	
			- Subscribed for a new Intranet system, eClass;	
			- IT seed teacher scheme;	
			- Each teacher was provided with a notebook computer;	
	2006		- Lesson observations (by peer or senior) using ICT or reading.	
3	2006			
	2007		- All classrooms were installed with desktop computers.	

6.5. Report of data collected from the case study

Collection of Phase 1 data of the present study started in 2003. When the plan was first drafted, the many changes between 2003 and 2007 had not been anticipated. Thus, data collected through teacher surveys, student questionnaires, interviews and lesson observations as planned beforehand were subject to modifications and adjustments. Other data that had emerged and thought to be useful for this study were also collected though they were not in the original plan. However, there were also some data that could not be collected as scheduled due to unforeseeable reasons. For example, two of the teachers participated in the research in Phase 2 left the school before the second interview was carried out.

Actual data collected included three teacher surveys, three different sets of student questionnaires, one given out in Phase 1, the other two in Phase 3 collected for different purposes, an interview with Principal B, one or two interviews with selected teachers and group interviews with students of two of the selected teachers, written comments collected on School Self-Evaluation days from students and teachers. Data collected in the three phases are recorded in Tables 6-2(a), 6-2(b) and 6-2(c) respectively.

Table 6-2 (a): Aims and purposes of data actually collected in Phase 1

Phase 1	Quantitative Data	Qualitative Data	Aims and Purposes	Remarks
Pilot stage May 03	F1 Student Questionnaire (S1a,b,c)		The following information collected: - Students' view/comments on lessons using ICT; - Students' view on teachers' role when ICT was used; The aim: - to guide the design of student questionnaires and teacher surveys in the following phases.	- Q and A in Chinese; - Given out to the whole class.
July 03		Q&A issued to a F1 English teacher who was also the English department head (T1)	To collect information about the situation of use: - How often teachers used ICT in teaching F.1 English; - How they used ICT in teaching; - Their views / attitudes towards the practice; - Any comments or suggestions.	Open-ended questions given out and written responses received.
July 03 To Aug 05		Document analysis - Policy paper of the government and reviews	To look for the following information: - Background information for the understanding and construction of the contextual environment of the focal school; - Roles played and rules given by the government for ICT in Education.	English versions downloaded from the government official website.

Table 6-2 (b): Aims and purposes of data actually collected in Phase 2

Phase 2	Quantitative Data	Qualitative Data	Aims and Purposes	Remarks
Sept 05 to Aug 06		Document analysis: - Policy paper of the school (Dn) including school plan, IT plan, IT seed teacher minutes, etc. - External School Review report & e-notices, etc.	To collect information / evidence about the policy of using ICT in teaching: - Information about school policies towards the use of ICT in teaching and learning - Provision of hardware and software	Documents retrieved from school server
Dec 05 To Jan 06	Teacher Survey 1 (TY1) 23 respondents		To collect information on Ts': - Amount of ICT usage in teaching; - Ways of usage; - Comments.	Collected online with an e-notice inviting teachers to answer the questions voluntarily.
Feb 06		School Self Evaluation – Teachers' Data (TX1)	Open-ended questions to collect: - comments on the hardware and software of the school computer systems - any comments on the usage of ICT for teaching and learning - comments on the provision of notebook computers - - any other suggestions by teachers	Written comments collected on a SSE day.
April 06		School Self Evaluation – Students' Data (SX)	Open ended questions for Ss' to collect: - comments on the hardware and software provision; - comments on the usage of ICT for teaching and learning; - suggestions for improvement.	Written comments collected on a SSE day for students
July 06		First interviews with 6 teachers (Tn1)	To collect information from Ts': - Amount & views of usage of ICT for teaching; - Reasons for using/not using ICT for teaching.	All conducted in Cantonese and recorded.
July to Aug 06	Teacher Survey 2 (TY2) 12 respondents (anonymous)		To keep track of any change(s): - Amount of usage of ICT in teaching - Ts' ways of usage; - Reasons for change or not; - change in practice; - Order of importance of the reasons.	- collected online with an e-notice invited teachers to answer voluntarily; - their names were kept anonymous.

Table 6-2 (c): Aims and purposes of data actually collected in Phase 3

Phase 3	Quantitative Data	Qualitative Data	Aims and Purposes	Remarks
Dec 06		Interview with Principal B (TP)	To collect information about: - Principal's beliefs/ reasons for the ICT policies; - P's view on hardware and software provision; - P's strategies for the implementation; - Principal's view on Ts' use of ICT for teaching; - P's view on the progress.	- Done in English and tape recorded
Sept 06 To Aug 07		Lesson observations of two selected teachers (D12)	To collect the following information by observation: - Evidence of ICT usage in teaching - Ways of usage in teaching - Students' responses to teachers' use of ICT in teaching.	- One F5 lesson and one F1 lesson observed; - Field notes taken.
Sept 06 To Aug 07		Student focus groups (SG1 & SG2)	To collect the following information: - Students' responses and views on lessons using IT; - Students' comments on teachers' usage.	- Done after the lessons were observed; - Done in Cantonese and all were recorded.
Feb. 07		Second Interview with the selected teachers (Tn2)	To collect information about their progress in the use of ICT in teaching: - Changes in the amount of usage; - Change in ways of usage; - Their reasons for any change of practice and their comments. - Their views and attitudes towards the use of ICT for teaching and learning.	All done in Cantonese and were recorded.
July 07	Questionnaire 5 (S5a,b) for F.1-5 students; Questionnaire 2 (S2a,b) for F.3 students ; Questionnaire 3 (S3a,b) for F.4 & F.5		To collect information about - Ss' views on using ICT for learning - Ss' ICT usage at school for school work, outside school for school work and for other purposes - Ss' way of using ICT	- Questionnaires were in Chinese; - Students answered the questionnaires in lessons.
July to Aug 07	Teacher Survey 3 (TY3) - 20 respondents (anonymous)		To collect information about any change in practice or perceptions: - Amount of ICT usage in teaching; - Ways of usage; - Change(s) they perceived; - Reasons for changes / no change in practice; - Order of importance of the reasons given.	- Similar to Teacher Survey 2; - Done online with names anonymous;

Tables 6-2 (a), (b) and (c) show the quantitative and qualitative data collected in each of the three phases in chronological order with brief descriptions of their purposes. Collection of school self-evaluation data and ESR report were not in the data collection plan but emerged during the research period. The online teachers' survey was also the result of the setting up of the school Intranet eClass in the beginning of Phase 2, otherwise, the teacher surveys had to be given out in hardcopy. All of the data collected are put in the Appendices for reference and their labels used are put inside brackets in the tables. The analysis of these data will be reported according to the three phases respectively in chapters 7, 8 and 9. A cross-phase analysis of the three will be given in Chapter 10.

CHAPTER 7 Analysis of Phase 1 Data

7.1. Introduction

Phase 1 of the study was designed as a pilot study. Data collected in this phase, mainly from May 2003 to August 2005, included the school documents, a Form 1 student questionnaire and a teacher questionnaire. Table 6-2(a) on page 155 gives a summary of the data collected with the aims and purposes for collection. In this chapter, the data collected in Phase 1 will be reported and analysed. The results will be represented in an activity system. The analysis of data will be guided by the framework suggested by Activity Theory as described in Chapter 3 in order to portray the situation of ICT usage in teaching and learning of the school in this phase.

7.2. Data collected for Phase 1

Phase 1 of the study was the period when the school piloted the use of ICT in teaching English with the software packages installed in the computer room and the MMLC. During this period, ICT in education was not yet very popular but was rapidly developing in Hong Kong schools. There were big changes in infrastructure, hardware and software provision as well as supports given to teachers and schools. These changes were brought forward by the joint efforts of the government, tertiary and educational institutions, private sectors, the school management boards and not the least, the school principals.

According to the data collection plan, a questionnaire was designed to collect from the Form 1 students their opinions on using computers in learning English in the MMLC or the Computer Room. In May 2003, the Student Questionnaire 1 (Appendices S1a, b & c) was given out to all Form 1 students. Another questionnaire with open-ended questions was given to the English Department head in July 2003 to collect her opinions about teachers' use of ICT in teaching and learning in the Form 1 English lessons. It should be noted that the department head was also an English teacher teaching Form 1 during this period. Before reporting the data collected in this phase, the key events that had happened during Phase 1 will be highlighted in order to provide background information about the changes in the focal school.

7.2.1. Key events in Phase 1

The key events that might have brought about changes and affected the development of ICT in education included the two ICT in Education initiatives declared by the Hong Kong government and the big improvements in infrastructure, hardware and software provisions and supports given resulting from the huge amount of investments that came with the initiatives. The school policies were also important factors affecting teachers' use of ICT in their teaching.

ICT in Education Initiatives by the Hong Kong Government

One of the major events that had brought about a breakthrough in the development of ICT in Education in Hong Kong was the introduction of the first 5-year IT in Education Strategy by the government that came with a large amount of public money for the hardware provision and connectivity. The accelerated improvement

in infrastructure and hardware laid the foundation for big leaps in the development of using ICT in teaching and learning. It set forth guidelines and provided opportunities for teachers to learn the skills and prepare themselves for the change in their teaching. It aimed to transform school education from a largely teacher-centred approach to a more interactive and student-centred approach. According to the evaluation report issued in 2005, all teachers reached at least the basic level of ICT competency and used ICT for at least 25% of their lessons and this first 5-year IT strategy was commented as ‘successful’ (EMB HKSAR, 2005).

The second ICT in Education Strategy was launched in 2004 after the evaluations of the first one and the consultations with different parties were carried out. The main theme of the second strategy was empowering teaching and learning with Information Technology. ICT focused on the further integration of ICT into the learning and teaching process. The strategy was a student-centred one and aimed to enhance community-wide support for a sustainable development of ICT in education (EMB HKSAR, 2004a). Improving ICT infrastructure and pioneering pedagogy using ICT were the strategies. Schools were required to write a 3-year plan in order to apply for a matching grant for the improvement of the ICT infrastructure from the government. They needed to get support from their communities, stakeholders, the businesses or any other organizations in order to get the grant from the government. This matching grant format was adopted so as to involve other parties of the society to contribute and show their support to education. At the same time, a number of professional groups formed from teachers and educators from tertiary institutions were set up to try out practices of using ICT in teaching and learning and give support to teachers. The Hong Kong

Education City (HKEdCity), Centre for ICT in Education (CITE) and Association of ICT Leaders in Education (AiTLE) were some of the examples.

Development of ICT in Education in the Focal School

As a result of the two ICT initiatives, the focal school had significant improvements in both its ICT infrastructure and its planning for implementing the use of ICT in teaching and learning. The following is a summary from the review of government and school documents in Chapter 6.

Improvement in ICT Infrastructure and Hardware Provision

With the funding for the first and second initiatives, the school had great improvement in its ICT infrastructure, including the increase in the number of computers for both students and teachers throughout the years from 1998 to 2005, the establishment of networks in the school and broadband connection to the Internet early in the 2000, the setting up of a MMLC in 2000 and a wireless network in 2005. These initiatives all contributed to lay the foundation for using ICT for teaching and learning. With the donation from alumni, all classrooms were installed with LCD projectors to facilitate the use of ICT for teaching in classrooms in 2005. Other facilities such as network nodes installed in staffrooms and provision of a certain number of notebook computers for teachers' use in the late nineties prepared teachers for the implementation of use of ICT in teaching.

School Policies for ICT in Education

In the focal school, the use of ICT in teaching and learning of subjects other than Computer Studies started in the late nineties. The school set up plans to pilot the use of ICT for junior form English lessons as soon as the MMLC was set up in early 2000. As required by the government, the school provided school-based training to teachers and organised sharing sessions for teachers to demonstrate the usage of ICT for lessons. They were also given opportunities to attend training organised by the government and other tertiary institutions. There were also training sessions for the use of the Computer Assisted Learning (CAL) packages given by software developers. Not only the skills in using the software, but the pedagogies of using it were also emphasized.

In line with the government policies, the school put the use of ICT in teaching and learning one of its major concerns and required all subject panel heads to include its usage for not less than 25% of the lessons for their subjects. The school also recruited an ICT support staff with the government funding, appointed a teacher to be ICT coordinator and set up an ICT team to plan for the development of ICT usage. Although teachers did not have their own notebook computer, they could borrow notebooks and LCD projectors from the school for use in lessons. A support staff could help install them in the classrooms. However, only some teachers used computers for teaching in the laboratories and a few used notebook computers in classrooms occasionally.

Other Events

A key issue affecting the development of using ICT in education was the outbreak of SARS in Hong Kong in March 2003 during which time schools were suspended for a number of weeks. It speeded up the development of e-platforms for teaching and learning. Both the government and schools found it a possible solution for continuing teaching and learning through the e-platforms during the suspension of schools. The focal school had also subscribed the use of an Intranet system and given all teachers and students an account for using it. However, the system was not well received by the school and was not actually used as much as it was desired.

Another important event for the focal school was the change of principalship by the end of Phase 1, that is, the end of the school year 2004-2005. The leadership style as well as the belief and attitude of Principal B towards the use of ICT in teaching and learning marked a period of change in Phase 2.

7.2.2. Results of the Questionnaire given to Form 1 Students

In the early 2000's, Form 1 students were assigned to different classes according to their results in the pre-S1 attainment tests. The top 40 were assigned to 1R, the next 80 were assigned to 1W and 1B according to their results in English with those who scored higher put in 1W and the rest in 1B. The remaining 40 students were then put in 1G. Students in 1R and 1W were mixed together and then divided into three groups, A, B and C, for English lessons according to their English results in the pre-S1 attainment test. Similarly, students in the other two classes were also divided into three groups, D,

E and F, according to their results in English. As a result, group A consisted of about 30 students with better results in English, Group B and C followed in order. Students in Groups D, E and F belonged to the weaker half in terms of English results in the pre-S1 attainment test and they were arranged with group D having better results in English and Groups E and F followed in order.

Near the end of the second term in May 2003, a Student Questionnaire 1 (Appendices S1b) was given to the Form 1 students and the results were collected right after they had finished answering them. The questionnaire in Chinese, the translated version and the results were put in Appendix S1 (S1a, b & c). The following is a summary of the results.

There were 149 questionnaires returned from the students. Among them, 54% were boys and 46% were girls. Except three missing data, 99.3% of the students had computers at home. That is, only one said that he/she did not have a computer. The overall results showed that a little more than one third of the students said that they had lessons in the MMLC for more than 5 times throughout the year. 77% of the students commented that the number of lessons in the MMLC was insufficient. The majority (88%) of students expressed that they liked to have lessons in the MMLC. The major reasons given included 'freer environment' and 'more fun in learning'. Less than 20% students chose 'more effective' as a reason and only a few thought that they were 'closer to the teacher' in the MMLC. Respectively 38%, 29% and 23% students chose 'learn slower than before', 'less interaction with teachers/classmates' and 'waste of time and troublesome' as the disadvantages of lessons in the MMLC. Only a few students felt

that it was ‘boring’.

Figure 7-1 to Figure 7-8 show the results of the questionnaire and compare the opinions of the ‘Better English’ and ‘Weaker English’ groups. The total number of students in the three ‘Better English’ groups, A, B and C is 82 and that in the ‘Weaker English’ groups, D, E and F is 66, which is 15% fewer than the ‘Better English’ groups.

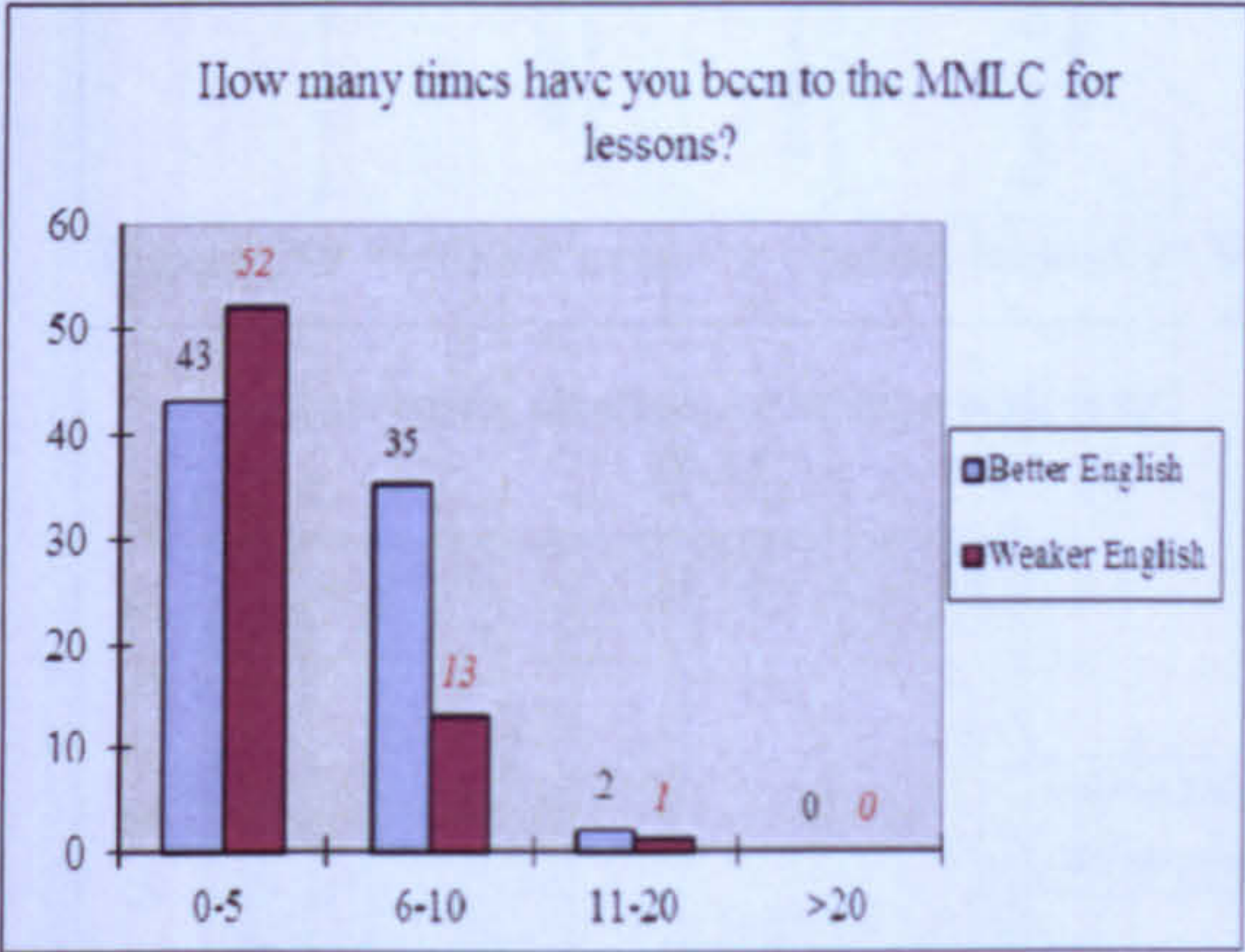


Figure 7-1 Number of lessons in the MMLC

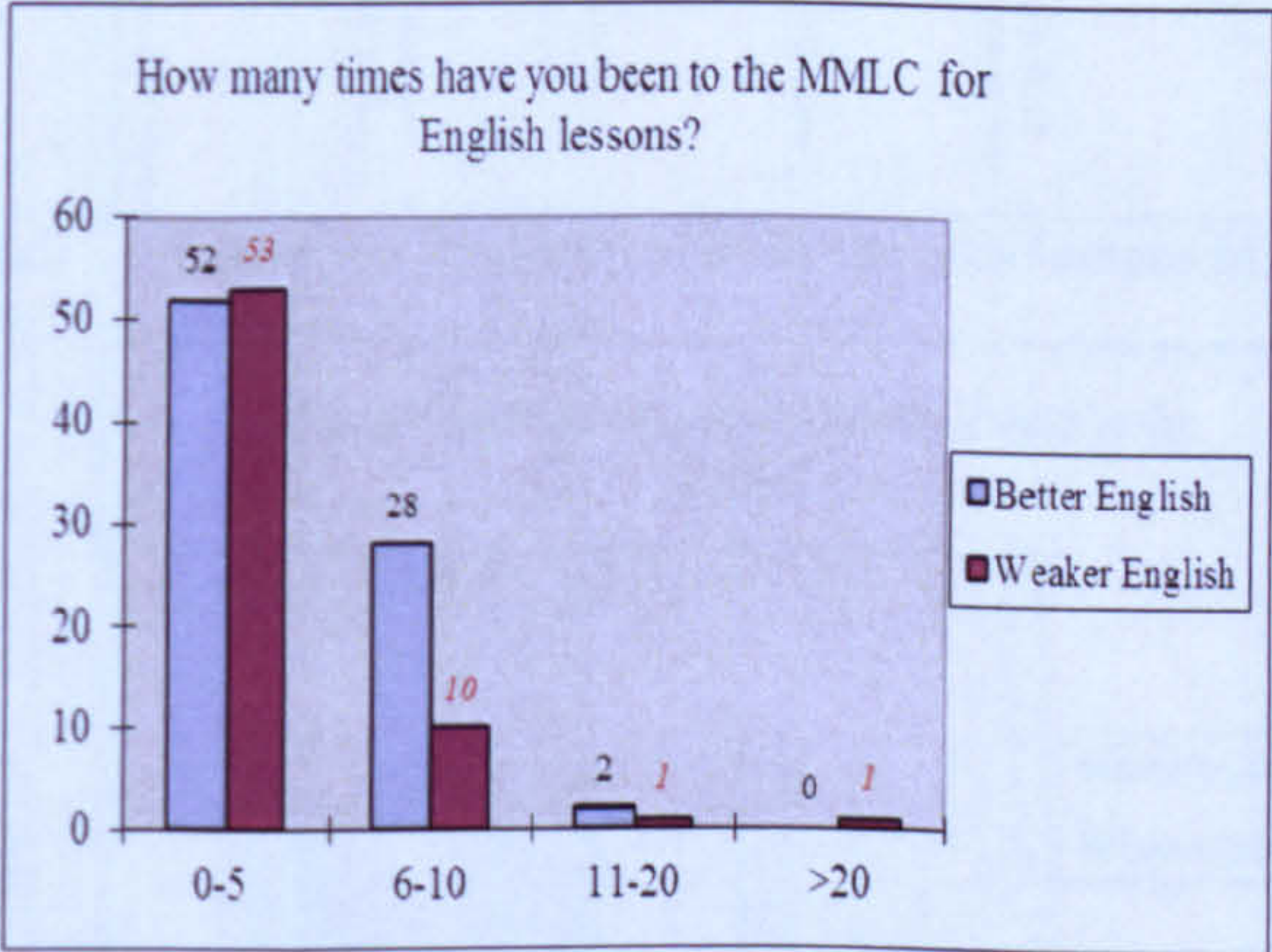


Figure 7-2 Number of English lessons in the MMLC

From Figure 7-1 and Figure 7-2, it can be seen that the ‘Better English’ groups had more lessons in the MMLC than the ‘Weaker English’ groups. More students in the ‘Better English’ groups than in the ‘Weaker English’ said that they had 6 to 10 lessons in the MMLC. The majority of students, 130 out of 149, thought that they did not have enough lessons in the MMLC. Figure 7-4 shows that 132 out of 149 expressed that they liked to have lessons in the MMLC.

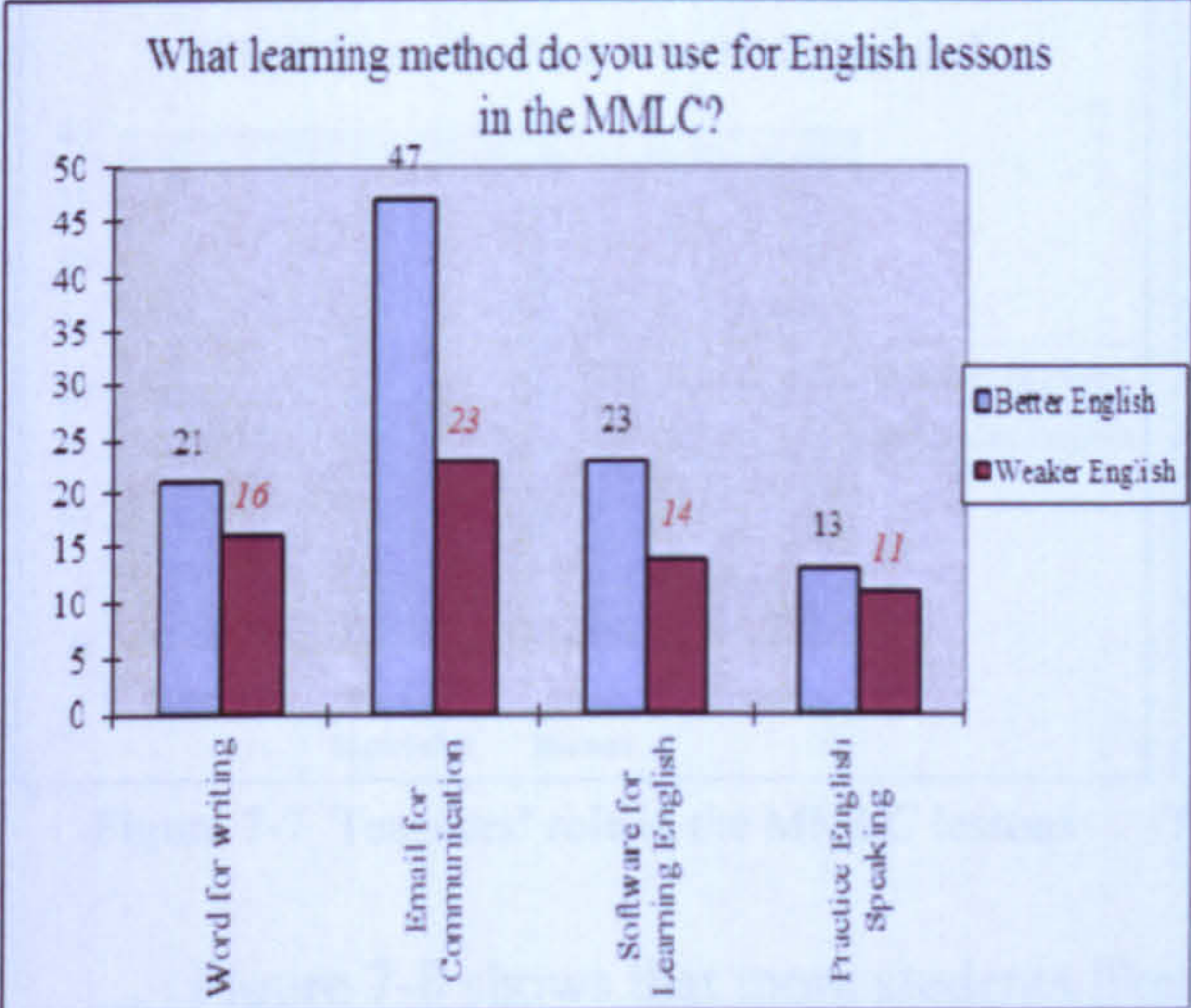


Figure 7-3 Methods used for English lessons in MMLC

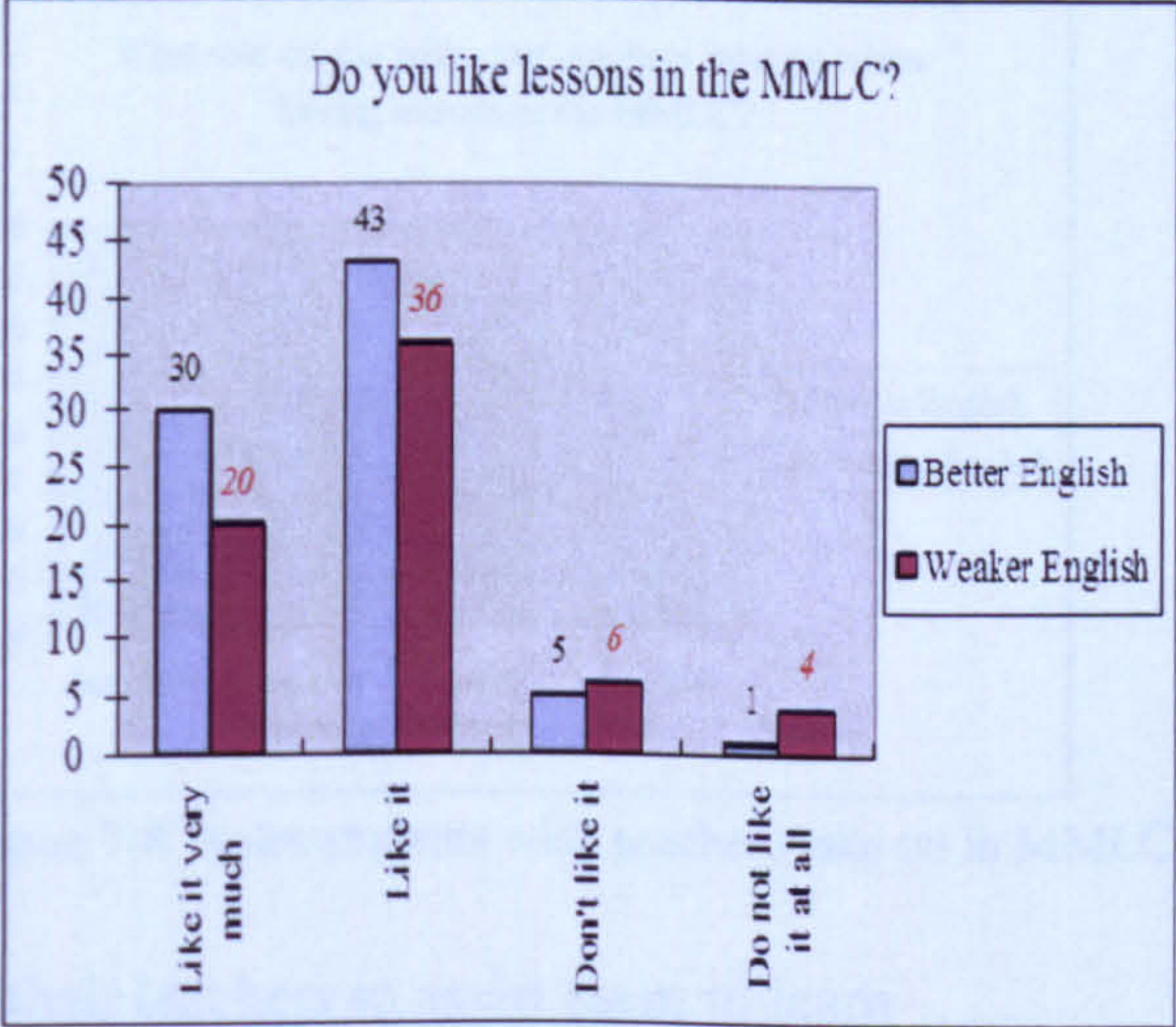


Figure 7-4 Students' attitude towards lessons in MMLC

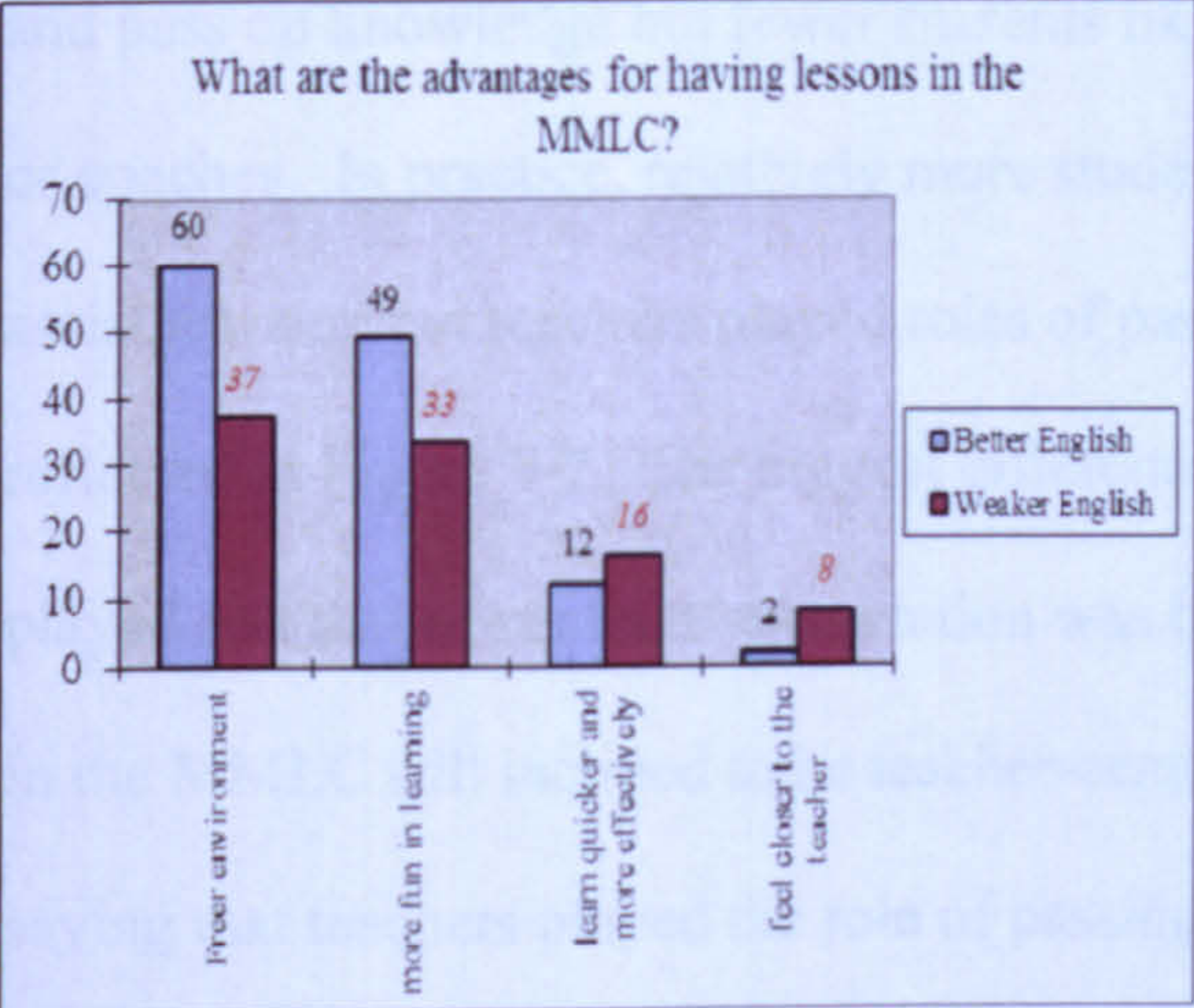


Figure 7-5 Advantages of having lessons in MMLC

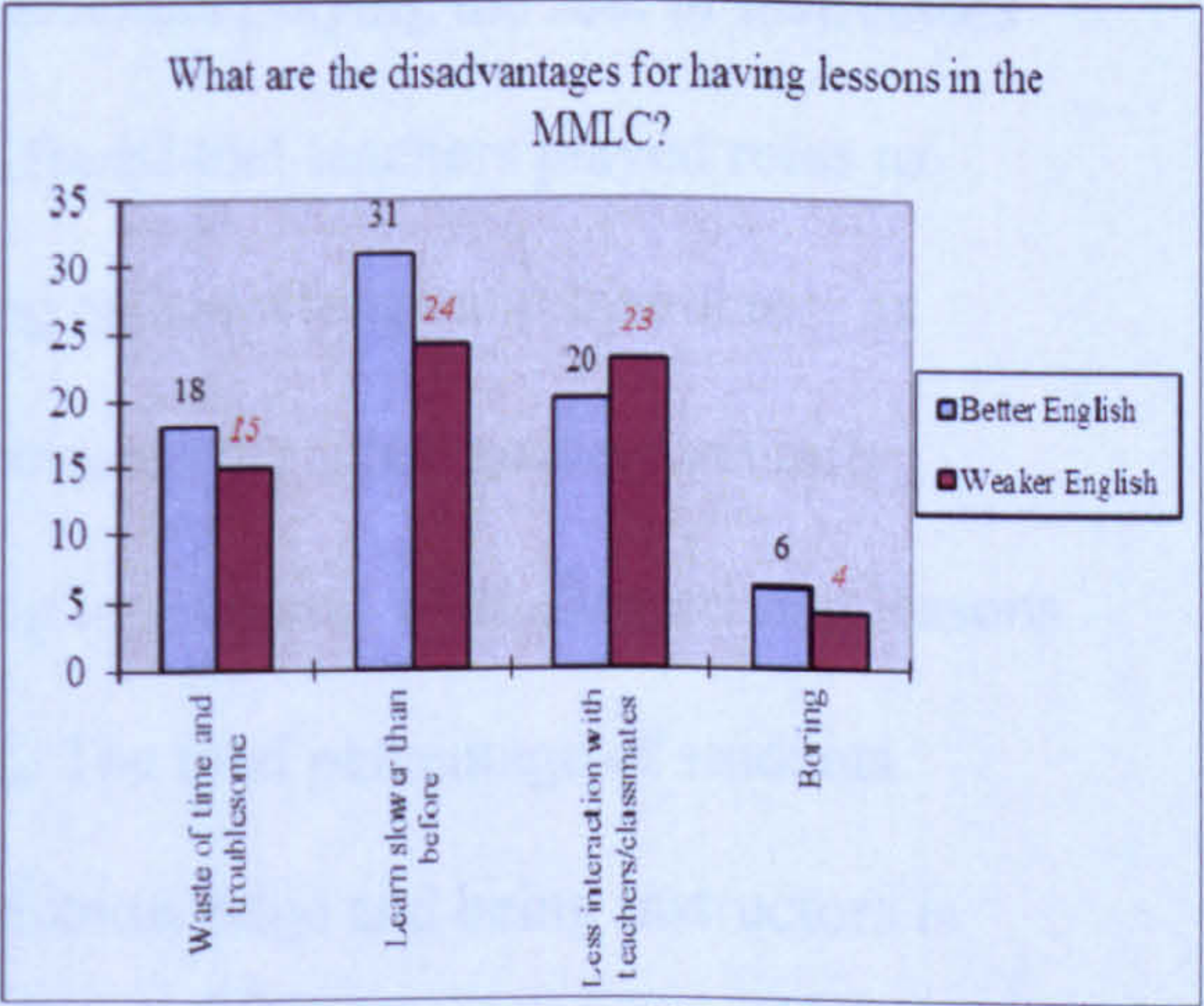


Figure 7-6 Disadvantages of having lessons in MMLC

Figure 7-5 and Figure 7-6 show that most students felt that ‘freer environment’ and ‘more fun in learning’ are the advantages of having lessons in the MMLC but many of them found that they ‘learned slower than before’ and ‘had less interaction with teachers and classmates’. About one quarter of them thought that it was a ‘waste of time and troublesome’ to have lessons in the MMLC and a few of them felt it boring. Concerning the ways of usage, students expressed that they had used, in order of popularity of choice, e-mail for communications, word processor for writing and CAL for learning grammar during the English lessons in the MMLC.

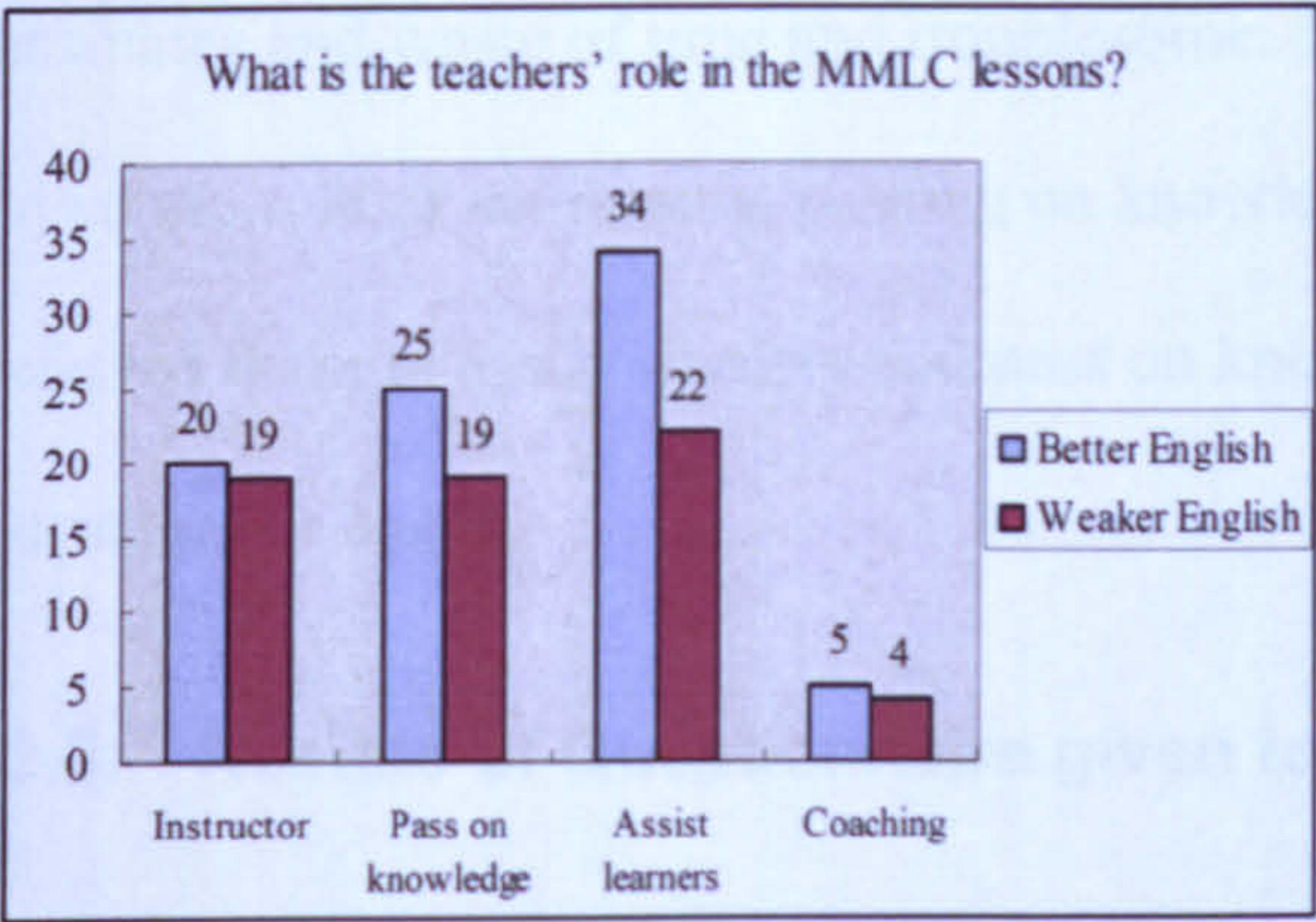


Figure 7-7 Teachers' role in the MMLC lessons

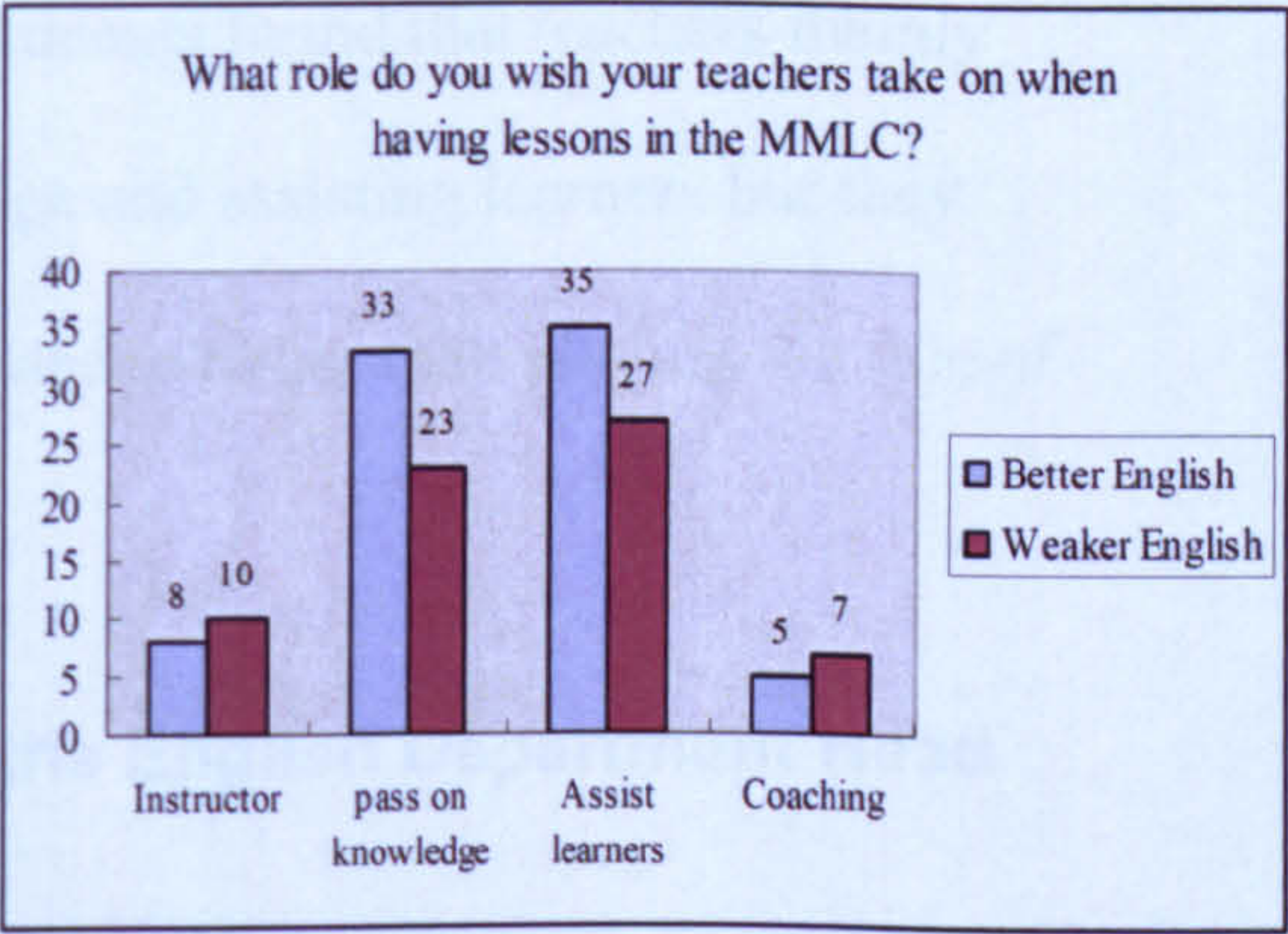


Figure 7-8 Roles students wish teachers take on in MMLC

Figure 7-8 shows that more students liked their teachers to assist them to learn and pass on knowledge but fewer students liked teachers playing the role of instructors or coaches. In practice, relatively more students found that teachers played roles to assist learners but teachers played roles of passing on knowledge and instructors as reflected in Figure 7-7. The biggest difference between the roles teachers actually played and that of students' expectation was being instructors. Data showed that lessons in the MMLC still inclined to be teacher-centred. The total percentage of students saying that teachers played the role of passing on knowledge and being instructors is higher than that of assisting learners and coaching students. Almost equal percentages of students expressed the wish that teachers should assist learners and pass on knowledge.

Overall, students pointed out that they had fewer than 10 lessons in the MMLC throughout the year and those were mainly English lessons. A large proportion of students expressed that they liked or very much liked to have lessons there. The advantages were mainly more fun in learning and freer environment. However, there were also disadvantages such as they learn slower, less interaction with teachers or

classmates and waste of time and troublesome. Students found that teachers mainly played the role of instructors, passing on knowledge and assisting learners but they preferred them to assist learners and pass on knowledge rather than playing the role of instructors or coach.

7.2.3. Results of Questionnaire given to the English Department Head

A questionnaire with open-ended questions was given to the English Department head who was also a Form 1 English teacher to collect her opinions on lessons in the MMLC. A record of the questions and answers was given in the Appendix TQ1 and the results are summarised in the following.

Firstly, the teacher reported that she used the MMLC as assigned but the use was limited to 6 to 10 times in the school year due to the outbreak of SARS in Hong Kong and suspension of the school for a few weeks. The ways computers were used include ‘using word processors for writing’, ‘emails for communications’, ‘Dynamic English (CAL program) for Grammar’ and ‘Searching for information on the Internet’.

Secondly, she observed that students became ‘active’ in using their computers and the teacher became relatively ‘passive’ in those lessons. In the conventional classrooms, the teacher played a ‘stronger’ and ‘more explicit’ role as an instructor, a coach and a facilitator than that they played in the MMLC. In the MMLC, she became ‘passive’ since students would not listen to her instructions once they started working on computers. She therefore had to explain in details for all the steps of operating the computer and playing the software to the students before they started doing anything.

The teacher pointed out the advantages that the use of ICT was good for motivating students, catering for individual differences and providing rich resources for obtaining information. She also agreed that computers could help and facilitate learning. The disadvantages she expressed include technical problems, teachers' confidence in using the equipment and difficulties in monitoring and managing students. The teacher emphasized the need of ICT training for teachers and technical support during lessons since teachers might encounter technical problems while using computers in classrooms.

7.3. Activity System 1 (AS₁): The Focal School at Phase 1

In order to represent the school as an activity system focusing on its development for using ICT in teaching and learning, the aims of analysing the data are to identify the components of it and locate the factors that facilitate and those that inhibit the development. Therefore, when the results are reported in the above section, the terms that teachers and students used to describe the facts and situations as well as the advantages and disadvantages they perceived are noted. These terms will be used for the description of the activity system in the analysis of data. Discussions will also take into consideration the influence of the wider context which included the school community, the Hong Kong educational system, the Hong Kong government and the neighbourhood cities. Data from the government and school documents will be used.

7.3.1. The School Context at Phase 1 of the Study

A summary of the situation of the school from the review of government and school documents in the previous section helps to describe the school context at Phase 1 of this study.

Hong Kong Education System

The Hong Kong Government first launched the Digital 21 Strategy in 1998 (ITBB HKSAR, 1998) and updated it in 2001 and 2004 (ITBB HKSAR, 2004), showing its determination in keeping Hong Kong in the forefront of information and communications technology (ICT) development. Reports in the 2005 Hong Kong year book (HKSARG) also recognized the great strides made in the adoption of ICT by the whole community with the right environment, infrastructure, skills and culture in place.

The first and second ICT initiatives declared in 1998 and 2004 respectively (EMB HKSAR, 1998 & 2004a) together with the huge sum of money invested were examples demonstrating its commitment to the strategy and its belief in the important role of ICT in education. This education reform targets at transforming teaching and learning from largely teacher-centred to student-centred and developing the generic skills of students to prepare them for life-long learning. In the curriculum reform documents, 'IT for Interactive Learning' was considered as one of the Four Key Tasks to achieve and 'IT skills' as one of the nine generic skills to acquire through education (CDC HKSAR, 2001).

The policy of the government and its strategies to implement it made up the rules and its investigation in the infrastructure, provision of hardware and software, trainings and supports given to teachers played important roles in laying the foundations and enabling schools to adopt the educational changes. The outbreak of SARS in 2003 had speeded up the development of using ICT in teaching and learning through the use of e-learning platforms.

Situation of the School

The school gradually built up an IT-rich environment with government funds and donations from alumni in Phase 1. The standard of ICT provision was a little higher than the basic level. The government requirements were satisfied with all teachers reaching certain levels of ICT competencies. In addition to this, the focal school set up its' own ICT policies. By the end of the school year 2004-05, all teachers reached the ICT Intermediate (comfortable) Competency Level (Appendix D4). All subject departments planned for more than 25% of their lessons using ICT. Teaching in the MMLC with CALL programs was piloted in junior form English lessons.

From the data collected, more than 95% of the Form 1 students had computers at home and almost all of them had access to the Internet (Appendix S1c). Computer courses were offered to all levels as a subject. All students in Forms 1 to 3 had computer lessons per week while one quarter of students from Form 4 and Form 5 could opt for Computer Studies as an elective. Form 6 and Form 7 students could also opt for Computer Applications as a subject. That is, all students had some knowledge and skills

in using IT. However, from the observations, not many teachers used ICT in their teaching except those junior form English teachers.

7.3.2. Description of the Components of Activity System 1

It has been stated in Chapter 3 that the activity to be studied is teachers using ICT for teaching. The focal school in Phase 1 will be represented in an activity system, AS₁, with reference to Figure 6-1 as a guide. The components of the activity system and the interactions between them will be identified by analysing the data collected mainly in this phase and the document analysis in Chapter 6. An outline of Activity System 1 is given in Figure 7-9. Detailed descriptions of the components and explanations will be given below.

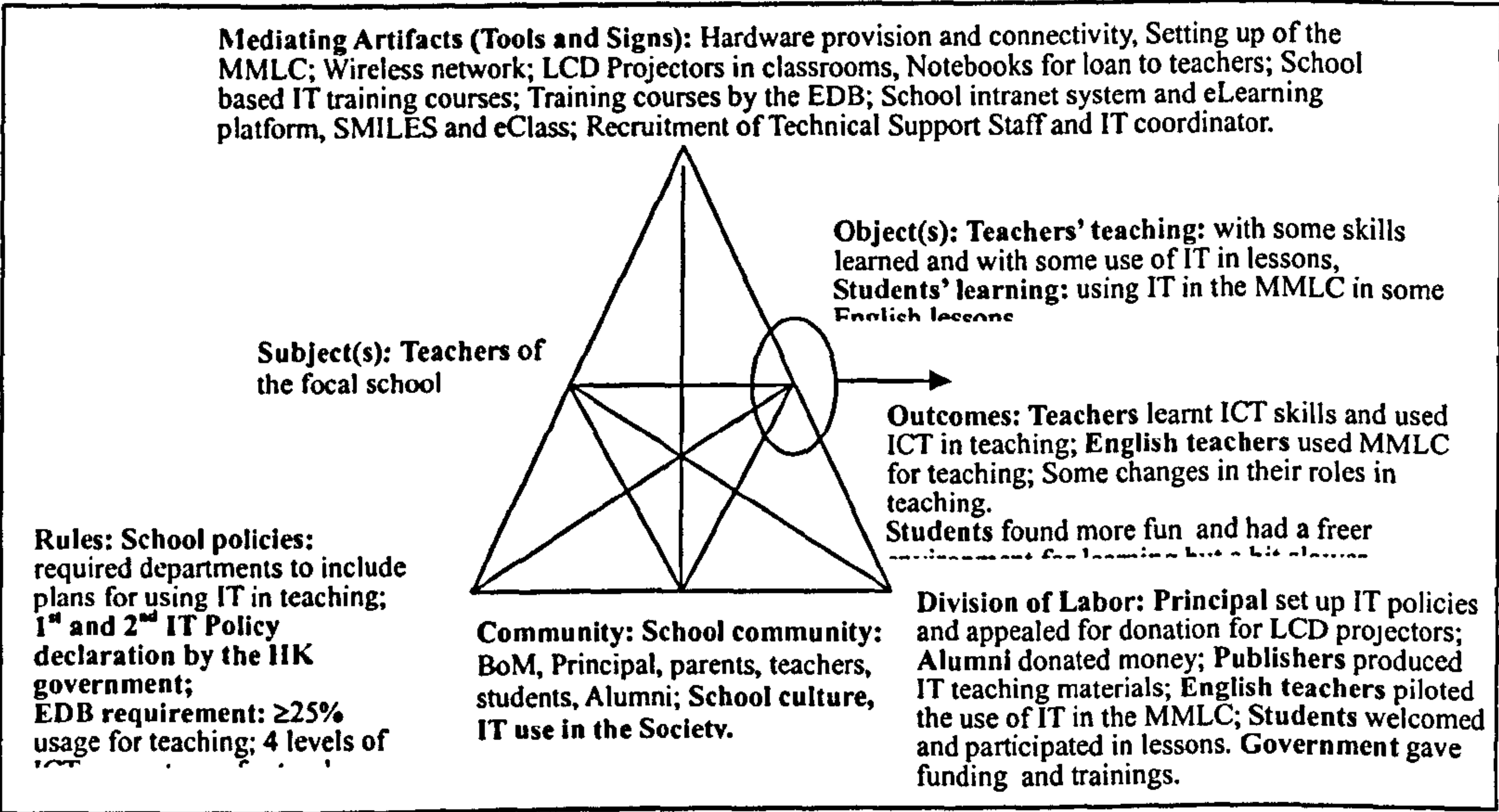


Figure 7-9: Activity System 1 (AS₁) - the school at Phase 1 of the study

Subject, Object and Outcome

The subjects of the activity system are the teachers. The object is teachers' teaching and students' learning using ICT. The expected outcome of the activity is improved efficiency and effectiveness of teaching and learning when ICT is used. From the data collected from the student questionnaire and that from the English department head, the outcome of using ICT in teaching and learning included more fun in learning, freer environment for learning, more motivated to learn, catered for learner diversity and more resources for learning.

Mediating Tools

In Phase 1, hardware, software and support are the major mediating tools for the development of the system. From the government and school documents, it can be seen that the ICT infrastructure, provision of hardware and software to the focal school had a big leap forward during this phase as the result of the launch of two ICT in education strategies. The setting up of the school-wide network and the MMLC are factors enabling the school to pilot the use of ICT in teaching English in junior forms. The procurement of the software package, Dynamic English, for teaching and learning English in the MMLC, the training given to the English teachers by the publisher and the school policy of allocating English lessons in the MMLC are the key factors that initiated the change to use more ICT in teaching. The availability of notebook computers for loan, the LCD projectors donated by alumni installed in all classrooms, the wired and wireless network are also factors that made it possible for teachers to use more ICT in classrooms though very few teachers actually used them in this period.

Government funding for hiring technical support staff and ICT coordinators was another facilitating support given to teachers for adopting the change. The eLearning platform had also given teachers and students some experiences of using ICT for teaching and learning during the period of school suspension though the usage was not really successful. Nevertheless, the concept of eLearning had been introduced to the school as a consequence and the school started to experiment on its usage.

Community

From the background information in Chapter 6, different parties in the society had played roles to enhance the development of ICT in education in Hong Kong. For instance, the universities and tertiary institutions offered staff development programs and training to both in-service teachers and student teachers. They played an important part in developing teachers' IT expertise and conducting research in ICT in education as well. The setting up of the Centre for IT in Education (CITE) at the University of Hong Kong is an example. Private sectors, such as the Microsoft Limited, played a leading role in sponsoring the development by launching the Partners in Learning program and lowering the price of software for schools.

Expectations and support of different stakeholders including the government, the school board, alumni, parents, teachers and students of the school all played important roles in creating an environment facilitating and supporting the change. A school culture which provided a safe and supportive environment for teachers to learn and try new pedagogies was also an important factor. The rules given by these stakeholders and the roles they played will be explained in the following sections.

Rules - Government and School Policies

The requirements given in the government and school policies played an important part to ‘mandate’ the changes in some ways. To fulfill the requirement of the 5-Year IT in Education Strategy, all teachers learnt the basic ICT skills and reached at least the basic ICT competency level before end of 2003. The focal school and its subject departments had drawn up plans for the usage of ICT in teaching in line with the specifications for funding by the government. A strategy of allocating double lessons per week in the MMLC timetable for junior form English lessons was used to implement the ICT in Education plan. Starting from the Form 1 English lessons, this policy was gradually extended to all Form 2 and Form 3 through the school years 2001 to 2003. Thus, both the government and the school head established rules for the development of the system.

Division of Labour

The principal’s influence and the government policies were the underlying causes that brought the mediating tools into being. The principal, Principal A, had taken up an active role in initiating and implementing the use of ICT in teaching and learning by setting up policies, writing plans to acquire the funding for the improvement of the ICT infrastructure and the hardware and software provision, appealing to the alumni for the donation of money and the school management board for using school funds for further improvement of the ICT environment of the school.

Throughout this period, teachers received training both inside and outside the

school and fulfilled the requirement of the government as stated in the first 5 year IT strategy. Subject heads put using ICT in teaching as one of the major concerns in their annual plans. The government granted money for the provision of hardware, software and support services for the implementation of its ICT in Education plans. The publishers and software house produced ICT materials to facilitate teaching using IT.

In response to the Digital 21 Strategy, the government and education sectors organised international conferences for sharing the practices of using ICT in education with competitive counter-parts like Singapore, Taiwan, Macau, Mainland China, Australia and the U.K. The government also organised visits to those areas for teachers, educators and government officials to learn from them.

Contradictions as driving force for the development

In Hong Kong, ICT development was fast but that of the focal school was comparatively slow. Expectations of parents, alumni, employers and the society as a whole made up an environment with urges for the change. The advanced development of these areas served as challenges and models for the development in Hong Kong. These thus created a driving force to speed up the development in order to keep up its competitive position in the world.

The rapid development and the widespread use of ICT for education in the 21st century created a need for the change in teaching and learning. In order to be competitive, the school had to improve and show its determination to use the advanced technology for providing better education to its students. Though it demanded a large

amount of efforts from teachers to attend training courses and create teaching and learning materials for their students, the fear of being left behind created impetus for the school to move forward. Besides meeting the requirements of the government, the school also set up policies and added on funding for the improvement of the infrastructure and facilities for teaching using IT. The provision of hardware and software of the focal school by that time was above the average when compared to her counter-parts in Hong Kong.

From the student questionnaires, it was found that the students liked using ICT in their learning though they did not find much improvement in the efficiency or effectiveness in learning. They wanted to have more varieties in learning. Although most teachers of the focal school did not have any experience of teaching and learning using ICT when they received their initial teacher-training, they did attend training courses and attempted to use ICT in their new role. Teachers encountered with the changing world and students' increased experience of using ICT in their daily life. Hence, they had the urge to change their old ways of teaching and put efforts in using the new methods of teaching even though there were limitations in their own IT expertise and difficulties in their try-outs.

As reported by the English teacher who answered the open-ended questionnaire, teachers encountered technical problems when they used ICT in classrooms. Teachers lacked the confidence in using the equipment which they were not familiar with. The computer network was not quite stable at that time. Therefore they needed on-site technical support and further training in using the equipment. In addition, time constraint was another issue. They lacked time to set up the equipment and prepare

the materials. The MMLC was already fully utilised for junior form English lessons, so it would not be available to allow teachers use the facility and to familiarise themselves with how to use the equipment.

As observed by the researcher, only a few teachers used ICT in their classrooms. However, both teachers and students reported that teachers played different roles when they had lessons in the MMLC where students had the opportunity of working on their own on individual computers. The Computer Assisted Learning package did provide them with individual feedback and allowed them to work in their own pace. Since teachers were still in their early stage of using IT, there was much to improve in effectiveness and efficiency. Also, the outbreak of the SARS problem in Hong Kong was another obstacle for the progress since the school had to be suspended for some time in the middle of the second term which reduced the number of lessons in the MMLC.

7.4. Summary of Phase 1 Study

In this chapter, the data collected were reported and analysed under the framework of the activity system as described in Figure 6-1. The results are represented 2-dimensionally as Activity System 1. The components of the system are identified from the analysis of the data collected in this phase and the review of documents in Chapter 6.

In Phase 1, student questionnaires were given out by the end of the school year 2002-03 for collecting students' opinions on lessons in the MMLC and a

questionnaire was given to the English department head for her comments. Data on teachers' way of using ICT in teaching was supplemented by observation of a lesson using ICT by the researcher.

Results from the student questionnaire showed that students had only a few lessons in the MMCL throughout the year. Students found both advantages and disadvantages of using ICT in learning. They also voiced out their wish to use ICT in learning during which they expected to have more varieties and fun. From the answers given by the English department head, it was found that teachers requested different kinds of support for using ICT in teaching. They needed more training, on-site technical support and time for preparing teaching and learning materials. The advantage of using ICT in lessons included motivating students, catering for learner differences and richer resources for collecting information.

In the second part, the development of using ICT in teaching and learning in the focal school in Phase 1 is represented as Activity System 1. The situation of usage of ICT in education in areas around Hong Kong had strong impact on the government which then invested money and set up policies for it. This influence of the wider context of the community created contradictions that drove the growth of the system. The basic infrastructure and connectivity, provision of hardware and software, the recruitment of ICT coordinators and technical support staff supported by the funding from the first 5-Year ICT Strategy of the government launched in 1998 are considered the mediating tools of the system. The government policies, with example of the requirements stipulated in the first ICT in Education strategy, and school policies are

represented as the rules in the activity system.

In the focal school, the setup of the MMLC in 2000 and the piloting of English lessons using a software package were considered key issues mediating the change. The donation from the alumni to install projectors in all classrooms was another key issue influencing the change. The MMLC, LCD projectors and the notebook computers for loan to teachers were mediating tools in this phase. The roles played by the government, the school and the alumni in bringing these tools to existence and the roles played by the teachers in using them were also identified. Students' responses to the new practice also had an important part to play in the development.

The contradictions from both inside and outside the school created forces for the development. Principal A and the ICT team of the school had initiated the ICT usage in teaching and learning and teachers started to follow the practice. However, the development was rather slow in this phase. After all, teachers did learn some skills in using ICT in their teaching and start using it though only in limited number of lessons and with limited scope of usage. Students had some experiences of using ICT in learning besides using ICT for entertainment and communications with their friends as reported in the questionnaires. The outcome of this phase was a breakthrough in teaching and learning using IT. Both teachers and students had been involved in this educational change. Although there might not have been much improvement in efficiency and effectiveness of teaching and learning, both teachers and students found it worth in trying, and they had some expectations for further improvement.

CHAPTER 8 Analysis of Phase 2 Data

8.1. Introduction

During the period of the Phase 2 study, there were not many policy changes introduced by the government. The Second IT in Education Strategy was launched just before this phase in 2004 and the focal school had also begun implementing the policies. However, there were significant changes in the school during this period. Change of principal was one of it.

According to the design of data collection, core data for studying the change process of teachers were collected in Phase 2 and Phase 3. Both quantitative and qualitative data were collected from teachers and students. In this chapter, data collected in Phase 2 will be reported and analysed with the framework suggested by the Activity Theory. The key events that might have affected the development of ICT in education during this period will be reported and referenced as the background information for changes in this phase. Similar to Phase 1 of this study, the situation of the use of ICT in this phase will be analysed and represented in Activity System 2.

8.2. Data collected for Phase 2

The key events that happened in the school and the development of ICT in education in Hong Kong or over the world during this period all have some impacts on teachers' change in the focal school. Therefore, before analysing the data collected in this phase, a study of the government and school policy documents, circulars and

reports concerning ICT in education is carried out and a summary of the findings will be given.

In Phase 2, online surveys were designed to collect teachers' situation of usage of ICT in their teaching and their views on it. Written comments on the provision of ICT equipment and support for teaching with IT, as well as teachers' comments on the use of ICT were collected on a school self-evaluation (SSE) day early in 2006. It is worth noting that this was not in the original plan drafted at the beginning of this research. However, the researcher saw the SSE as an opportunity to collect data that would help to understand the situation and the process of change. Besides, six teachers were selected according to the data collection plan and invited for interviews. Details of the reports and analysis will be given in the following sections.

8.2.1. Key Events in Phase 2

During the school year 2005/06, that is Phase 2 of the study, the school experienced important changes due to the change of principal and the implementation of the ICT improvement plan initiated and supported by the government funds. At the same time, a new building of the school came into operation on the first day of the school year. The change of principal brought about new school policies. The External School Review (ESR) towards the end of the school year was also an opportunity for the school to review on the quality and effectiveness of education provided and to receive feedback from external inspectors for the improvement of the school.

Improvement of the ICT infrastructure of the school

It has been mentioned in the previous chapter that, the focal school was required to draft its ICT plan and get funding in order to apply for the matching grant from the government for the improvement of the ICT infrastructure. The plan submitted by the focal school was approved by the government in the school year 2004/05 and the project was to be completed by the end of the school year 2007/08. An amount of about HK\$ 3,000,000 (~£ 230,000) was granted to the school for upgrading the computers, installation of a wireless system, setting up of an eLearning platform and training for parents for using ICT in learning (Appendix D6). According to the plan, the school upgraded the computer systems and set up a wireless network system to cover the whole school campus and this first stage was completed near the end of the school year 2004/05. At the start of the school year 2005/06, the school subscribed to the service of another eLearning platform, eClass.

Change of principal

Principal A, who had been working in the school for more than 10 years, resigned and Principal B joined the school in September 2005. Principal B was an experienced teacher who had worked in a few other schools prior to this new post. With her experience from other schools using ICT, she had a strong belief that ICT could be a useful tool in making teaching and learning more effective and could even improve external examination results. She initiated a number of changes in the school and requested the school management board to allocate school funding to improve the ICT

environment of the school. Provision of notebook computers to all teaching staff was one of the outcomes.

Provision of notebook computers to all teachers

With her firm belief that the use of ICT in teaching could make vigorous changes, Principal B successfully persuaded the School Management Board to allocate more than HK\$ 250,000 (~£ 21,000) for the purchase of notebook computers for all the 50 teaching staff (Appendix D4). Soon in November, 2005, each teacher was provided with a notebook computer. The aim was to encourage teachers to use ICT for teaching and learning. A number of school policies were set up accordingly.

School policies on the use of ICT for teaching and administrative work

School based ICT policies were announced by the principal after the provision of notebook computers in November. First, teachers were required to log on the school Intranet, eClass, to check for school notices every day. The urgent and important notices would be posted on it instead of hardcopies (Appendix D10). Second, Principal B requested teachers to prepare using the online platform for teaching and learning in case schools had to be suspended due to some very special incidents, such as the World Trade (WTO) Conference or outbreak of bird flu like the outbreak of SARS in 2003. Third, the school asked each subject committee to appoint a teacher to be an ‘IT Seed Teacher’ to report their situation of ICT usage, reflect their needs and explore ways of usage across subjects. Fourth, peer lesson observations with the main focus on either using ICT or reading for teaching was held in the second term of the same school year.

To familiarize teachers to the use of notebook computers, they were sometimes required to bring along their notebooks to meetings and staff development sessions (Appendix D10). In February, the school built in school SSE days for teachers and students to review on the school policies. ICT in Education was one of the areas for evaluation. Teachers and students were invited to give comments on the ICT infrastructure, ICT facilities provided and the ways teachers and students used ICT in teaching and learning. The results will be reported and analysed in the following sections. The researcher was at an advantageous position so that she could make use of this source of data to get the feedback from both teachers and students.

External School Review

The External School Review (ESR) team of the EDB arranged to inspect the school in May 2006. The school had never been inspected in such a big scale before since this was in the first cycle of External School Review started in 2003. The school was informed of the review less than three months in advance. The ESR team was stationed at the school for a week to evaluate all aspects of the school through reading school documents, interviewing stakeholders, observing lessons, shadowing students and inspecting students' work and teachers' marking. A report was given to the school after the inspection and the school was required to draw up action plans for improvement. The use of ICT and the eLearning platform for teaching and learning was one area of concern in this cycle of evaluation. Comments from the ESR team on ICT in education of the school stated that the school had used ICT in Education to some extent but still needed to make more interactive use of it (Appendix D9).

8.2.2. Extent of Use of ICT for Teaching and Learning

The extent of use of ICT at the school would best be reflected in the school documents, teacher interviews, student questionnaires and observation of the researcher.

From the School Plans

In the School Plan 2005/06, 'Implement the use of ICT across curriculum' was one of the targets put under the heading 'Strengthen staff development'. In the School IT Plan 2005/06, it was mentioned that 'the school has decided to give the priority to ICT training in the development days for this school year'. 'Creative ICT and Science Education using high tech equipment' was one of the six school curriculum features for 2005 to 2010. The IT Development Plan for the year 2005/06 was in line with the 3 year plan of the school which aimed at developing an environment favourable to the use of ICT in teaching and learning.

ICT usage from the Minutes of IT Seed Teachers Meeting

The intention of the school to develop ICT in teaching and learning in different subjects could be found in its policy of appointing an 'IT Seed Teacher' from each department. The purposes were to promote the use of ICT for teaching and learning in different departments by exploring and developing ways of usage through collaborative efforts (Appendix D7). The first notice for the selection of IT Seed Teachers was issued in early December and the first meeting was held in mid-December of 2005. From the minutes of the first meeting with representatives from all departments, a snap shot of the

degree of adoption of ICT usage in teaching different subjects was taken. The following is a summary of the reports from the departments.

PowerPoint presentations offered by publishers or designed by teachers themselves were reported to have most commonly been used in lessons. The reports showed that some teachers had used the school Intranet for making announcements to students, some had used audio-visual materials such as films, animations or documentaries to attract students' interests in learning and stimulate students' thinking. Materials provided by the Hong Kong Education City, for example, the 'TV news' for the English learning and 'An Article Daily' for Chinese were also commonly used. Teachers in the Mathematics department were sharing software developed by teachers in other schools. Besides, departments were required to write action plans for promoting the use of ICT in teaching their subjects. They were also required to plan for peer lesson observations on the use of ICT in lessons from January to March in 2006.

A summary of the ICT usage in the seven departments as reported by the representatives is given below. Ways of using ICT were 'Software developed by other schools', 'DVDs to arouse the interest of students and stimulate students' thinking', 'Use of eClass', 'PowerPoint Presentation', 'eBooks or materials provided by publishers', 'Use of visualizers or WebCams', 'Handwriting board', 'Video recording' and 'Web-based materials' with 'PowerPoint Presentation' being the most popular mentioned by five out of the seven department representatives. The problems encountered when ICT was used reported by the seven representatives included 'Difficulties were found in searching useful teaching resources', 'Technical problems',

‘Seek help from the IT team’ and ‘Do not feel confident’ (Appendix D7).

From the Principal’s Report

In the principal’s report for the school year 2005/06 issued in October 2006, technology had played a part in student learning. In her report, it was mentioned that

“... the increased use of IT, providing more visual support in classroom teaching has facilitated understanding and enhanced interest. The access to teachers’ notes and resources in eClass has helped students’ learning (Students’ Self Evaluation)” (Appendix D8).

Principal B also pointed out that there was a significant improvement in academic results in external examinations and the use of ICT in teaching and learning was one of the contributing factors.

Report from the External School Review Team

The external School Review gave a report with the following points related to the use of ICT:

First, about the areas of concern: *“to improve IT infrastructure”*; Second, about facilities: *“full utilization, IT facilities – properly maintained; Interactive and self-learning through the e-platform”*; Third, about eClass: *“should develop towards a more interactive e-learning platform”*; Fourth, about ICT use: *“use PowerPoint to facilitate student learning”* (Appendix D9).

8.2.3. Written Comments Collected from Teachers on School Self-Evaluation Days

On the School Self-Evaluation day in February 2006, teachers were invited to freely give their comments in the four areas: school administration, academic policies, pastoral care and ICT in teaching and learning. All teachers were present in the school hall on that day and big boards with headings of the four areas were displayed. Teachers were encouraged to freely talk to the teachers in charge or post their comments on the boards under corresponding headings. These four areas were in fact the major concerns of the school for that year. Teachers in charge of those areas collected the data after the meeting for evaluation and planning.

Concerning ICT in teaching and learning, three questions were asked. First, their comments on the provision of notebook computers to all teachers; Second, the use of ICT in teaching; Third, their suggestions for the improvement of hardware and software. Teachers were free to give their comments and opinions and they did not have to write their names. As a result, 52 anonymous comments were collected from 39 teachers out of a total of 50. Most of the opinions expressed were related to teaching and learning and they were summarised in the following.

Nine of them were comments concerning the advantages of using ICT in teaching but another six of them stressed that teachers should be encouraged to use ICT and be given the freedom of choice of whether to use ICT or not. There were some comments saying that it should neither be compulsory for teachers to use ICT in their lessons nor be a requirement for judging the quality of a lesson. Some emphasized

that suitable amount of usage was good for students to learn but using ICT merely for the purpose of 'IT' was not desirable.

Technical problems were another issue over which teachers showed their concern. There were ten comments related to it such as unstable networks and computer system problems. The school Intranet, eClass, also received some comments on its stability and user friendliness. Five expressed the need of improvement of hardware provision. For the rest, five expressed the need of support including technical support and assistance for preparing teaching and learning materials using ICT. Six expressed their wishes to have all classrooms installed with computers connected to the school network so that they did not need to set up the notebooks when they use computers in lessons (Appendix TX1).

8.2.4. Surveys for broadly collecting views from Teachers

Two teacher surveys were given out in Phase 2, one in the middle and the other towards the end of the school year. The first one was administered two months after notebook computers were given to teachers and the school ICT policy was enforced. The purpose was to take a snap shot of teachers' usage, their concepts and attitudes of using ICT in teaching and learning right after the big change in the provision of ICT equipment and introduction of ICT policy. The second one was carried out near the end of Phase 2 which is a few months after the first. It was designed to track the changes in ICT usage for teaching and learning, if any. Questions set for both surveys were similar with only some questions added in the second one to see if teachers did have any

changes in their usage of ICT in teaching and learning and the reasons for changing or not changing their practice.

The surveys were given out to teachers on the school Intranet, eClass, with a message inviting teachers to answer the surveys. Teachers were informed that the survey results would be used for the research and they could choose whether to answer the questionnaire or not and the respondents were kept anonymous in the system. As mentioned in earlier chapters, the researcher was a senior teacher in charge of the ICT policies of the school, this method of administering the surveys was intended to free teachers from fear of any consequences. Teachers felt safe and relaxed in answering the questions though some teachers did not feel it necessary to answer the surveys so the responding rates were not high.

Report of the Two Teacher Surveys

The first survey was posted on the Intranet from December 2005 to January 2006 and the second one was posted from June to July 2006, that is, the middle and the end respectively of Phase 2. The number of respondents to the first survey was 26 out of 50 (52%) teaching staff and that for the second was 12 out of 50 (24%). One possible reason for the low respondent rate for the second survey might be that the first two surveys were so close together that teachers had overlooked the second one. Another possible reason was that the surveys were just posted up on the Intranet with an icon on the top right corner blinking to alert teachers to attempt voluntarily. Some teachers might not have been aware of it. There would also be some who did not like to answer similar surveys in such short period of time.

Table 8-1 Basic information about the two teacher surveys given out in Phase 2

Teacher Survey	Survey 1	Survey 2
End of Date for the Surveys	15/01/2006	31/07/2006
Total Number Received	26 out of 50 (50%)	12 out of 50 (24%)

Although Teacher Survey 2 received a relatively small number of respondents, the results are nevertheless worth reporting and a simple analysis of the data is given below.

Table 8-2 Percentages of teaching time using ICT from Survey 1 and Survey 2 (Phase 2 data)

Teacher Survey	Survey 1 (Jan-06)	Survey 2 (Jul-06)
Less than 10%	6 (23%)	1 (8%)
11%-30%	7 (27%)	3 (25%)
31%-50%	6 (23%)	1 (8%)
51%-70%	3 (12%)	3 (25%)
More than 70%	3 (12%)	4 (33%)

Table 8-3 Cumulative percentages of teaching time using ICT (Phase 2 data)

Teacher Survey	Survey 1 (Jan-06)	Survey 2 (Jul-06)
More than 10%	74%	91%
More than 30%	47%	66%
More than 50%	24%	58%
More than 70%	12%	33%

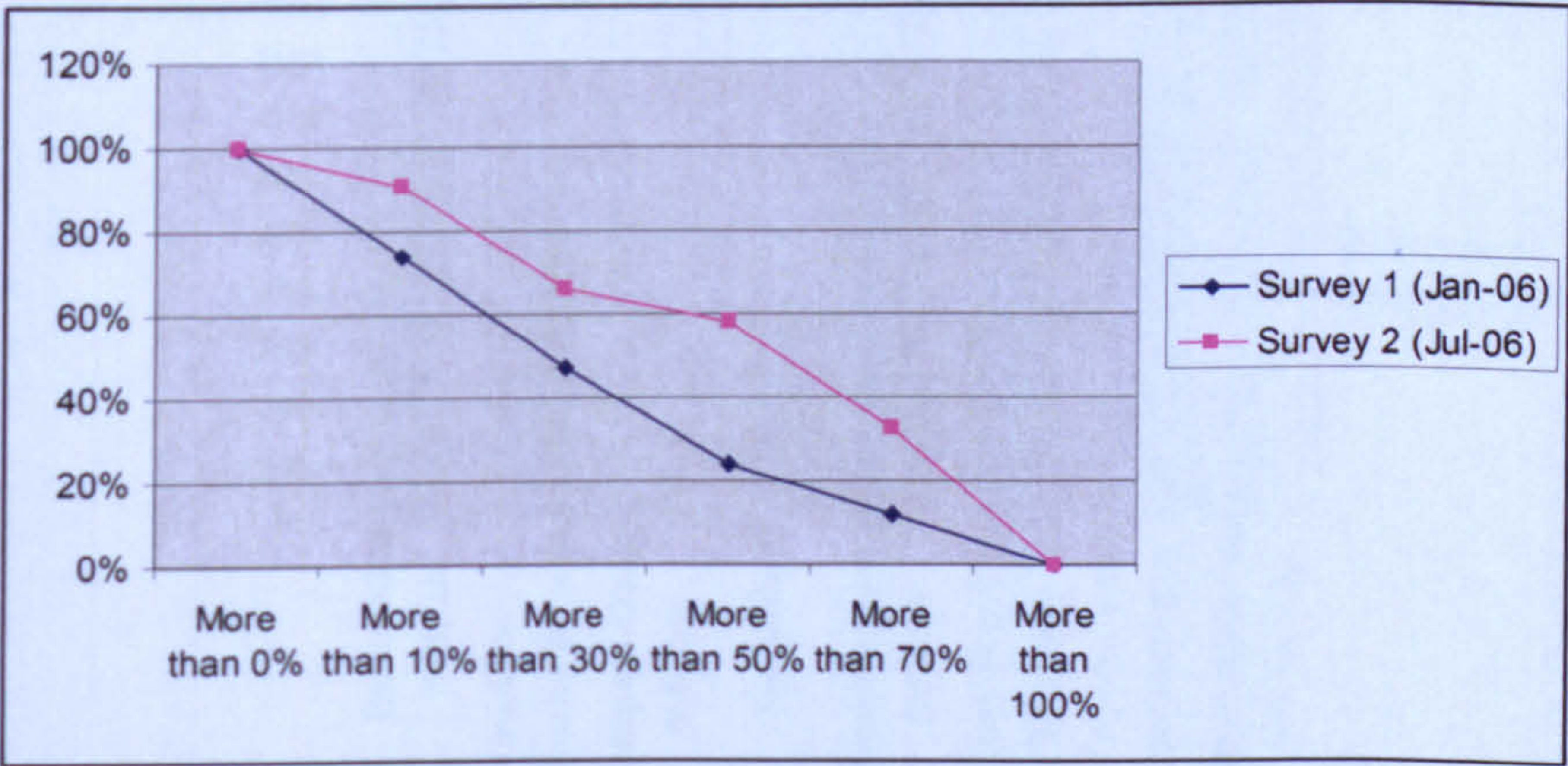


Figure 8-1 A graph to compare the cumulative percentages of teaching time using ICT (Phase 2)

From the graph in Figure 8-1, teachers had shown an increase in ICT usage for lessons in the second term of the school year 2005/06 with the biggest increase at the value 'more than 50%'. It is worth noting that the External School Review was

conducted in May 2006 and use ICT in teaching and learning was a key area for the review. The reasons for the increase of usage as collected from the surveys will be given in the following section.

Type of usage of ICT for teaching

In the surveys, teachers were asked about the type of software they had used for teaching. They were invited to express their frequency of usage by entering 0 to 3 with 0 representing ‘never’ and 3 for ‘all of the time’ with 1 and 2 in between. The number of respondents choosing 2 and 3 will be added up while those choosing 0 and 1 will not be counted. It is assumed that those who chose ‘1’ might have only incidentally used the software for one or two times and would better be excluded.

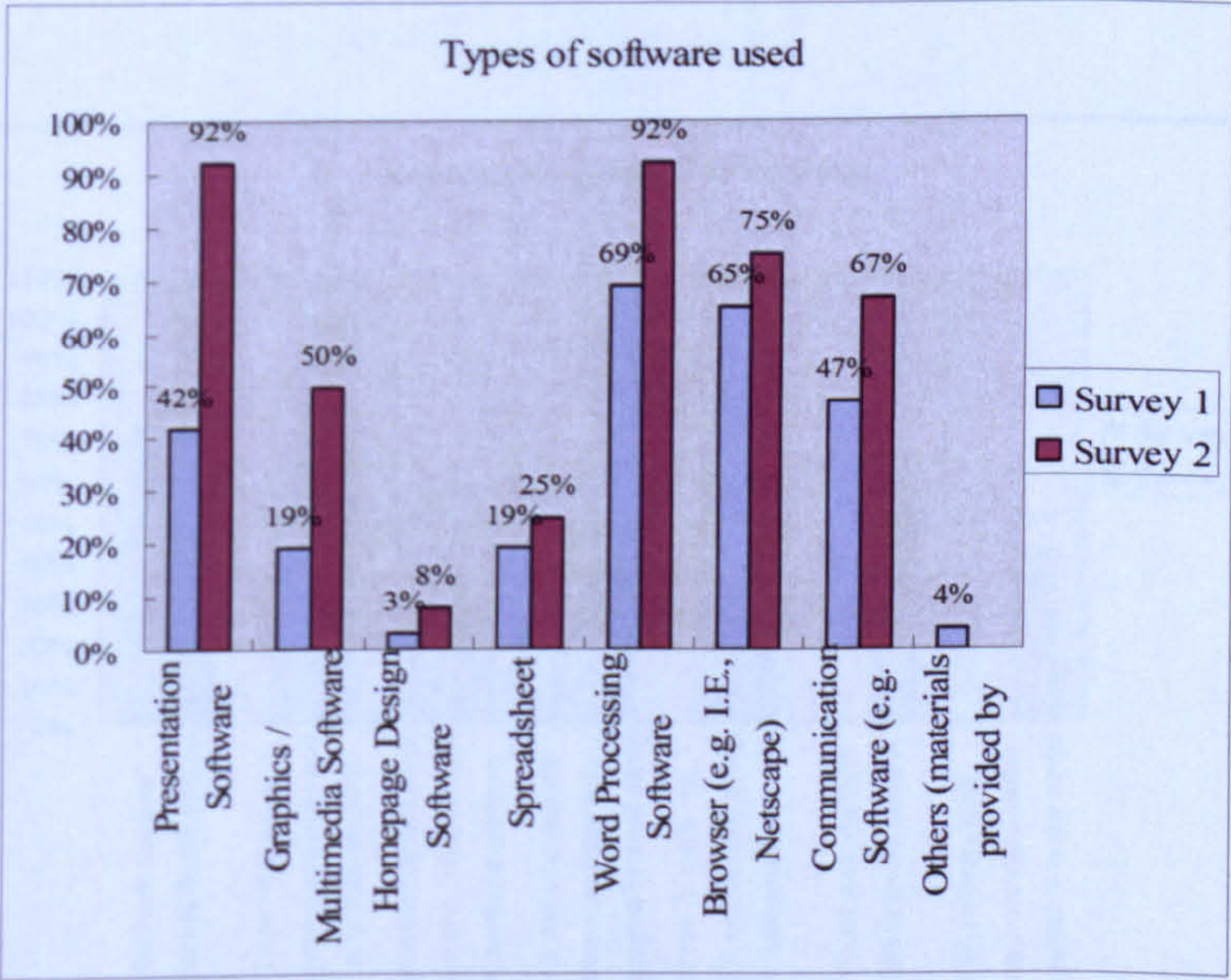


Figure 8-2 Types of software used by teachers (Phase 2)

Figure 8-2 shows that the most commonly used software for teaching is presentation software, e.g. PowerPoint, followed by word processor and they both

increased in Survey 2 with the percentage of usage approaching 100%. The significant increase of usage of Presentation Software in Survey 2 when compared with Survey 1 is worth further consideration. The requirement of lesson observation by senior teachers and mutual observation by peer teachers in the second term may be one reason for this big change.

Reasons for Using ICT in teaching

A question in the surveys asked teachers’ reasons for using ICT in teaching. It should be noted that two new items were added to survey 2 after review of the first one. They are ‘to let students learn interactively using IT’ and ‘To let students learn through communication with people all over the world’. Results of the two surveys are given in Figure 8-3.

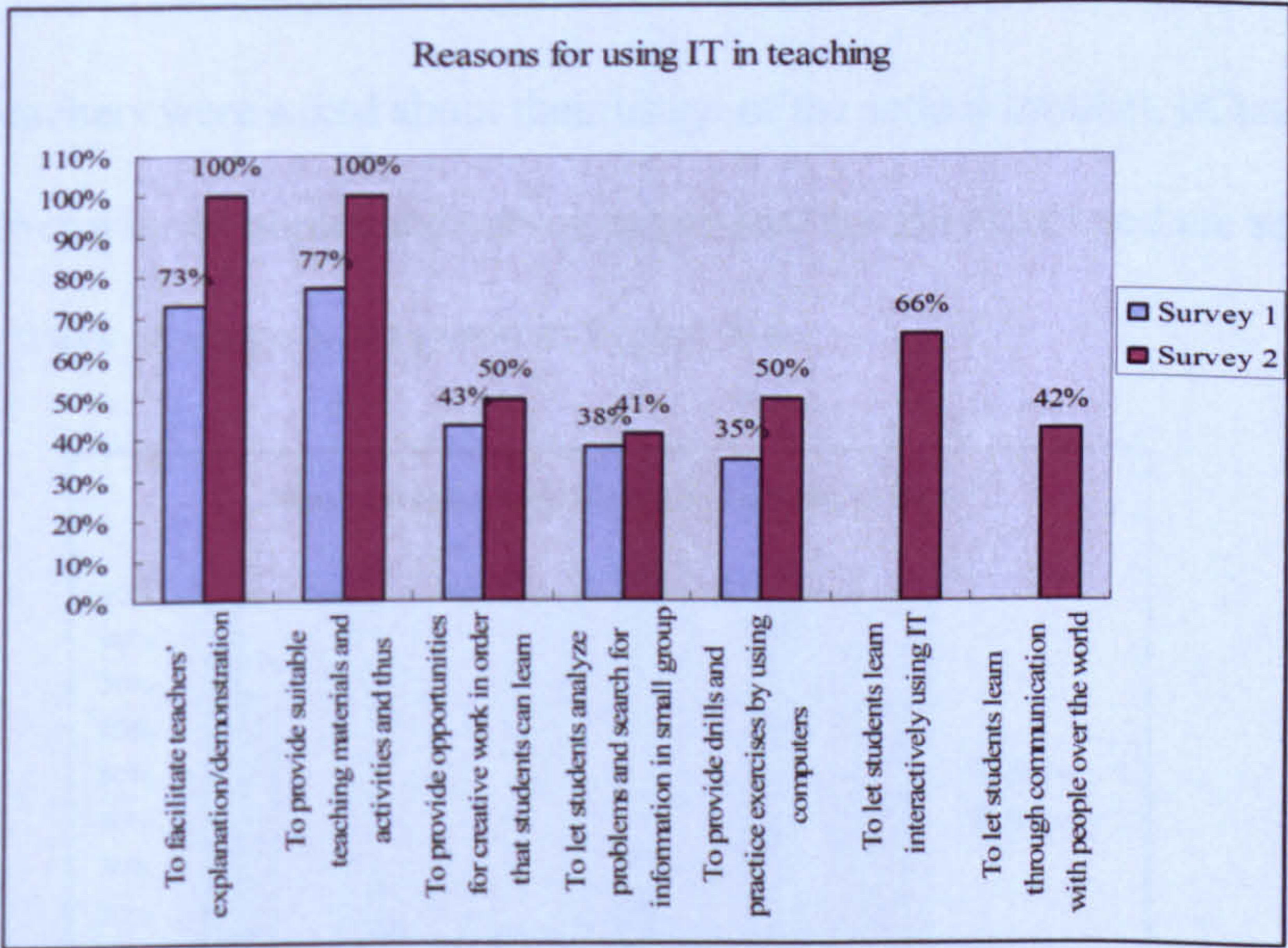


Figure 8-3 Reasons for using ICT in teaching (Phase 2)

From Figure 8-3, the main reasons for teachers using ICT in teaching were ‘to facilitate teachers’ explanation / demonstration’ and ‘to provide suitable teaching

materials and activities and thus enhance the understanding of knowledge’. All teachers who attempted Survey 2 selected these two reasons for using ICT in lessons. Around 40% to 50% teachers chose the other three items which are ‘to provide opportunities for creative work in order that students can learn better’, ‘to let students analyse problems and search for information in small groups’ and ‘to provide drills and practice exercises by using computers’. In survey 1, some teachers put ‘To let students learn interactively using IT’ and ‘To let students learn through communication with people all over the world’ as additional reasons for using ICT in teaching. Therefore, they were put in survey 2 as well to check the response of teachers. Results of survey 2 show that more than 60% teachers chose ‘To let students learn interactively using IT’ which is another popular one next to the highest two.

Use of the School Intranet for Teaching and Learning

When teachers were asked about their usage of the school Intranet, eClass, all except one teacher who attempted the survey expressed that they had used the school Intranet. Their ways of usage were given in Figure 8-4.

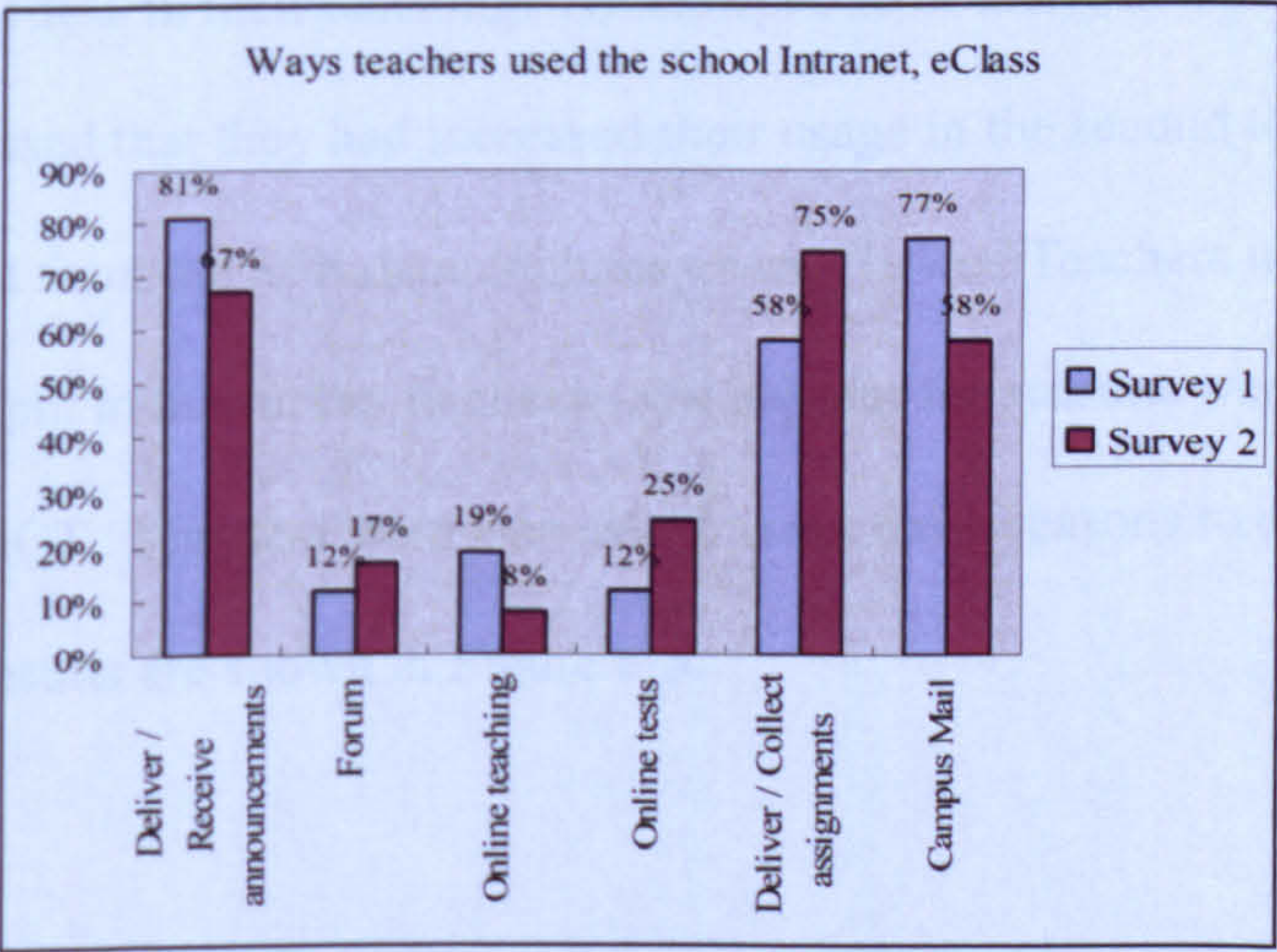


Figure 8-4 Ways how teachers used the school Intranet, eClass (Phase 2 data)

From Figure 8-4, it is found that teachers mainly used the school Intranet for sending and receiving notices and emails. Increasing percentage of teachers used the school Intranet as a platform for teaching such as delivering and collecting assignments from students towards the end of the school year. When teachers were asked whether they had used ICT more frequently in their teaching, 92% of those who filled out the survey expressed that they had increased the usage. Only one of them had not increased his/her usage. From answers to these two questions, it is found that teachers of the focal school used ICT more frequently and did use the school Intranet as a platform for teaching and learning in the second term when compared with that in the first term. Since the number of teachers who answered the questions in Survey 2 is small, the results will further be explored in the interviews with the teachers in the next section.

Reasons why teachers increased their usage of ICT in teaching

The data collected from teachers on the SSE day shows that some teachers had increased their usage of ICT in the second term and reasons for using computers in lessons were given. In survey 2, there was a question asking teachers if they had increased the use of ICT in their teaching. All except one of them, that is 92% of the respondents, expressed that they had increased their usage in the second term. A list of reasons was drafted from the SSE data, minutes of the IT Seed Teachers meeting and other research and put in the survey to check how popular the reasons were in affecting teachers' usage of ICT. Teachers were also asked to put those reasons in order of importance. The results are shown in Figure 8-5.

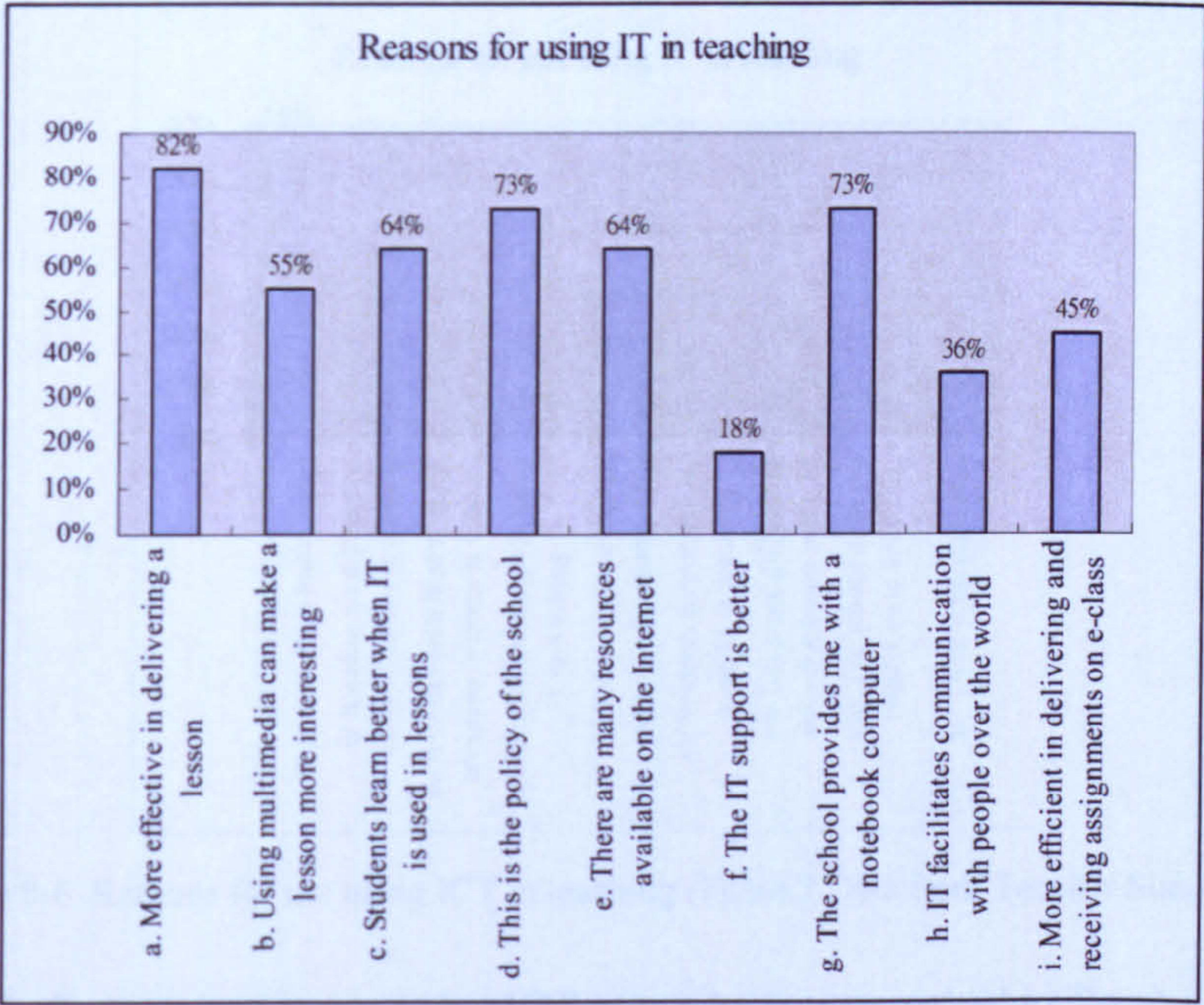


Figure 8-5 Reasons why teachers increased the use of ICT in their teaching (Phase 2 Data from the Teacher Survey 2)

From Figure 8-5, the top 3 reasons chosen by teachers for changing to use ICT in teaching are ‘More effective in delivering a lesson’, ‘The school provides me with a notebook computer’ and ‘This is a policy of the school’. More than 70% of the teachers who answered Survey 2 chose those items as their reasons. It has been shown that more than half of the teachers considered making lessons more interesting, getting more resources for teaching and effectiveness of teaching and learning as important reasons for adopting the change. School policy also scored very high among the items and the availability of hardware is another important condition for motivating teachers to try out new ways of teaching and learning. Besides, the External School Review carried out in May 2006 was also expressed as a reason for teachers to change their practice in order to fulfill the requirement of the EDB and the school since ‘Using IT in Teaching and Learning’ was one of the major concerns of the school in that school year.

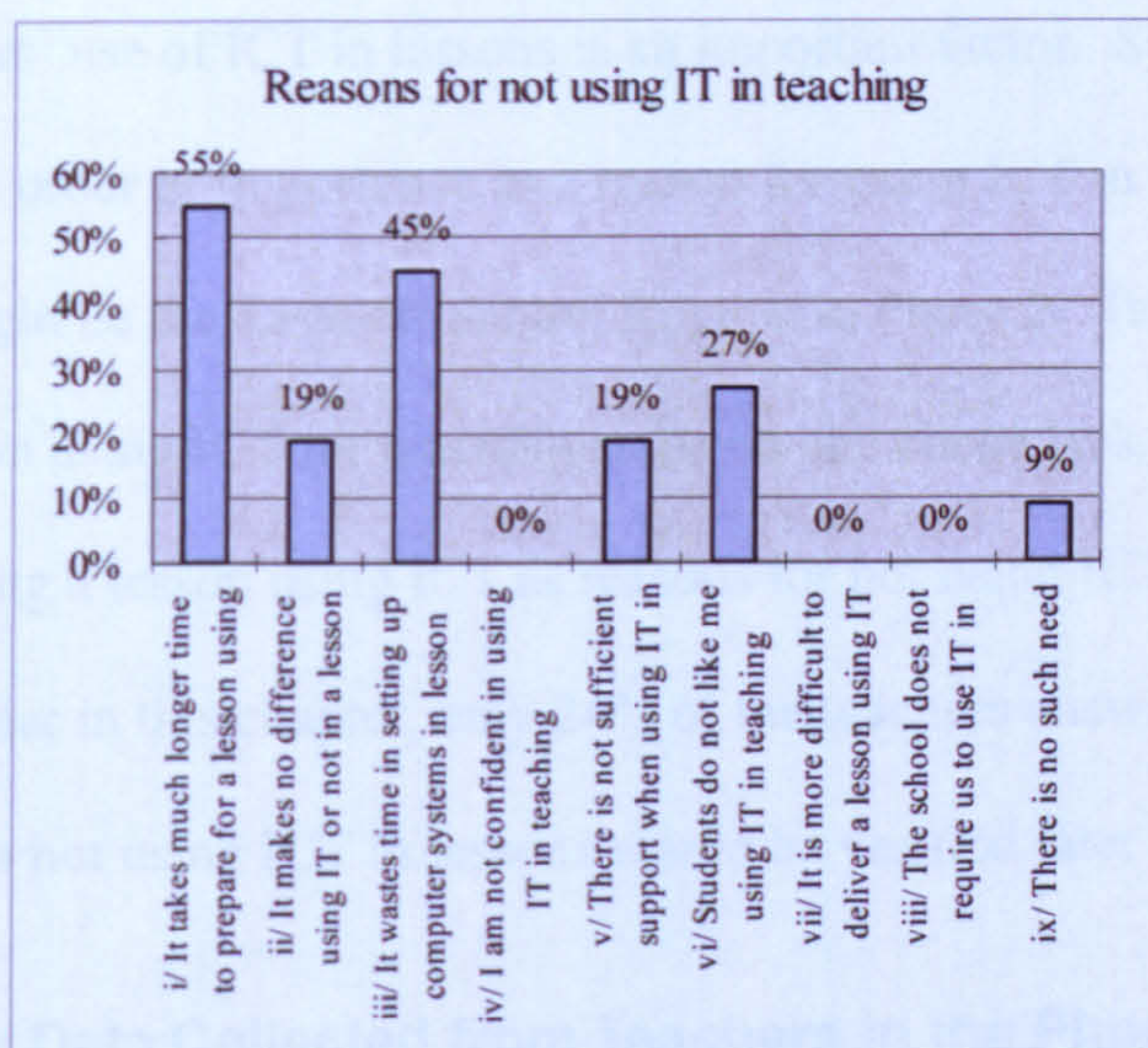


Figure 8-6 Reasons for not using ICT in teaching (Phase 2 Data from Teacher Survey 2)

Similarly, reasons for not using ICT in teaching were asked in Teacher Survey 2 and the results are shown in Figure 8-6. From the results, ‘IT takes much longer time to prepare for a lessons using IT’ and ‘It wastes time in setting up computers systems for lessons’ are the main reasons for teachers not using ICT in lessons. That is, the limitation of time was the major obstacles for implementing the change. Immediately following these two reasons is ‘Students do not like me using IT in teaching’. Students’ response was important in determining teachers’ willingness to try using ICT in their teaching. Teachers did not see the need or did not see any differences whether or not ICT was used are reasons why they did not change their way of teaching.

From the answers to these two questions, it is found that the effectiveness of teaching and learning is the most important factor that had determined whether teachers would change to using ICT in teaching or not. Other important factors related to the technical issues include the availability of hardware and software and the time needed for preparing a lesson and setting up the equipment. Students’ feedback and

response on teachers' use of ICT in lessons is an important factor. School policy was also ranked high in order of importance as a reason for using ICT in teaching. One possible reason might be the External School Review in Phase 2. Teachers seemed to be quite confident in using ICT for teaching since no one chose lack of confidence or difficult in delivering a lesson using ICT as reasons for not using ICT in their teaching. As pointed out earlier in this chapter, only 24% of the teachers answered Survey 2. The reasons for using or not using ICT in lessons would be verified later in the interviews.

8.2.5. Interview Data Collected from Teachers in the Phase 2 Study

According to the data collection plan, six teachers were selected for the Phase 2 study from September 2005 to August 2006. In the middle of the school year, three male teachers and three female teachers from different departments, namely English, Chinese, Science, Social Sciences and Cultural and Creative Subjects were invited to participate in the research and all of them accepted. Their years of services at the school ranged from 10 to 25 and had been colleagues with the researcher for more than ten years and had already built up trust relationships. They agreed to attend interviews and have their selected lessons either observed or video-taped by the researcher. The researcher had explained to them about the purpose of the research and how the data collected would be treated. The basic information about those teachers is given in Table 8-4.

Table 8-4 Information about teachers selected for Phase 2 study

Teacher	Sex	Department	Years of Service	High/Medium/Low Level User *
A	F	Social Science	10-15	High
L	M	Science	10-15	High
B	F	Cultural & Creative	15-20	Medium
K	M	Social Science	20-25	Medium
H	M	Chinese	10-15	Low
T	F	English	20-25	Medium

* High/Medium/Low Level User was judged by the percentage of ICT usage for teaching and learning just before the school year 2005/06 as reported by the teachers themselves.

The male and female teachers ranked as high level users of ICT in teaching and learning according to the criteria set as the use of ICT in more than 40% of the lessons. One ranked as low level user since he used ICT for less than 10% of the lessons and the rest were ranked as medium users. One of the female teachers selected was the English Department Head of the school. She was the one who participated in the Phase 1 study and answered the open ended questions given. However, she was seconded to the Education and Manpower Bureau (EMB) after the Phase 2 study. Although she was not teaching at the school in Phase 3, she was helping the development of a language project at the school. She visited the school and observed lessons about once a week as part of her job.

An overview of the interviews with teachers

The first interviews with the selected teachers were carried out in July 2006, near the end of Phase 2. The purposes of the first interviews were to collect information from the teachers about (1) how much they had been using ICT in their teaching and how much they had changed their usage compared with that in the first term of the same year and why; (2) their comments on the use of ICT in teaching and learning, including the advantages and disadvantages and (3) their attitudes towards ICT in education.

The interviews were conducted in Cantonese and were recorded. They were transcribed and translated into English. The translated interview reports are attached in Appendix T.

While coding the interviewing data, it is found that some terms and concepts have been repeated many times. Though the number of occurrences of these terms may not be directly proportional to their importance, it may have reflected, to some extent, the concerns of the interviewees and thus are worth further consideration. Therefore, the first step in the analysis of interviewing data is simple tallying of the terms mentioned by the interviewees. The popular terms identified are put on a check list for analysis. Table 8-5 is a summary of the basic information of the interviews with the selected teachers in Phase 2 and Table 8-6 is a record of the frequencies of occurrences of key words or topics mentioned by them.

Table 8-5 Basic information of interviews with the selected teachers in Phase 2

<i>Number of Interviews:</i>	N=6	
Total time taken:	177.5 min	25.2 min per interview
Total number of words:	19436 words	2777 words per interview
Words by interviewees only:	14124	2017 words per interview

Table 8-6 Frequency of use of the key words in the interviews in Phase 2

Category	Words/ Topics used	1st Interviews N=6	
		Total	Average
Leadership & policy	“Principal”	22	3.1
	“Leadership”	4	0.6
	“Policy” / “requirement” / “rule”	83	11.9
	Subtotal		15.6
Hardware provision	Hardware (except notebook)	117	16.7
	Notebook computer	25	3.6
	Subtotal		20.3
Software available	Software (except publishers)	39	5.6
	“Publishers”	5	0.7
	“PowerPoint”	52	7.4
	Subtotal		13.7
Advantage of using ICT	“Convenience” / “convenient”	15	2.1
	“Efficient”	9	1.3
	“Effective”	6	0.9
	Subtotal		4.3
Pressure and Support	“External”	14	2
	“Pressure”	5	0.7
	“Support”	3	0.4
	Subtotal		3.1
Belief and Culture	“Belief”	2	0.3
	Culture	8	1.1
	Subtotal		1.4
Disadvantages / Limitations	Time	77	11
	Problem	22	3.1
	Subtotal		14.1
Frequency of ICT usage	“often” / “more frequently”	30	4.3

Table 8-6 shows the key words or topics mentioned by the teachers in the interviews and these are further grouped into categories. They are mainly related to the reasons for using or not using ICT in teaching and learning. On the average, each interviewee had repeated four times that they had used ICT more frequently or they had often used ICT. The others can be organised as the reasons for their increase of usage. They are (1) Leadership – principal, leadership, policy, requirements and rules; (2) Hardware and Software – hardware, notebook computer, software, PowerPoint and publishers; (3) Advantages of using ICT – convenience of usage, efficiency and effectiveness; (4) Pressure and support; (5) Belief and culture and (6) Disadvantages and limitations – technical problems and time. Further analysis of these data is

given below. Though the IT Seed Teachers meeting and the School Self Evaluation (SSE) days were not included in the original plan, data collected there are important showing the extent of ICT usage in teaching and learning in the school and teachers’ attitudes towards it. They are useful for triangulating with the data collected in the interviews. Therefore, these data will be used to supplement the data collected in the teacher interviews in the analysis reported in the following sections.

Report of the interviews with teachers

Records of first interviews with the teachers are given in Appendix T while that of the teachers’ opinions collected on the SSE day can be found in Appendix X. Labels used for the different teacher interviews in the appendices are as follows:

Table 8-7 List of labels used for the teacher interviews in Appendix T	
Teacher	Labels used for 1 st Interview data in Appendix T
A	TA1
B	TB1
H	TH1
K	TK1
L	TL1
T	TT1

Usage of ICT in teaching and learning

When the teachers were asked about their ICT usage in the second term of the school year 2005/06, most of them expressed increasing use. For the frequent users, Teacher A and Teacher L, their percentages of usage increased to above 80% and for those of medium usage, Teachers B, K and T, the percentages increased to about 75%. For those of low usage, the percentages also increased to about 60%. However, the amount of usage in a lesson and the nature or way of usage needed to be further

explored. Almost all of them emphasized that they used computers for only some time of the lessons but not for the whole lessons.

About the way of usage, PowerPoint presentation was most frequently reported in the interviews. Other usage, like watching videos, searching and using online materials, using word processing and using spreadsheet for recording marks, were reported. According to the data collected from the IT Seed Teachers selected from different departments, PowerPoint presentation was used in almost all departments, including the Social Sciences, Cultural Subjects, English, Chinese and Science Departments. Some of them, with the Mathematics department as an example, also used PowerPoint presentations provided by publishers or other schools.

Teachers' reasons for using ICT in teaching and learning

In the interviews, all the six teachers mentioned that they had definitely used ICT more in the second term than in the first. On the average, each mentioned that they used ICT 4 or more times. The reasons are summarised in the following. Teacher A and Teacher H both pointed to the External School Review while Teacher L considered the software and notebook computer available, Teacher B and Teacher T referred to the provision of the notebook computer and Teacher K emphasized on the lesson observations. These factors were mentioned frequently during the interviews.

Teacher A (Refer to Appendix TA1 for the full record of the interview)

Teacher A, who was a high user, had increased usage to above 80% in the second term of the school year 2005/06. Her reasons for increasing the usage were the External School Review (ESR) and the requirement of the school for using ICT in lesson observations. She pointed out that whether ICT was used in lesson or not depended on whether she could find a way of using it for the topic. She emphasized on the design of the presentation to suit the need of her students. She spent plenty of time designing the ICT material for teaching a lesson. As a result, time constraint was one of her concerns. To rank the factors influencing her usage, external factors, in particular the External School Review, was on the top of the list followed in order by suitable design of the teaching material, school policy and hardware provision.

Teacher B (Refer to Appendix TB1 for the full record of the interview)

Teacher B was a user with medium level of usage. She pointed to the provision of notebook computer as the main reason for her increase of usage of ICT in teaching. The increase was from about 25% of the lessons, that is, the basic requirement according to the government policy, to almost every lesson in Phase 2 of this study. The convenience of use, capability for storing data and ease of data retrieval during lessons were the most important reasons mentioned by her. On the other hand, she pointed out that technical problems were the main obstacles for using ICT. Similar to teachers' opinions mentioned, she stressed the time needed for lesson preparations when ICT was to be used. She considered technical support essential in making the use of ICT in lessons possible when teachers were not yet familiar with the techniques. She had

tried different ways of using ICT for lessons but she was not sure whether students learnt better. She emphasized that it was more convenient for keeping records of students' performances and controlling the sequence of lessons.

According to Teacher B, the availability of the notebook computer was the most important reason for her increase ICT usage. Secondly, she found that it was a convenient and accurate means of keeping data of students and searching for useful information. The third reason was the requirement of teaching using ICT when the External School Review team inspected lessons. School policy did matter and followed the previous three as a factor affecting the implementation of using ICT in lessons.

Teacher H (Refer to Appendix TH1 for the full record of the interview)

In Teacher H's opinion, the school's concern was of utmost importance. He mentioned that in the second term he started collecting homework on eClass and using ICT in teaching since he thought that ICT was one of the school's major concerns and it was required for the External School Review which would take place near the end of the term. Another reason for his increased usage was the provision of notebook computers. It made the use of ICT more convenient than before. The third reason was the encouragement by the school. Furthermore, in his experience, visual effects could help students understand poems and its interactive effect was exceptionally good. Confidence was a factor he mentioned several times. He expressed that when teachers were more familiar with the software and hardware, they were more confident in using it. Other reasons he mentioned included the culture or atmosphere, requirement of the school, principal's inspection of lessons and the felt advantages when teachers used

ICT. Teacher H also stressed on the limitations of using ICT in lessons. He pointed out that the large amount of time needed for preparing a lesson was an obstacle. Despite of the advantages, teachers might not spend time using ICT if it was not required by the school and there was no inspection by the principal. About the trainings for teachers, he thought that sufficient trainings had been given during the office of the former principal, Principal A. However, some teachers did not have the confidence in using it and the support given to teachers was not yet strong enough. When asked to rank order the reasons, he arranged them with school policy on top, followed in order by teaching concepts, provision of hardware and software.

Teacher K (Refer to Appendix TK1 for the full record of the interview)

Besides the factors given above, Teacher K had some more reasons for his increase of usage. He emphasized that confidence of use was important. With the support of student ICT helpers in class and help from colleagues, he gradually had the confidence of using ICT in lessons. According to Teacher K, the leadership of Principal B and her push and support were also important making him used ICT more frequently. He further pointed out that it facilitated teaching and learning was the most important reason. He found that using ICT could make lessons more interactive and the presentations were more attractive. To him, the order of importance of these factors were principal's policy and her leadership, his own belief and confidence, resources from publishers and hardware provision such as the notebook computer.

Teacher L (Refer to Appendix TL1 for the full record of the interview)

Teacher L was also a high user and had increased the usage to 80% in Phase 2. One of the reasons he gave was the change of syllabus. There were changes in teaching materials into PowerPoint presentations and other new ways of teaching using ICT were added. The provision of notebook computers to teachers and the major concern of the school being the use of ICT in teaching and learning had considerable influences on the increase of usage. The use of touch screen monitor as an interactive white board helped him to change the whole concept of teaching. He thought that PowerPoint could give structure to a lesson and make a lesson smoother even for a new teacher. This could safeguard the quality of a lesson and make sure the syllabus was taught. He himself had a strong belief that using ICT was good for teaching. However, he pointed out the same problem mentioned by other teachers, that is, the need for a large amount of time for the design and preparation for lessons. During the interview, he also mentioned the change of teachers' role and the need for paradigm shift in teaching.

Teacher L pointed out that the availability of hardware was important in the first step to implement the use of ICT. As a subject head, he observed that the provision of notebook computers did make other teachers change to use ICT in lessons. He thought that as long as the basic requirements of hardware were satisfied, software became important in determining whether teachers used ICT or not. The change of syllabi and the software provided by publishers of teaching materials were important factors that brought about the changes. When asked to put the factors in order, he placed the availability of software in the first position, followed in order by the school policy, the External School Review, and hardware provision. He emphasized that school policy

was important affecting the change. Otherwise, it was very difficult to make teachers spend so much time in developing the ICT materials for teaching. He gave the comment that the whole school had shown big improvement in using ICT in teaching and there was a turning point after notebook computers were provided to teachers.

Teacher T (Refer to Appendix TT1 for the full record of the interview)

According to Teacher T, the provision of notebook computers was the most important factor for her increase in ICT usage. It should be noted that she was among the English teachers who had used the MMLC when the school piloted the use of ICT for teaching and learning. She was also the one who answered the teacher questionnaire in Phase 1 of this study. After some years of experience, she found taking the full class of 40 students to the MMLC was not as good as having lessons in the classrooms. She gave the comment that the provision of notebook computer gave her more convenience and flexibility in ICT usage. Therefore, she had increased ICT usage for lessons. The English department joined a TV news project organised by the HKEdCity and gave teachers in her department more chances of using ICT in teaching. Besides, the online assessment of the Territory-wide System Assessment (TSA) given by the Hong Kong Examinations Authority was an external factor that had made it compulsory for teachers to use ICT as an assessment tool. Teacher T summarised that the varieties as well as the audio-visual effects introduced to lessons were the major advantages of using ICT. They helped attract the attention of students and the visual effects could help students, especially those of lower abilities, follow instructions and reduce the chance of losing track during lessons. With different materials designed for the low and high ability groups, the use of ICT could cater for learner differences. However, it needed much

more time in the design in order to match the needs of students. When asked to rank order the factors affecting her usage, the availability of hardware and software came first on the list, followed by the requirement of the principal and the school policy.

Summary of the factors affecting teachers’ usage of ICT in lessons

The reasons given by teachers in the first interviews for increasing the use of ICT in lessons can be summarised into eight areas. Four of them were popular and were ranked high in almost all of the interviews. They are (1) ‘The provision of hardware’, in particular the provision of notebook computers to all teachers; (2) ‘The availability of software’ and teaching materials with examples of PowerPoint presentations provided by the publishers; (3) ‘External Factors’ such as the External School Review held near the end of Phase 2; (4) ‘School policy and requirements of the school/government’ such as ICT in education as a major concern of the school for the school year in Phase 2. The other four were also mentioned in the interviews as important factors by one or two of the teachers. These include ‘The principal’s leadership’, ‘Teaching concepts’, ‘Belief and culture’ as well as ‘Support and pressure’. A summary of the factors and their order of importance as mentioned in the six interviews are given in Table 8-8.

Table 8-8: Order of importance of the factors affecting teachers’ ICT usage in lessons
(Phase 2 data collected from the teacher interviews)

<i>Teacher</i>	<i>A</i>	<i>B</i>	<i>H</i>	<i>K</i>	<i>L</i>	<i>T</i>	<i>Times mentioned</i>
Provision of Hardware (e.g. notebooks)	4 th	1 st	3 rd	4 th	4 th	1 st	142
School Policy, Requirements	3 rd	4 th	1 st		3 rd	4 th	83
External Factor(s) (e.g. ESR)	1 st	3 rd			2 nd	3 rd	14
Availability of Software (e.g. Publishers)			3 rd		1 st	1 st	96
Teaching Concepts	2 nd	2 nd					
Belief & Culture			2 nd				10
Principal’s Leadership			1 st				26
Support and Pressure							8

From Table 8-8, it can be seen that ‘Provision of hardware’ and ‘notebook computers’ were mentioned respectively 117 and 25 times (refer to Table 8-6) with a total of 142 times in the interviews. Both terms were put under the category of ‘Provision of hardware’. The terms ‘Policies’ and ‘Requirements’ which were put under the category Policies were mentioned a total of 83 times and ranked by five of the six interviewees as one of the top four reasons. Availability of software including the terms ‘software’, ‘publishers’ and ‘PowerPoint’ were mentioned a total of 96 times in the interviews and ranked top four reasons by four of the six interviewees.

“Yes, I’ve used it more frequently since I have a notebook computer” (TB1).

“I think it is because of the notebook computer. ... I think it is the most important reason” (TT1).

“... First, it is now more convenient since we have notebook computers. Second, the school encourages us to use IT in teaching” (TH1).

“Policy is of the first position, the second is my own belief and confidence (in using IT) ... ” (TK1).

“Software is of the first priority. School policy is also important. Since if there is not such school policy, it will not be like this since it is really very hard to do. ... ’ (TL1).

‘External factors’, in particular, the External School Review, had big influence of teachers’ usage. With reference to the number of times mentioned in the interviews, this term was not mentioned as often as the other three. However, it was named as one of the top four reasons in four out of the six interviews. Almost all of them said that it was a factor mandating the change. Since the reviewers stationed in the school for a week interviewing teachers and inspecting lessons and the use of ICT in lessons was one area for them to review, teachers participated in the interviews expressed that they used ICT in almost all lessons during the ESR period.

“... For external review, we know the requirement of the external review so we will think of more interactive materials. If there was no ESR, I would still make IT materials but the degree of interaction would have been lowered” (TA1).

“... Maybe because we have to collect homework after the new year holiday and prepare for the external school review. In ESR, we may be required to show how we have used IT such as PowerPoint ...” (TH1).

Other Factors

Teaching concepts and teachers’ beliefs and culture were addressed in the interviews and had some weight in influencing the usage though only two out of the six interviewees put them high on the list. Leadership of the principal as well as support and pressure given by the school or colleagues were mentioned in some of the interviews but they were of lower importance compared with the above four.

“There is an atmosphere that we must follow. If we do not follow then we will be lagging behind the requirement” (TH1).

“For sure, I will say those in the leading position have significant influence. ... Teachers need a little push. In an environment that they are all required to do it together. I think they can be given a little more push so that they can move forward a little further ...” (TL1).

Positive Effects of Using ICT

Other reasons for changing to use ICT in lessons mentioned in the interviews included the ‘efficiency’ of carrying out lessons by well-planned and structured PowerPoint presentations, the ‘effectiveness’ such as the increase of students’ attentiveness and interest during lessons. These two terms were mentioned 30 times in the interviews. Some teachers pointed out its advantage of being able to cater for learner diversities. These were mentioned in one way or the other by all the six teachers in the interviews. The following are what teachers said about the effects on the change.

“Students find it more interesting in learning on the whole. Students are better involved in learning and more efficient in learning” (TK1).

“... Also, for some abstract concepts in science, it helps students to understand better with IT since the multimedia application is good for helping students to understand in my subject. ...” (TL1).

“It would help them to attend to the lesson for longer time since they can both hear and see so it’s easier for them to follow and understand. ...” (TT1).

“First, it makes the lessons richer. ... Because the lessons are richer, they are more attractive to students. ...” (TT1).

The high level users, Teacher A and L mentioned the change of role of teachers and paradigm shift as well. Support given by Principal B as mentioned by Teacher K, technical support by the ICT staff and student ICT helpers mentioned by Teachers K, B and H were also important reasons for those teachers of low to medium usage to change to use ICT in lessons. Culture and atmosphere were reasons facilitating change as

observed by both Teacher L, a high level user and Teacher H, a low level user. The high and medium users, Teacher A, B and L, considered the suitability of using ICT in teaching some topics but not all showing that they understood and considered the pedagogy as well.

“In fact, it is not whether using computer or not that make the difference. It depends on whether you can think of a way of using it to make the lesson more effective. ... ” (TA1).

“... So, the most important point to consider ... are what is the subject, the topic and the situation” (TB1).

“... So, the role of the teacher is not as strong after IT is used in teaching. ... The paradigm has been shifted. ... ” (TL1).

“The teacher’s role can have changed. ... If computers are used, teachers’ role can be facilitators. ... They (students) can assume more responsibility in their learning” (TA1).

Comparison with the teacher surveys

The reasons given above matched with those identified from the teacher surveys but there were some differences in order. From Teacher Survey 2, more effective in delivering a lesson was on the top of the list as a reason for using ICT followed by the provision of notebook computers and the policy of the school. Resources available on the Internet and students learnt better were also popular choices of reasons in the teacher surveys.

Overall, from the three sources of data, the SSE data, the teacher surveys and teacher interviews, it was confirmed that teachers had increased usage of ICT in lessons since notebook computers were provided to them. In both the teacher surveys and interviews, availability of resources was also an important factor for facilitating the

usage. Government and school policies, leadership of the principals, teaching concepts and belief of teachers all had influences on the change. Therefore, it can be concluded that hardware provision, availability of software, policies and requirements were the major tools and signs mediating changes in this phase. Both the government and the principals played important roles in facilitating the change process.

Teachers' attitudes towards the use of ICT in teaching and learning

Overall, the teachers showed a positive attitude towards the use of ICT in teaching and learning despite the problems they encountered. Most of them wished that they could have more reliable hardware and higher quality software with better technical support for the development of using ICT in teaching and learning. They all considered that there were more advantages over disadvantages and they favoured the development towards using more ICT in lessons. When they used more ICT for teaching, they found it more useful and they gained the confidence of using it as well.

"... The most important is that I have the confidence. ... The conditions are more favourable in this year. It makes teachers more willing to use. ... Yes, we have more confidence, more familiar after using it many times" (TK1).

"I think students can be provided with more resources especially for those better students. ... More IT resources can help cater for learner diversities" (TT1).

Teachers' comments collected on the SSE day reflected teachers' positive attitudes towards using ICT for teaching and they gave a number of suggestions for the improvement of using ICT in lessons. Some of them emphasized the appropriate use of ICT in lessons and that teachers should not use ICT just for the sake of using it. A

record of the data collected on the SSE day and its translated version can be found in Appendix TX1.

Teachers' Reasons for Not Using ICT in Teaching and Learning

Time constraint was mentioned in all the six interviews as an obstacle preventing frequent ICT usage. The time needed for preparing the teaching materials such as designing and making PowerPoint presentations were mentioned by all of them. Technical problems of using the facilities and the school eLearning platform were also mentioned as problems that had hindered the progress of implementation. Increase in confidence of using the facilities when the notebook computers were given to teachers and the improvement of technical support were pointed out by the low level users as one of the factors encouraging them to use ICT more frequently in the second term of the school year.

"... Teachers need more time to think of the way to teach. So, the preparation time is longer" (TA1).

"When I am going to search for information for preparing PowerPoint etc. It is very time consuming. ..." (TB1).

"The disadvantage is that it reduces the flexibility of the lesson ... the interactivity in lesson will have been lowered ... It is also very time consuming" (TL1).

It could be summarised from the interview reports that the main reasons that had hindered teachers from using ICT in their teaching and learning before Phase 2 were the inconvenience of use of the facilities. They had to book the notebooks or book the MMLC for using ICT in lessons. They lacked the confidence since they did not have much time using them and the culture or atmosphere of ICT usage had not been rich.

Support given to them, both technical and psychological, were not sufficient. Though teachers knew that using ICT could make lessons more effective and this was the trend for change, they had not made the effort to change if there was not the need or push given by the government or the school.

“ ... May be all accepted that it is the trend that we need to follow. ... ” (TK1).

“... If it is implemented as a school policy, that is, not only you but the whole staff is required to do that. ... I am saying that through school policy to build up a culture, everyone does something then you don't need to do it again in the next year... ” (TL1).

From the SSE data, the main obstacles for using ICT in lessons were also the technical problems, lack of support and short of resources. Problems like the instability of the school network, not able to get help immediately when there were technical problems, not accessible to the hardware when they needed them before they were provided with notebook computers (Appendix TX1).

8.3. Activity System 2 (AS₂): The Focal School at Phase 2

The context of use of ICT in teaching and learning of the school at Phase 2 is represented as Activity System 2 (AS₂) as shown in Figure 8-7. The components in Figure 8-7 are identified from data collected in Phase 2 and will be described briefly in the following sections.

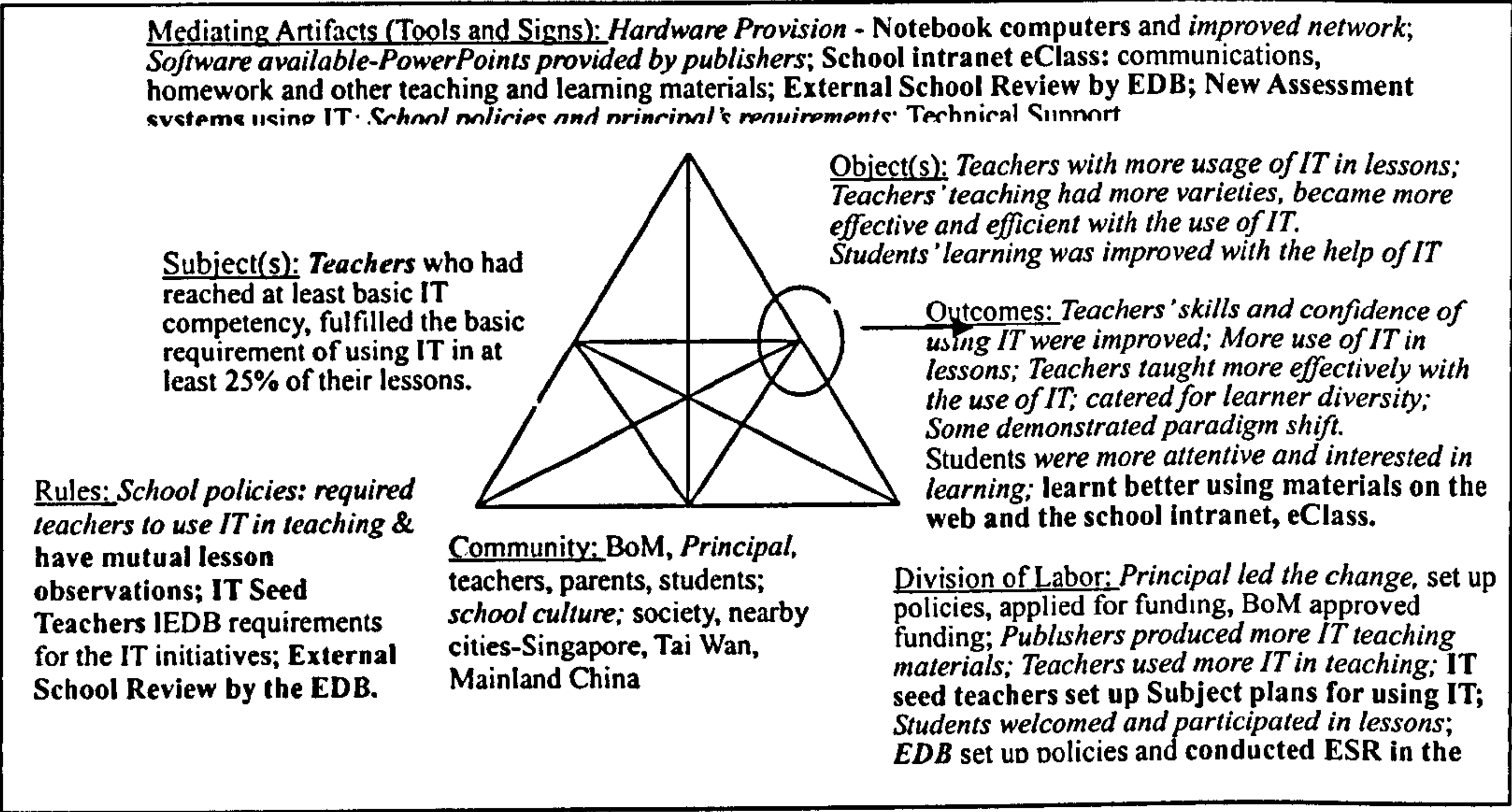


Figure 8-7 Activity System 2 (AS₂) – the school at Phase 2 of the study

Legend: Words in standard font: elements identified; Words in bold: new elements introduced; Words in italic: changes identified

8.3.1. The School Context at Phase 2 of the Study

As reported in Section 8.1, the project for the improvement of the infrastructure of the school and enhancement of ICT facilities accompanying the implementation of the second IT strategies of the HK government was underway in this phase. The school had just finished the installation of wireless network systems and upgrading the networks and ICT facilities.

At the same time, there were a number of significant changes in the school while no change in the government policies towards ICT in Education occurred during this period. The major events that might have contributed to any changes in teaching included the change of principal at the beginning of Phase 2 and the plans and policies Principal B introduced to promote the use of ICT in teaching and learning. These included the provision of notebook computers to teachers in November, the

requirements of using the school Intranet for internal circulation of messages and the inspection of lessons either using ICT or reading for teaching in the first few months of the second term. Besides, appointment of an IT Seed Teacher in each department to promote the use of ICT and arrangement of sharing and demonstration sessions on the use ICT in teaching and learning on staff development days were the strategies to implement the ICT policy. The School Self Evaluation programs and the External School Review by the Education Department were the events that had pushed the school to face their problems in using ICT in teaching and learning and found ways to improve the situation.

8.3.2. Description of the Components of Activity System 2

Subjects, Objects and Outcomes

The subjects, teachers, at the beginning of this stage had already acquired some basic skills of using ICT in teaching and learning and had reached at least the basic level of ICT competency as required by the government.

The objects of the study, which were the teachers' teaching and students' learning using ICT, had shown big changes. From the data collected in the teacher surveys and the first teacher interviews, teachers had increased their usage of ICT in their teaching. In the teacher surveys, most teachers showed that they had more than 50% in usage (refer to Figure 8-1). The six teachers, selected from the originally high, medium and low user groups, for the interviews all said that they had increased their usage to above 60%. The most significant increase of usage was the use of PowerPoint for lessons. This could be found from the two surveys and the interviewing data in

Phase 2. Teachers in the interviews like Teacher K and Teacher W expressed that they gradually got the confidence of using ICT in lessons and they felt the atmosphere and culture conducive to the change. As a conclusion from the above, teachers were becoming confident and competent users of ICT in teaching and learning.

The outcomes towards the end of this phase were most teachers used ICT in the lessons. As observed by the researcher and reported by Teacher L in the first interview, teachers had used their notebook computers in most of the lessons. From the teacher surveys, all teachers had increased their usage and in the interviews, all the six teachers reported an increased in ICT usage in their lessons after they were provided with notebook computers in the second term of the school year, that is, Phase 2 of the study. Teachers had built up the habit of reading and circulating messages on the school Intranet and students had the habit of getting learning materials from and submitting assignments on the Intranet as reported in the interviews and the teacher surveys.

One of the most important reasons for using ICT in their teaching was that they found lessons more effective and efficient when ICT was used. They had the experience that well-planned ICT materials could facilitate teaching and learning. Despite the demand of time for the preparation, they gradually favoured ICT even though they started the practice with different reasons. They did not just use ICT, many of them such as Teacher A and Teacher B, put emphasis on the way of usage and suitability for the topics. Teacher A and L pointed out the change of teachers' role when ICT was used and they recognized the paradigm shift when ICT was used in teaching. From the SSE data, some teachers realized that ICT should be used not merely for the sake of using it

but should be used when there was the need.

According to the teachers' comments, lessons had greater varieties, and were more interesting when ICT was used. The teaching materials in electronic form and resources from the Internet both helped teachers to organise and present their lessons smoothly and helped students to understand the contents though they sometimes found that the progress was slower than before. Teachers also found that the visual effects ICT could provide and the varied resources from the Internet helped students to learn. They could find ways of using these materials to cater for learner diversity as well. These demonstrated that teachers had not just adopted the change but had implemented it to some extent.

Mediating tools

With the provision of notebook computers, teachers started using computers for both administrative work and teaching. The school policies, which required teachers to have mutual observations and observations by senior teachers and the principal, was an impetus for the change. The External School Review which was ranked high on the list of important factors facilitating the change in the teacher interviews was another positive factor.

In the focal school, both technical and psychological tools were important in mediating the change. Technical tools included the notebook computers provided to teachers and projectors installed in all classrooms and the teaching resources such as PowerPoint presentations prepared by the publishers and teachers. Teachers put the

provision of notebook computers high on the list of factors facilitating the implementation of using ICT in teaching both in the teacher surveys and interviews.

Psychological tools included teachers' felt need of the change, knowledge and confidence for the change as well as students' feedback on their usage. The felt need of the change might consist of the requirements of the government and the school as reported in the interviews. Students' responses to teachers' use of ICT and their increased pleasant feeling when they had lessons in the MMLC or when teachers used ICT in lessons could also be a psychological tool to encourage teachers to change.

Other possible reasons that might have affected the change included the fear of lagging behind when compared with other schools and schools in other cities, expectations of the parents and alumni who donated money and gave comments and suggestions.

Rules-Government Policies and School Policies

In Phase 2, the major rules that had affected the development were the EMB policies and school policies. The policies of the EMB that invested money in the improvement of ICT infrastructure and the provision of resources and training to schools had a significant role to play in making the change possible. The requirement that teachers should demonstrate certain level of competence of ICT usage in teaching and learning was a major factor that pushed schools to adopt to the change. The school had put using ICT in teaching and learning a major concern of the year. The corresponding school policies had provided all teachers with notebook computers and

required them to demonstrate usage of ICT in their lessons through lesson inspections. These rules were enforced and reviewed by the External School Review Team of the EMB towards the end of the school year.

From the interview data and teacher survey results, both the government policies and school policies played important parts in the changes observed in this phase. The government policies which invested a large amount of money for the infrastructure, such as the provision of the computer systems and networks and provision of trainings in the prior to this phase helped to prepare the teachers for the change. Teachers pointed out in the interviews that they had already got sufficient trainings and they tried to meet the requirement of the government so they had attempted to use ICT in their teaching for at least 25% before this phase (TB1, TH1). The government funding also provided the basic infrastructure for the use of ICT for lessons except that they did not have their own computers but had to share and borrow for use in classrooms. Although the provisions were not sufficient to encourage teachers to use ICT in lessons, they did lay the foundation for it.

The school policies set up by Principal B gave the teachers strong encouragement to move forward. The procurement of notebook computers for all teachers was recognized by all the teachers in the interviews and most of the teachers answering the teacher surveys to be an enabling factor for implementing the use of ICT in lessons. The requirement of mutual lesson observation and observation by the principal or senior staff of lessons using either ICT or reading was a big push for moving forward. The External School Review by the EMB speeded up the change process. These were mentioned very frequently in the interviews and also the

teacher surveys. The strategies of appointing IT Seed Teachers in departments and inclusion of ICT plans together with lessons observations within departments created a culture and atmosphere of using ICT in teaching and learning (TH1).

Division of labour

From the data collected in and for the Phase 2 study, the roles played by the government, in particular the EMB and Hong Kong Examination and Assessment Authority (HKEAA), Principal B, teachers and students as well as the board of management of the school were all mentioned either in the school documents, SSE data and interviews or teacher surveys.

For the change in Phase 2, Principal B had played a significant role. With her many years of experience in other schools, Principal B found that the hardware and software provision of the school as well as teachers' usage of ICT in teaching and learning were far behind the standard of other schools. She then applied for money from the Board of Management for the procurement of notebook computers for teachers early in her first year of service in the school. She also put using ICT in teaching and learning one of the major concerns of the school for the year. Both the provision of notebook computer and the school policy were mentioned most frequently in the teacher surveys and interviews as major reasons for changing to use ICT in teaching and learning.

Teachers, who were the front-line users, played an important part in the educational change. Teachers at the school were willing to learn and try the new way of

teaching though not actively changing their practice due to various reasons mentioned previously. They were equipped with the skills for the change before Phase 2. Their positive attitudes towards school policies and compliance to requirements made them susceptible to change. Their concern about students' learning and their willingness to improve were important drives as well. Of course, students' feedback to the teachers' teaching were important indicators which either encourage or discourage them to try using ICT in their lessons.

The IT team of the school played an important part in writing the ICT plan and carrying out the procurement of equipment. The plan for the purchase of the notebook computers for teachers and the tendering procedures all depended on the work of the ICT team. The management of the IT staff in supporting teachers' usage of ICT for teaching and learning and the ICT resources were the work of the IT team too. The team also arranged for training courses for teachers, students and parents. Therefore, they had played a role in facilitating the usage of ICT in teaching and learning at school. It was reported by teachers that they had already got sufficient training courses during the office of Principal A, that is, Phase 1 of the study.

The EMB played a role in setting up the policies, granting money to support the setting up and improvement of ICT facilities in schools. The ESR team of the EMB played an important role in inspecting schools and reviewing the schools to see if the policies were carried out and the public money was properly used. The HKEAA was another external body that played a role in encouraging schools to develop its usage of ICT for School-Based Assessments (SBA).

For this educational change, publishers and software developers who provided text books and ICT resources for teaching also played an important role. This was mentioned several times by teachers in the interviews. Without these, teachers could not have time to prepare all ICT materials to be used (TL1, TK1).

Last but not the least, other stakeholders of the school such as the board of management, parents and alumni also had their roles to play for the implementation of using ICT in teaching and learning. The board of management of the school, as mentioned previously, approved the funding for the procurement of notebook computers for teachers. The alumni who were only mentioned in documents had donated money for the installation of LCD projectors into classrooms near the end of Phase 1 of the study and paved the way for the use of notebooks in classrooms. Parents, though never mentioned in the Phase 2 data, actually supported students' usage of ICT in their learning by installing computers at home and subscribing to Internet services. Expectations and comments of both parents and alumni were important in determining the progress of the implementation.

Community

The culture of the Hong Kong community and that of the school had significant effects on the change process. As mentioned earlier, the Hong Kong government had invited educators of nearby cities such as Singapore and Taipei as well as other countries namely the UK and Australia to share their experiences and held conferences in Hong Kong to extensively discuss the issue of ICT in Education. The government had also sent representatives to other countries to learn from their practices.

Accompanying the large amount of money invested in the development of ICT in Education, there were a number of discussions on this issue both formally and informally organised by the universities, tertiary institutions, the government and other school organizations. The atmosphere created a pressure on schools as they were on the front line in preparing the younger generation for the 21st century. This had also drawn the attention of parents and alumni to the development of ICT in teaching and learning in the school.

Within the school, Principal B had raised discussions on this issue as well and introduced a change in the school culture which tended not to take risk (TK1). The practice of mutual lesson observation helped to develop the culture of sharing experiences and trying out new teaching methods as reported by some of the teachers in the interviews (TH1, TA1, TL1). The school self-evaluation programs also encouraged a culture among teachers and students to evaluate their practices and produced channels for them to voice their needs and wishes. Informal parents meetings provided opportunities for parents to voice out their concerns though those were not much related to using ICT in teaching but their wards indulgence in using ICT at home. The school culture and the school community were more favourable for changes in this phase.

Contradictions as driving force for the development

It was generally believed to be an irreversible trend for the society and in broader view, the world, to move towards an information age using ICT as a tool for life (TK1). ICT in teaching and learning has been a worldwide issue that had pushed schools to adopt the change. As mentioned earlier in this chapter, comparisons with

nearby cities, such as Singapore, Taipei, Shanghai and other countries also created forces to change. The contradiction between Hong Kong government's determination to keep Hong Kong in the forefront of ICT development and the more advanced use of ICT in teaching and learning in the nearby cities and other countries drove the government to invest money for the improvement of the infrastructure, hardware and software provision as well as the other supports, set up policies and plan for strategies to implement the use of ICT in teaching and learning.

Principal B of the focal school had the experience of using ICT in teaching and learning while she served in other schools previously. When she compared the ICT usage in the focal school with that in her previous schools, she found the focal school, with almost 50 years history and in this 21st century, was far behind in the development of ICT in teaching and learning. This drove her to urge the school management board to allocate funds of the school for the purchase of notebook computers for all teachers in order to meet the need for promoting the use of ICT in teaching and learning. Teachers were also aware of the trend of development and had the fear that they were lagging behind. They were willing to face the challenge rather than remain in the status quo so they were ready for the change.

To summarise, teachers' felt need, the fear of falling behind and their belief in the power of using ICT for teaching and learning contributed as the driving forces for the change. The advanced development of ICT in other schools compared with that of the focal school, the expectation of the stakeholders, the improved ICT environment as well as the culture favourable for change all moved the school a big step forward.

8.4. Summary of Phase 2 Study

In Activity System 2, the subjects were the teachers, some of whom had some experience in using ICT in lessons while some had very little. The objects, that is students' learning and teachers' teaching, had undergone quite big changes in Phase 2. Most teachers were more adapted to and had more confidence in using ICT for teaching. All teachers had some experiences of using ICT in teaching though the extents of usage varied quite a lot. They all had passed the inspection by the principal or senior teachers. Students had more experiences in lessons using ICT and found more varieties and fun in learning though they might also have found that some teachers used ICT inefficiently. Overall, students welcomed teachers' usage of ICT in lessons provided that they had clear objectives of using ICT. The outcomes include teachers were more skillful in using ICT in teaching and students more interested in learning through using ICT. There were changes in the ways of teaching and learning though the teachers were still mainly passing on knowledge using ICT as another way of delivery. Teachers also found ICT an efficient and useful tool for presenting concepts and materials as well as organising teaching resources. The successful implementation further encouraged them to develop in using ICT in their teaching.

The mediating tools included the hardware provision such as the notebook computers, software availability such as the PowerPoint presentations and teaching and learning resources provided by publishers as well as technical support provided by the ICT staff. Requirements of the government and the school principal could be considered as other kinds of tools that had mediated the changes. The policies set up by

the principal and the requirements stated in the ICT strategies of the government made up the rules that had directed the change. All parties, including the EDB of the Hong Kong Government, the school board, the school principal, teachers, parents, alumni and students, had some roles to play in and contribute to the development.

The culture of the school community, the Hong Kong society and the nearby cities had positive influence on the development of ICT in Education and facilitated the changes of the system. Teachers' felt need, fear of lacking behind and their belief supported by their improved confidence of usage created the contradictions that drove the development of the activity system.

CHAPTER 9 Analysis of Phase 3 Data

9.1. *Introduction*

Phase 3 of this study refers to the period from September 2006 to July 2007. As reported in the data collection plan, there were teacher interviews, lesson observations and student group interviews. Data were also collected through teacher surveys and student questionnaires. In this chapter, the data collected will be reported, analysed and presented in an activity system. As in Phases 1 and 2, the key events in this phase which could serve as background information for studying the results will be reported first. A description of how data were collected in this phase will be given in the next section. Both quantitative and qualitative data were collected from teachers and students. The quantitative data, which were collected from a wider population, will be reported first to give a more general description of the situation. The qualitative data will then be reported and studied in detail in order to find out what facilitated teacher change and how change occurred in this phase.

9.2. *Data collected for Phase 3*

In Phase 3, quantitative data were collected through teacher surveys and student questionnaires. Student Questionnaire 5 (Appendices S5a, S5b), which was modified from the one for the Form 1 students in Phase 1, was given out to Form 1 to Form 5 students. The purposes were to collect general data about students' usage of ICT for their learning and their views on it. Another purpose was to collect students' views on

teachers' usage of ICT in lessons. A second set of questionnaires, named Questionnaires 2 and 3 (Appendices S2a, S2b, S3a, S3b), was given to Form 3 to Form 5 students for collecting data about their usage of computers both inside and outside school, for their study and for other purposes. This set of questionnaires was modified from the one used for the ImpaCT2 study in the U.K (DfES, 2002). The purpose was to have a better understanding of students' usage of ICT, which would help to interpret students' response to teachers' usage of ICT in teaching.

Qualitative data were also collected according to the data collection plan. Two teachers from the six selected teachers in Phase 2 were interviewed again in this phase in order to understand how and why they changed their usage of ICT in teaching. A lesson of each teacher was observed and about five students were invited for a group interview after each lesson. Furthermore, an interview was conducted with Principal B in order to explore her view on the situation of ICT usage of the focal school. In the following sections, data collected in this phase will be reported and analysed.

9.2.1. Key Events in Phase 3

In the school year 2006/07, there were further improvements in ICT infrastructure. According to the ICT plan of the school, desktop computers were to be installed in all classrooms at the beginning of the school year 2006/07. However, there was a delay and the workstations were finally installed and ready for use by the end of February 2007, shortly after the second teacher interviews. Besides, switches connecting the visualizer and the computer to the LCD projectors were installed with the workstations. Teachers could therefore use the visualizers which were

connected to the projectors just like using overhead projectors. Since the installation work was completed towards the end of the school year, not many changes could be observed until the next school year.

In this phase, Principal B still put using ICT in teaching and learning high on the priority list. One of the goals of the year was to further strengthen the use of ICT to enhance direct teaching and the use of web-based materials to enrich content and enhance self-directed learning. In the school plan, one of the aims was to implement ‘creative IT and science education using high tech equipment as a tool’ and staff development for ICT usage was a strategy to achieve it (Appendix D2).

In September 2006, some teachers left and about ten new teachers joined the school. One of the teachers who attended the first interviews was seconded to the EMB but she officially visited the school weekly in support of a language program.

9.2.2. Overview of Data Collected in Phase 3

A teacher survey, similar to the two given out in Phase 2, was conducted towards the end of this phase. The way of administering the survey was also the same as the previous two. It was posted on the school Intranet and teachers were invited to answer the questions on a voluntary basis. The names of the respondents were kept anonymous so as to ensure that they would not be traced even when they gave answers not favourable to the researcher. Those quantitative data, which were collected from a wider population, could provide general information and references for analysing the data from the selected teachers.

Two teachers, Teacher A and Teacher B were invited to participate in the Phase 3 study. Teacher A was a frequent user who taught a senior form social science subject and Teacher B was a medium user who taught a junior form cultural subject. Both of them reported significant increase in using ICT in lessons during Phase 2 of the study. They had increased usage to over 80% and even for every lesson around the period of external school review in the Phase 2 study. Both teachers accepted the invitation and were willing to participate in it. They also agreed that one of their lessons would be observed to see how they actually used ICT in teaching.

In January, a Form 1 lesson of Teacher B and a Form 5 lesson of Teacher A were observed. The purpose was to see the ICT usage of these teachers in lessons and the response of students towards it. A group interview with five Form 1 students randomly selected by the researcher with the help of Teacher B was carried out immediately after the lesson. Three Form 5 students selected by Teacher A were invited to participate in an interview in May which was three months after the lesson observation. The reason of the delay was that the Form 5 students were busy preparing for the external examinations in February.

Second interviews were conducted with Teachers A and B as well as two other teachers, Teacher H and Teacher K, who attended the first interviews in Phase 2. The purpose was to track the changes both in their teaching practices and their perceptions of using ICT in teaching. An interview with Principal B was conducted in the first term of Phase 3 too. The aims of these interviews were, first, to investigate deeper the situation of implementation of ICT for teaching and learning in the focal; second, to identify the reasons for using and those for not using ICT; third, to find the factors

that had facilitated the implementation and those that had obstructed it. All interviews, except the one with the principal, were conducted in Chinese. They were all recorded and then transcribed and translated into English for analysis. Table 9-1 summarises the data collected in Phase 3. Analysis of the data will be given in the following sections.

Table 9-1: Record of data collected in Phase 3

Date	Teacher Interview	Lesson observation	Student Group Interview	Teacher Survey / Student Questionnaires
Dec 06	Principal B (TP)			
Jan 07		A Form 5 lesson of Teacher A		Questionnaire to F.1 to F.5 (S5a, S5b)
Jan 07		A Form 1 lesson of Teacher B	Form 1 Group Interview (SG1)	Questionnaire to selected F.3 students (S2a, S2b) and selected F.4&5 (S3a, S3b)
Feb 07	Teacher H (TH2)			
Feb 07	Teacher A (TA2)			
Feb 07	Teacher B (TB2)			
Feb 07	Teacher K (TK2)			
May 07			Form 5 Group interview (SG2)	
July 07				Teacher Survey 3 (TY3)

N.B. Record of the interviews, results of the questionnaires and Teacher Survey 3 are attached in the appendix with labels as shown inside brackets in the table above

9.2.3. Report of Data Collected from Student Questionnaire 5

Student Questionnaire 5 (Appendices S5a, S5b), Student Questionnaire 2 (Appendices S2a, S2b) and Student Questionnaire 3 (Appendices S3a, S3b) were given out in the second term of the school year 2006/07. Student Questionnaire 5 was modified from the one issued to Form 1 students in Phase 1. It was given to all Form 1 to Form 5 students for collecting information about their ICT usage. Student Questionnaires 2 and 3 were modified from the one used in the ImpaCT2 study in the U.K. They were respectively given to Form 3 and Forms 4 to 5 students for collecting information about their ICT usage both inside and outside school and comparing them with the UK situation.

Results of the Student Questionnaire 5 (Appendices S5a, S5b)

A questionnaire, Questionnaire 5 (Appendices S5a, S5b), to collect students’ views on their own use of ICT in learning and their teachers’ use of ICT in teaching was given out to Form 1 to Form 5 students in early 2007. There was a total of 340 respondents as shown in Table 9-2.

Table 9-2: Record of respondents to Student Questionnaire 5 (Appendices S5a, S5b)

Form	No. of respondents
1	75
2	112
3	65
4	50
5	38
Total	340

Among the respondents, six said that they did not have computer at home. In order to provide references to students, the percentages of less than 20%, from 20% to 50%, from 50% to 80% and above 80% were used to describe the terms ‘very little’, ‘sometimes’, ‘quite often’ and ‘always’ respectively.

Table 9-3 Students’ report of teachers’ use and students’ use of ICT for teaching and learning

	Teachers’ use of ICT in lessons	Students’ use of ICT for learning
Above 20%	92.4%	78.2%
Above 50%	70%	35.3%

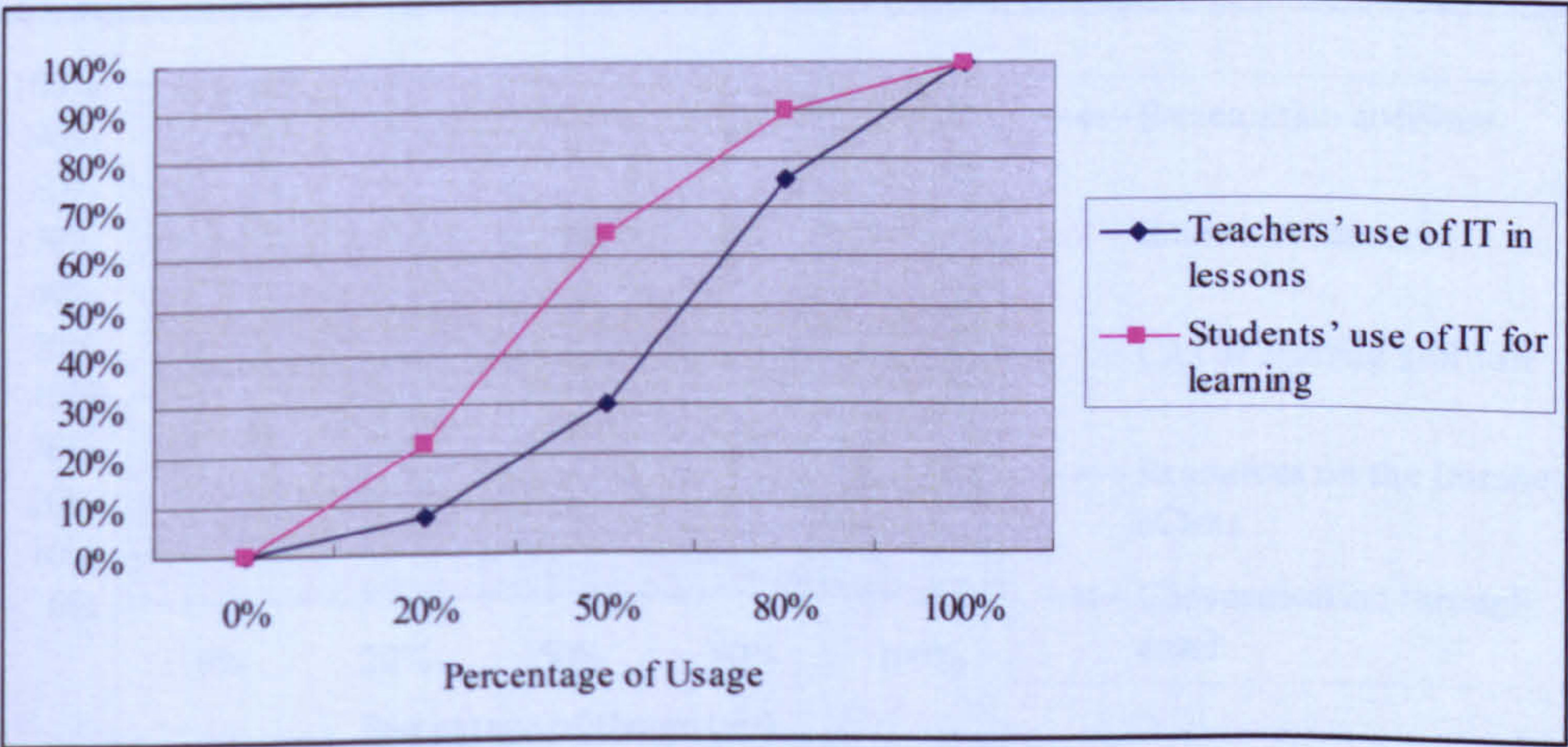


Figure 9-1 Comparison of teachers’ use of ICT in lessons and students’ use of ICT for learning as reported by students

The responses to the first two questions about teachers’ use of ICT in lessons and students’ use of ICT for learning are summarised in Figure 9-1. Percentages for at least some uses, that is, above 20%, as well as those for quite often to always, that is, above 50%, are given in Table 9-3. From Figure 9-1, it is found that as perceived by the students, teachers’ usage of ICT in lesson is higher than students’ use of ICT for learning. In Table 9-3, the percentage for frequent usage of ICT for learning is 35% which is only half that of teachers’ which is 70% according to the data collected. This large difference may mean that the way of using ICT in lessons was mainly for presentation which is one way but not interactive. There are two questions about the ways of using ICT and the results are summarised in Table 9-4 and Table 9-5. A comparison of teachers’ and students’ ways of usage as reported by the students is given in Table 9-6.

Table 9-4 Students’ report of teachers’ way of usage of ICT for teaching

	>20%	>50%
Presentation software	92%	71%
Internet resources	78%	31%
CAI or learning software	72%	36%
Resources on the Intranet, eClass	72%	29%
Communication through email	38%	17%

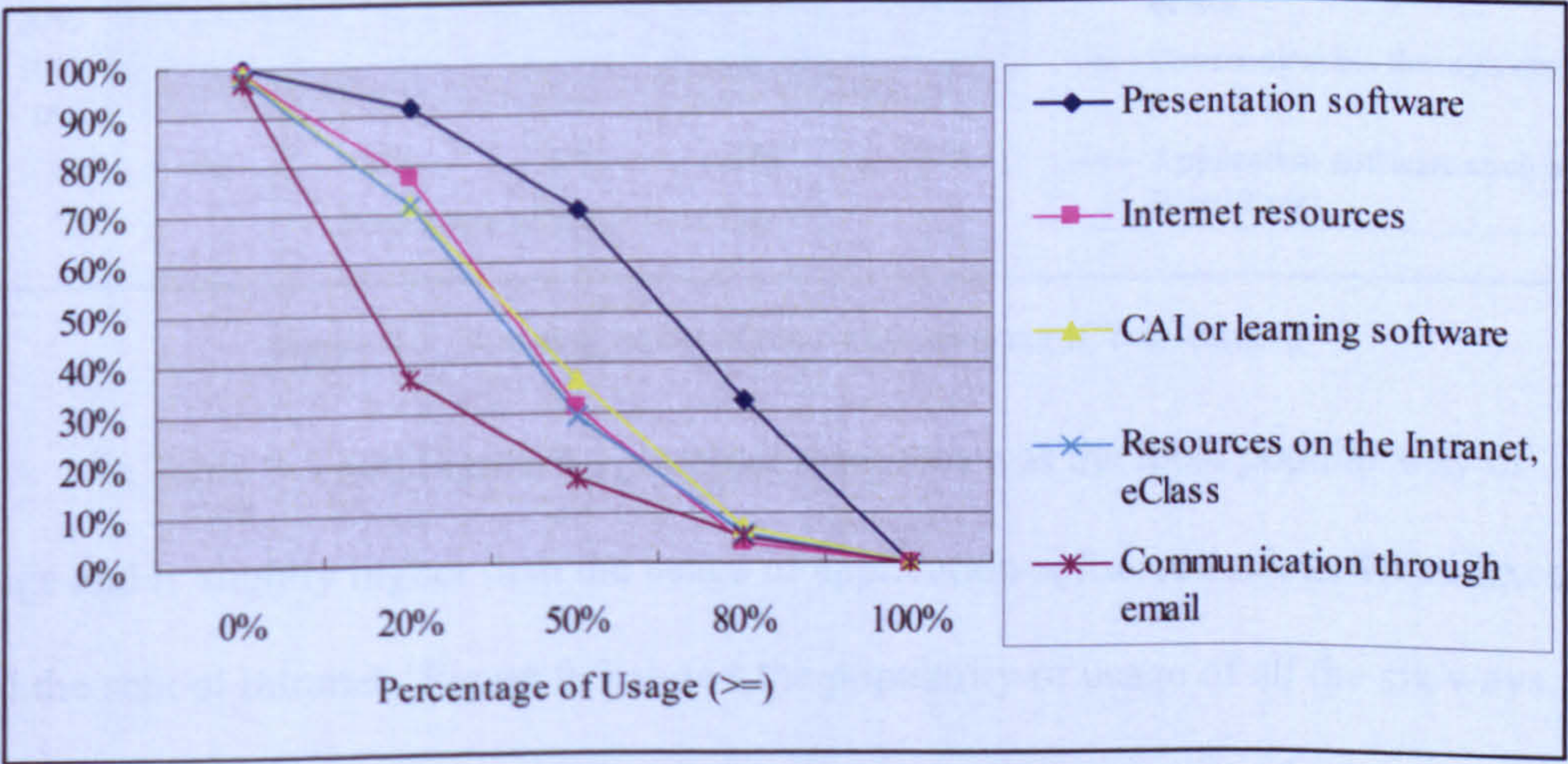


Figure 9-2 Students’ report of teachers’ ways of using ICT for teaching

Students reported that teachers used presentation software most frequently in lessons as shown in Figure 9-2. About 71% of teachers used ICT for more than 50% of their lessons and 92% used it for more than 20%. Teachers also used Computer Assisted Instruction (CAI) or other learning software, Internet resources as well as the school Intranet quite often in their lessons. About 30% of the students reported that teachers often used those methods while more than 70% reported that teachers had at least sometimes used these methods in lessons.

Table 9-5 Students' report of their usage of ICT in learning

	>20%	>50%
Presentation software	58%	26%
Internet resources	76%	47%
CAI or learning software	47%	12%
Resources on the Intranet, eclass	70%	37%
Communication through email	48%	19%
Application software such as Word/Excel	67%	40%

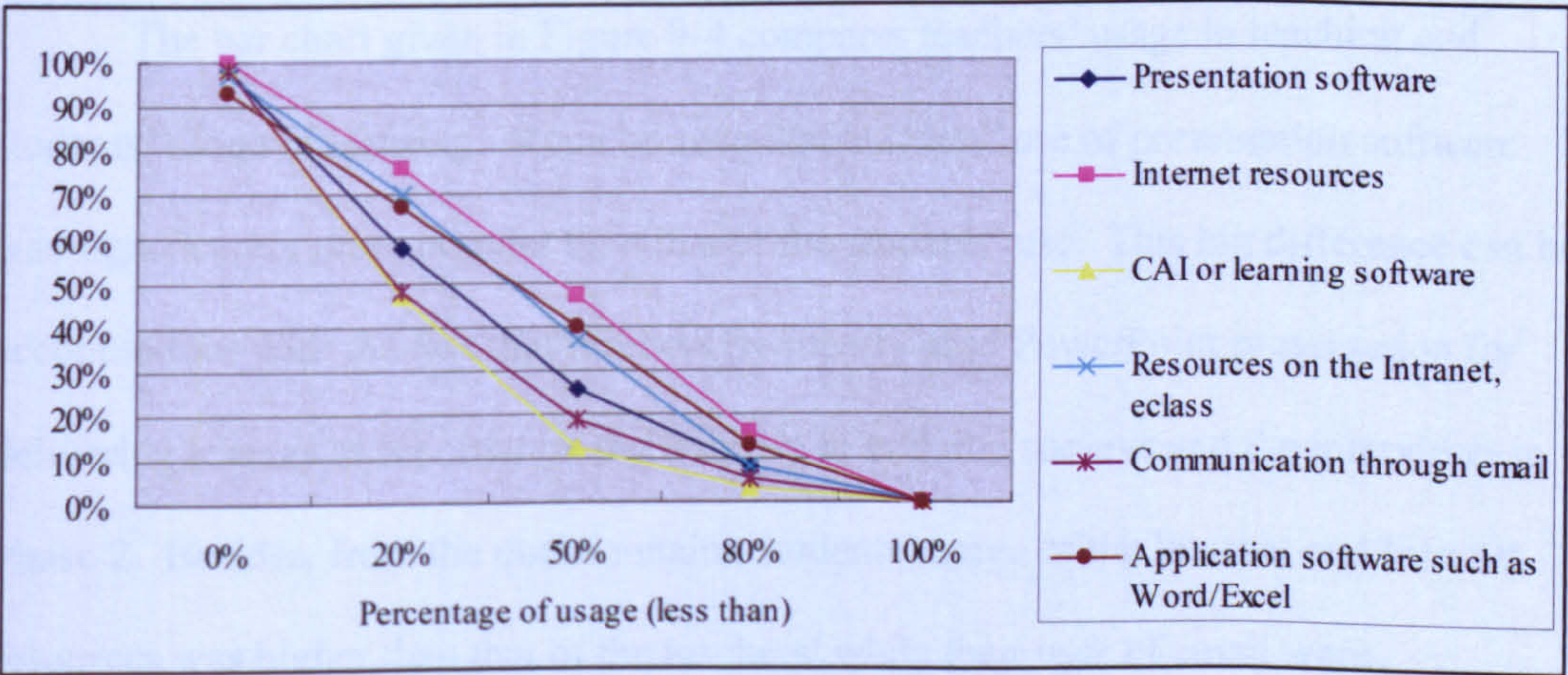


Figure 9-3 Students' report of their ways of using ICT in learning

In Table 9-5 and Figure 9-3, Internet resources was the most popular way of usage and is slightly higher than the usage of application software such as Word/Excel and the school Intranet. Figure 9-3 shows the popularity of usage of all the six ways named in the questionnaire and Table 9-5 summarises the percentages for usages of

often to always and sometimes or more. According to students' report, the most popular usage by students was Internet resources and the least popular one was CAI or learning software.

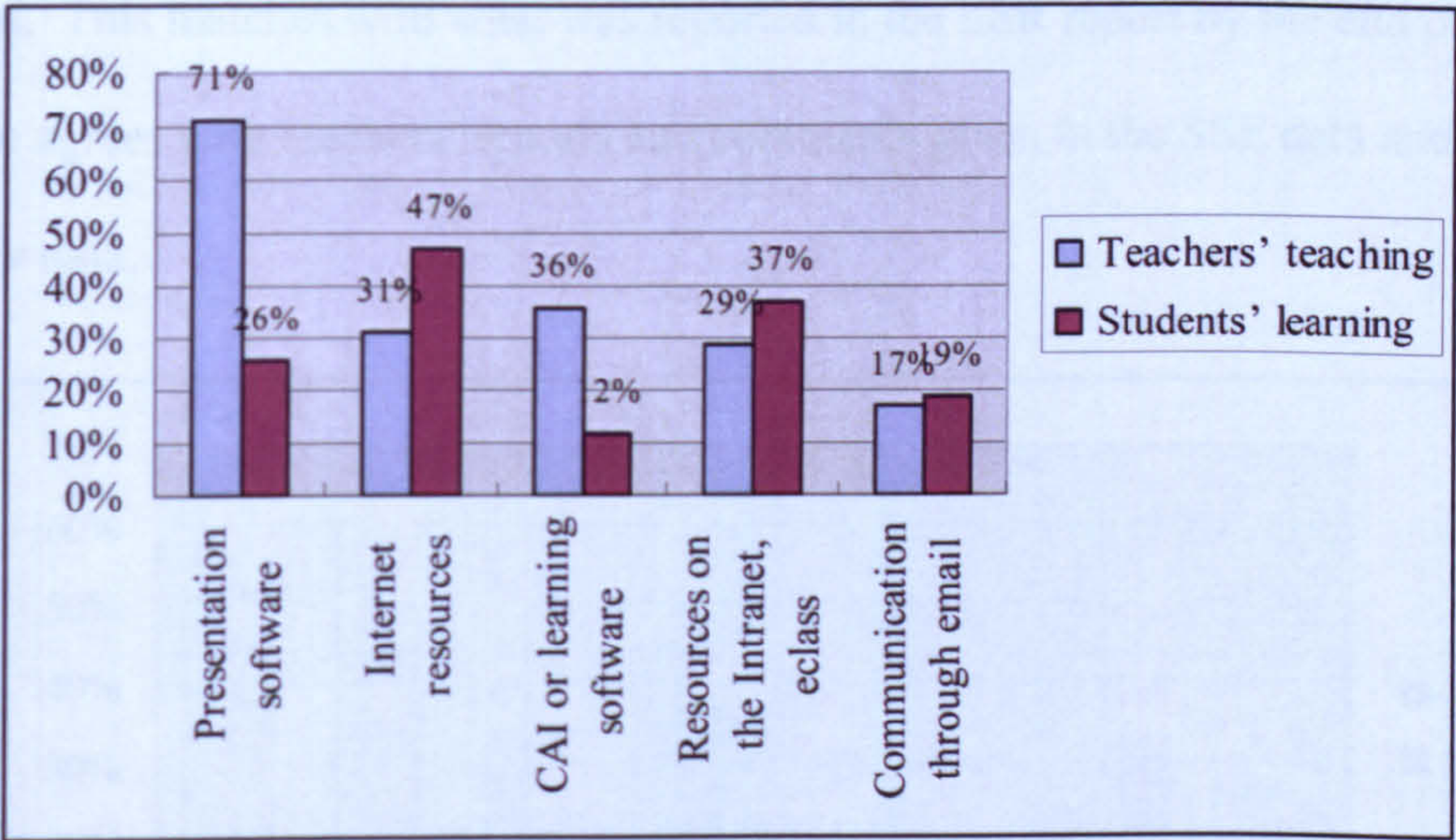


Figure 9-4 Comparison of teachers' and students' ICT usage

The bar chart given in Figure 9-4 compares teachers' usage in teaching and students' usage in learning. It can be seen that teachers' use of presentation software was significantly more popular than that of the students' use. This big difference can be accounted for with the fact that teachers frequently used PowerPoint presentation for delivering lessons as reported by the teachers in both the surveys and the interviews in Phase 2. Besides, from the questionnaire, students' usage of the Internet and Intranet resources was higher than that of the teachers' while their uses of email were approximately the same. Quite big difference is also found between teachers' use of CAI or learning software and that of students' use. This might have shown that the resources from publishers or other school teachers could not be accessed by students from home except for junior form English. Therefore, uploading teaching and learning

materials on the Intranet or Internet might be a solution to bridge the gap.

From the data above, teachers might have used ICT mainly for presentation of lessons which was one way and there was not much interaction with students when ICT was used. This matches with what was reported in the ESR report by the end of Phase 2. This also agrees with teachers' reports and comments given in the SSE data and the interview data.

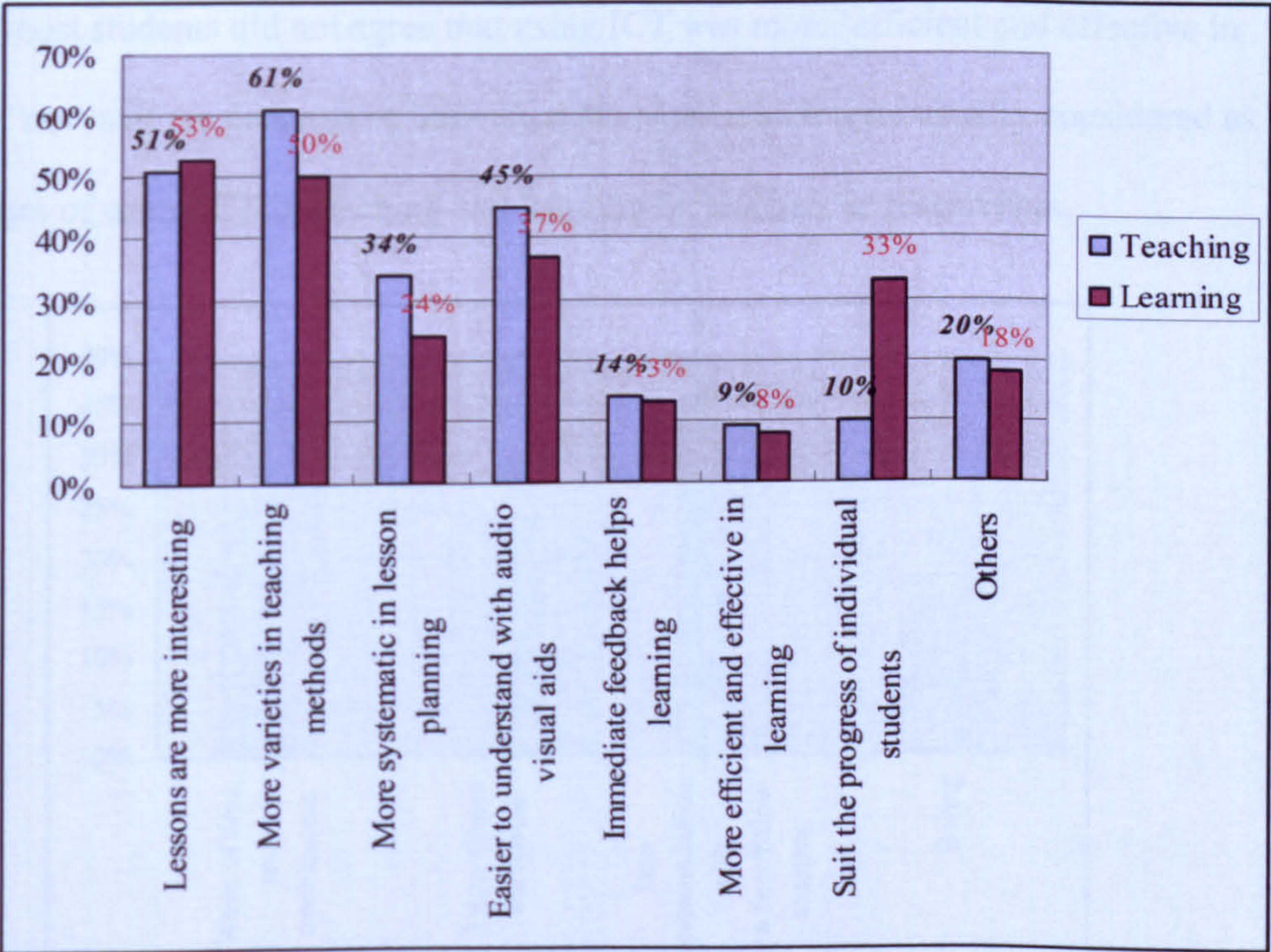


Figure 9-5 Comparison of students' views on the advantages of using ICT for teachers' teaching and that of students' learning

When asked about the advantages and disadvantage of using ICT in teaching and learning, students did not see many advantages but after all, they preferred the use of it. In Figure 9-5, the advantages of using ICT for teaching and that for learning as perceived by students are compared. The results agree quite closely with each other. More than half of the students chose 'more varieties in teaching methods' and

‘lesson were more interesting’ as the advantages of using ICT in teaching and for learning. A little less than half of the students expressed that ‘easier to understand with audio visual aids’ was an advantage in teaching and for learning. The above are amongst the most popular advantages mentioned by students. These are also the reasons for teachers to change to use ICT in lessons as collected from the teacher interviews and the SSE data in Phase 2. Besides, about one third of them agreed that ‘More systematic in lesson planning’ was an advantage. However, it was interesting to see that most students did not agree that using ICT was more ‘efficient and effective in learning’ nor ‘suit the progress of individual students’ which were usually considered as advantages of using ICT in teaching and learning by teachers or researchers.

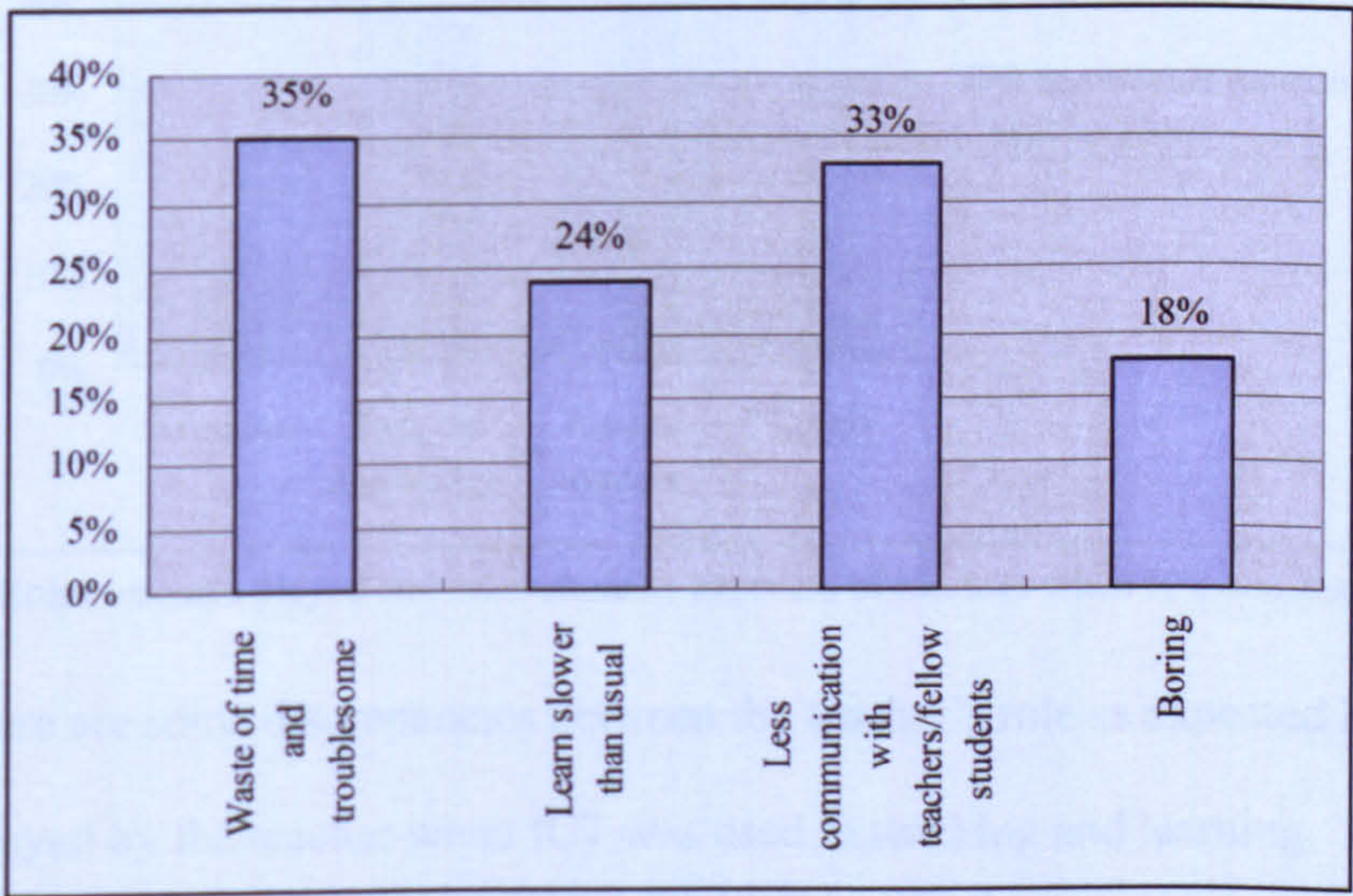


Figure 9–6 Students’ views on the disadvantages of using ICT in learning

Students did see some disadvantages of using computers in learning as well and Figure 9-6 shows the results from the student questionnaires. Amongst the disadvantages listed, about one third of them thought that it was ‘waste of time and troublesome’ and using ICT in learning would result in ‘less communication with teachers or fellow students’. About one quarter of the students thought that ‘they

learn slower than usual’ and less than one fifth thought that ‘it was boring’. The reason for students feeling that it was a waste of time and troublesome might be due to the fact that teachers needed to set up their notebooks in the classrooms when they wanted to use ICT in classrooms as reported in Phase 2. Since teachers mainly used PowerPoint presentations for lessons, students felt that there was less communication with teachers and fellow students. Some teachers also expressed this point on the SSE day. In the ESR report, it was pointed out that there was not enough interaction in class.

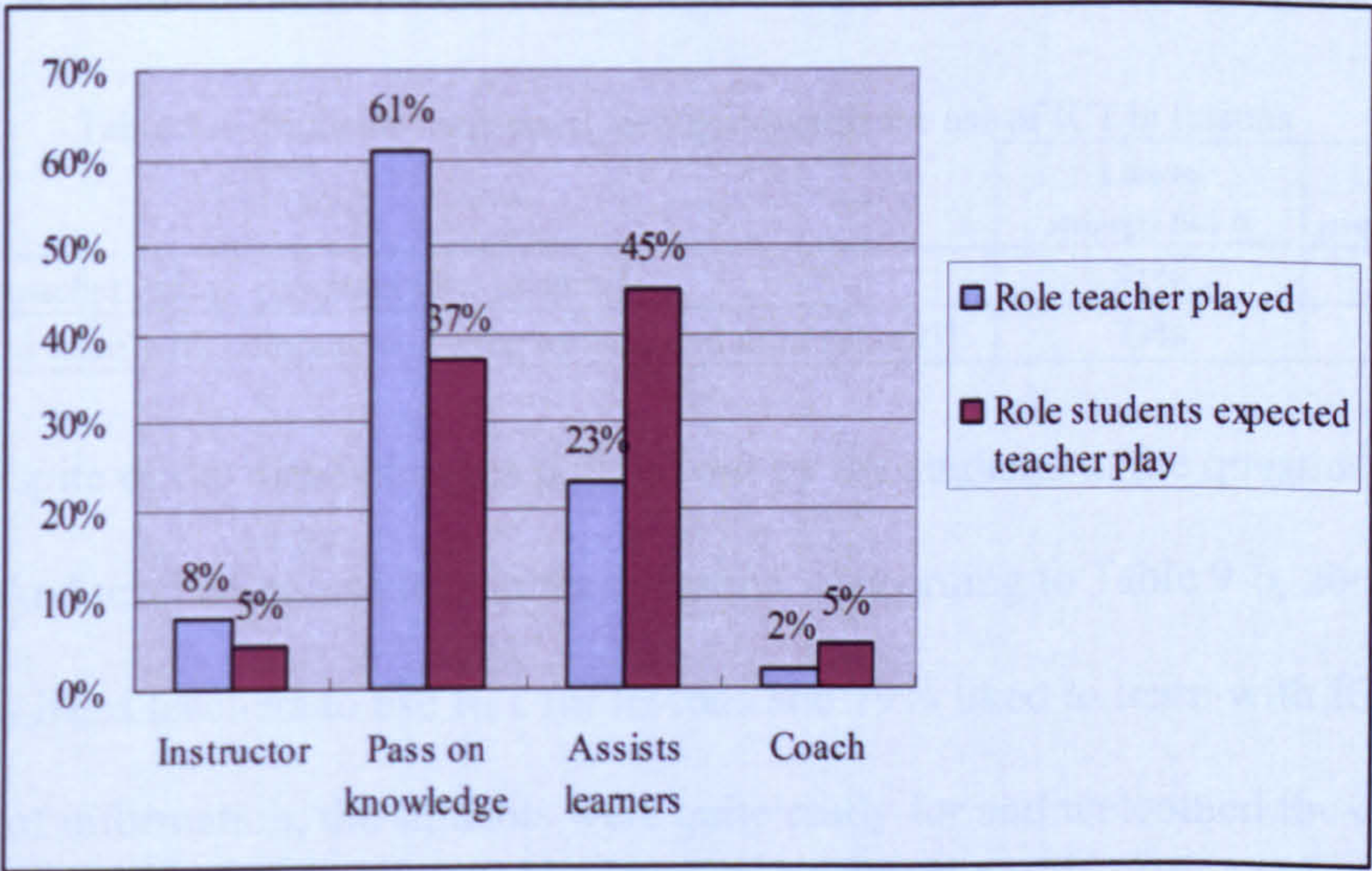


Figure 9-7 Roles teachers played and roles students expected of teachers when ICT was used for lessons

There are some discrepancies between the teacher’s role as expected by students and that played by the teacher when ICT was used in teaching and learning. Referring to Figure 9-7, more than 60% students felt that teachers were passing on knowledge and about one quarter of them found that teachers assumed the role to assist learners when ICT was used for teaching and learning. However, students preferred teachers to play the role of ‘assisting learners’ to ‘passing on knowledge’ though both of them are popular choices. The number of students who expected teachers to play the role of assisting learners is nearly double the number of students who actually experienced

it. On the contrary, nearly double the number of students found that teachers had taken up the role of ‘passing on knowledge’ compared with the number of students who expected it. Change from teacher-centred to student-centred teaching and learning was the aim of educational change by that time. The ultimate goal was to assist students so that they could learn how to learn. However, the teachers did not seem to ‘shape’ fast enough since they still assume the role as ‘passing on knowledge’ but not ‘assisting learners’. It needs to consider whether this change in practice reflects the educational change as stipulated in school documents.

Table 9–6 Students’ expressed feelings towards the use of ICT in lessons

	Like to strongly like it	Dislike to strongly dislike it
Do you like teachers using computers for lessons?	81%	17%
Do you like to learn with computers (during lessons and after school)?	79%	20%

Despite of the disadvantages pointed out by the students in the questionnaires, students liked teachers to use ICT in their lessons. According to Table 9-6, about 80% of students liked teachers to use ICT for lessons and 79% liked to learn with ICT. From this piece of information, the students were quite ready for and welcomed the change by that time. But according to Figure 9-7, the pedagogical usage of ICT in lessons was still mainly teacher-centred. The views of teachers and students would be further explored and clarified in the interviews with selected teachers and student groups.

9.2.4. Results of Student Questionnaire 2 & Student Questionnaire 3

The Student Questionnaire 2 and 3 about the ICT usage, modified from the one used in the ImpaCT2 project, was given out to Form 3, 4 and 5 students. Two classes in each Form were selected to answer the questionnaires. In Form 3, students were allocated to different classes according to their overall results of examinations in

Form 2. Out of the 160 students in Form 2, the top 80 were assigned evenly to the two classes 3D and 3C and the rest were put in the other two classes 3B and 3A. In Form 4 and Form 5, students were allocated to different classes according to their choices of subjects with 2 classes having the choice of the Science subjects while the other two having the choice of the Arts subjects, Geography, History, Chinese History, etc. Classes 4B, 5B, 4C and 5C were in the Science stream and 4A, 5A, 4D and 5D in the Arts stream.

Student Questionnaire 2 was given to 3B and 3D while Questionnaire 3 was given to 4A, 4B, 5A and 5B students. That is, one better performing class and one weaker class in Form 3 were chosen to answer Questionnaire 2 and one Science class and one Arts class were chosen from Form 4 and Form 5 to answer Questionnaire 3.

Table 9-7 Basic information about the questionnaires given out in Phase 3

	Form 3	Form 4	Form 5
A	0	23 (Arts Class)	12 (Arts Class)
B	37 (Weaker in academic results)	27 (Science Class)	32 (Science Class)
C	0	0 (Science Class)	0 (Science Class)
D	36 (Better academic results)	0 (Arts Class)	0 (Arts Class)
Total	73	50	44

In questionnaires 2 & 3, section one contains questions for collecting basic information about the student’s access to computer resources, their usages for learning and leisure both in and outside the school, during and after lessons. The main purpose of the questionnaire was to collect information about the level and pattern of usage of ICT of Hong Kong secondary school students as typified by the focal school. A comparison with the corresponding students in the UK as reported in the ImpaCT 2 project (Harrison et al., 2004) will be given in order to provide a reference for the investigation of the level and pattern of usage in the Hong Kong situation with the

focal school as an example. It should be noted that the Hong Kong data was collected in 2006 while that in the UK was collected in 2001, 5 years before the one collected in Hong Kong. In spite of the time lapse, the ImpaCT2 data is the most comprehensive set of data officially collected and not any other can be found up to the period of this research.

This questionnaire was given out in Phase 3 and the data collected were to help to understand students' response to teachers' use of ICT for teaching and their own use of ICT for learning. Whether they were frequent users of ICT or not might have affected their response to teachers' usage of ICT in lessons and their own usage of ICT in learning. The ease of access to the ICT equipment and their main purpose of using them might have affected their attitudes and perceptions of using ICT in teaching and learning.

The results of the questionnaires 2 and 3 given to the Form 3, 4 and 5 (age 14 to 16) students will be discussed in the following. A summary of the results is presented in Table 9-8 with the average of the results from Form 3, 4 and 5 compared with the corresponding results of KS4 (age 16) students in the UK as reported in the ImpaCT2 project. A full report of the results of the questionnaires is given in Appendix S (S2a, S2b, S3a, S3b & S4). When data of these questionnaires are compared with the UK situation, the fast development of ICT technology and drop in price throughout these five years should be considered.

Table 9-8 ICT usage of secondary school students in Hong Kong compared with the UK data

	UK 2002	Focal school 2006	Yes		
	KS4	F3-5	F3	F4	F5
Do you have a games console at home? (e.g.: Playstation,)	71.4	59.7	71	51	57
Do you have a computer at home?	93.9	99.0	97	100	100
Can you access the Internet from home?	76.8	97.7	95	100	98
Do you use computers in places other than your own home or school (e.g. the library, an Internet café, a friend's house or somewhere else)?	72.6	69.7	63	72	74
Can you access the Internet from those computers in places other than your own home or school?	77.5	79.0	82	81	74
Do you have personal email address?	79.7	97.3	96	100	96
Have you ever created your own web page?	19.5	60.3	55	62	64
Do you have your own mobile phone?	83.9	95.7	93	100	94
Do you use the Internet for visiting Test Revision Sites / HKCEE revision sites?	73.8	48.0	29	53	62

From the data in Table 9-8, only a few students in the focal school said that they did not have computers at home or could not access the Internet from home. The situation was better than that in the UK five years before. Nearly all students of the focal school who answered the questionnaire had email accounts and more than half of them had their own webpage. Almost all of them had mobile phones as well. About 70% of the students in the focal school had used computers other than that in their home or school. The percentage is slightly lower than that in the UK five years ago. The percentage is even lower when the usage of ICT in learning is considered. Slightly less than half of the students in the focal school showed that they had used ICT in their learning while more than 70% of the UK students had done so. This percentage increased considerably in Form 4 and Form 5. Slightly higher than 50% of Form 4 students used the Internet for revisions and the percentage increases further for the Form 5 students. This can be accounted for by the need of facing the external exam in the senior secondary level and the Form 5 students were closest to the public examination. Despite the ease of access of Internet materials and the drop in price of the ICT

equipment, the percentage of students using computers for their study was still lower for the HK students than their counterparts in the UK even 5 years back.

9.2.5. Report of Data Collected from Teacher Survey 3

A teacher survey, similar to the two surveys given out in Phase 2, was posted on the school Intranet, eClass, with a note inviting teachers to fill it out from July to August, 2007. As before, the survey was not compulsory and the teachers' names were anonymous. This was to minimize teachers' tendency to give favourable answers or the fear of any consequences in telling something not 'appropriate' as the researcher was at a senior position of the school. The number of respondents answering the third one was 23 out of 54, a little fewer than the first one which was answered by 26 out of 50 teachers. We also need to take into consideration the fact that seven teachers left the school and eleven new teachers joined the school in September 2006. Care is needed in interpreting the answers for those questions asking about any change in ICT usage. Another factor that should also be taken into consideration is the fact that it was one of the major concerns of the school and the government for developing the use of ICT in teaching for the school year 2005/06 (Appendix D1, D3, D4; EMB HKSAR, 2004a).

Instead of simply reporting the data collected from Teacher Survey 3, comparison with the previous two will be given. The cross phase analysis of the surveys will be used to show the changes both in practice and in perceptions of teachers. Table 9-9 shows the basic information about the three teacher surveys. Although the percentage of teachers answered the second survey is relatively low, the results still worth attending to since it was given out shortly after the External School Review in

May 2006. Some significant changes might have happened across this critical period. These three surveys are of similar design but there are some questions in Survey 2 and Survey 3 to check for the increase of usage and some questions to let teachers report on their own changes.

Table 9-9 Basic information about the three teacher surveys

Teacher Survey	Survey 1	Survey 2	Survey 3
End of Date for the Surveys	15/01/2006	31/07/2006	31/08/2007
Total Number Received	26 out of 50	12 out of 50	23 out of 54

Increase of usage of ICT in teaching

The data collected in the three surveys and a comparison of them can be found in Appendices TY1 to TY4. The fraction of teaching hours allocated for using ICT is a measure of their amount of ICT usage for teaching and the results from the three surveys are shown in Figure 9-8.

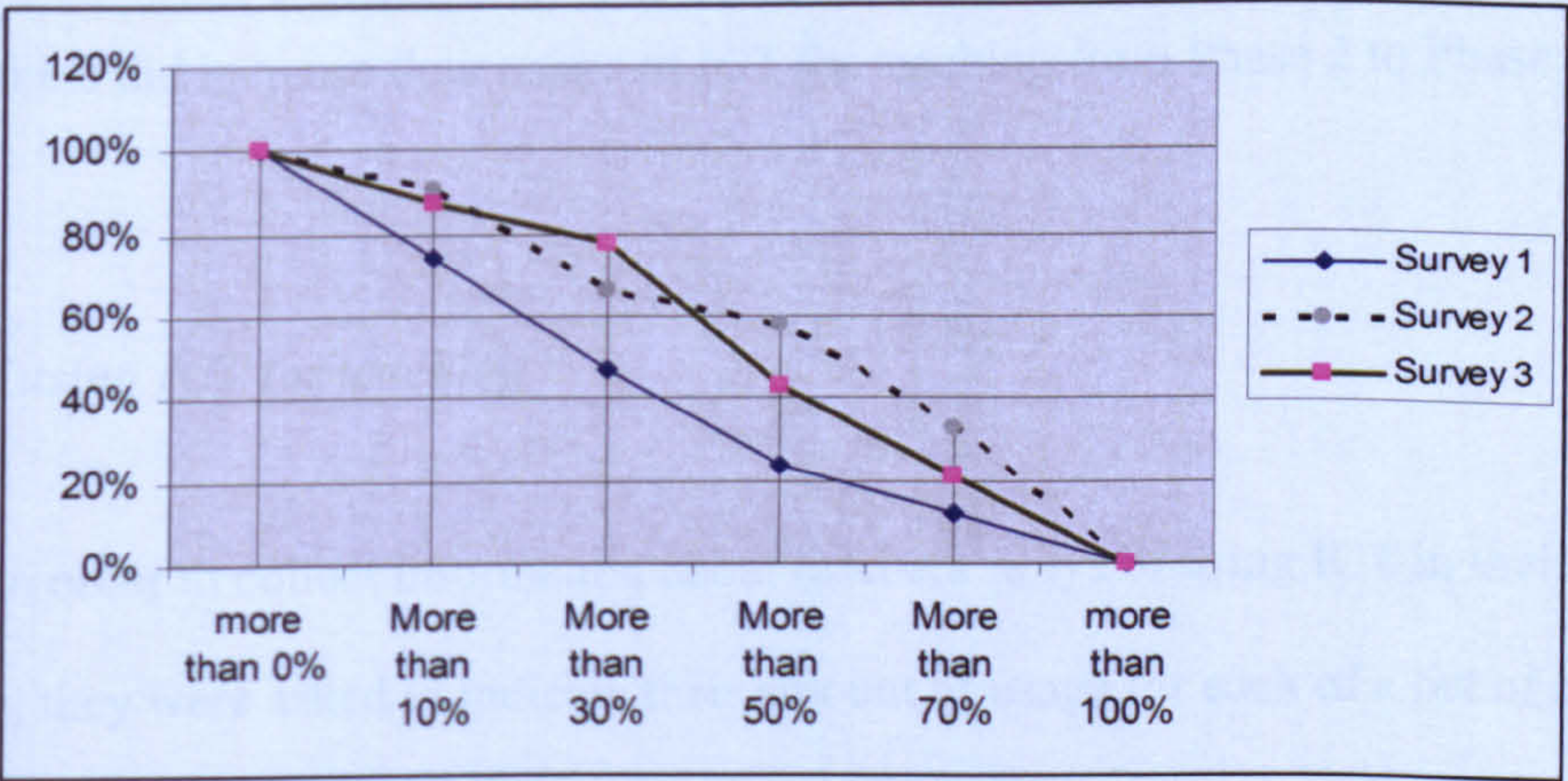


Figure 9-8 Percentage of teaching hours using ICT (Data from the 3 teacher surveys)

In Figure 9-8, Survey 2 is represented using dotted line because it might have represented a temporary increase of ICT activity at the time of the ESR. The exceptionally high percentage of teachers choosing their usage of ICT for more than 50% in Survey 2 (July 2006) is an example. When the fraction of teaching hours

using ICT collected from Survey 1 (January 2006) and Survey 3 (August 2007) are compared, an increase of percentages throughout the whole range is shown.

From the results, about 80% of teachers reported that they had used ICT for more than 30% of their teaching time in Survey 3 (August 2007) while only 47% reported the same amount of usage in Survey 1 (January 2006). The increase in the amount of usage to 50% and 70% was higher in Survey 2 than in Survey 3. Percentage of teachers using ICT for more than 50% of teaching time increased from 24% in Survey 1 to 58% in Survey 2 but dropped back to 43% in Survey 3. It has been mentioned earlier that using ICT in teaching and learning was a major concern of both the government and the school. The marked increase can be explained by the ESR held just before the survey was given out. The relatively low response rate of Survey 2 can also be a reason. However, we can still conclude from the increase from 24% to 43% that teachers did increase their usage of ICT for teaching from Phase 2 to Phase 3 of the study.

Ways of using ICT for teaching

In order to collect information about teachers' ways of using ICT in their teaching, they were asked to indicate their amount of usage for each of a list of common applications by entering 0 to 3 with 0 representing 'never', 3 for 'all of the time', 1 and 2 between the two extremes. In the report, the number of respondents choosing 2 and 3 are added up and treated as frequent usage for comparison.

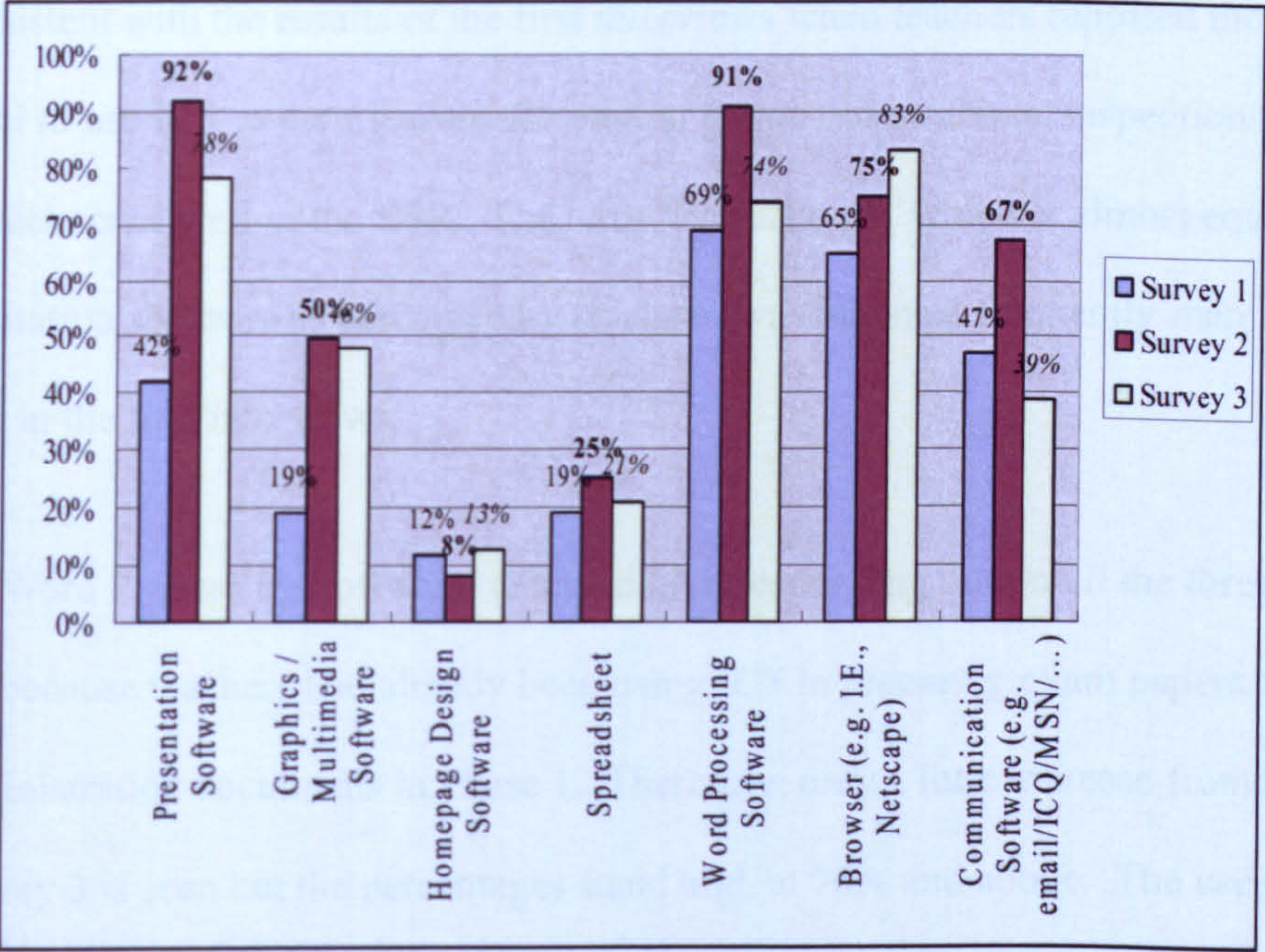


Figure 9-9 Ways of using ICT for teaching (Data from the 3 teacher surveys)

The bar chart in Figure 9-9 shows a significant increase in percentage of teachers using presentation software for teaching from Survey 1 to Survey 3 with a sharp increase in Survey 2 and a little drop in Survey 3. A similar trend is shown for using graphics or multimedia software. There is a steady increase in the use of browsers, that is the Internet, from Survey 1 to Survey 3. Slight increase is also shown in the usage of word processing software and very little increase is found for the use of spreadsheet. There is almost no change and even a small drop in Survey 2 for the use of homepage design software. There is also a sudden rise and finally a drop in the use of Communication software.

From the results described above, Presentation Software, Word Processing Software and Web Browsers were the most frequently used software for teaching throughout this study. The significant increase in the usage of presentation software,

was consistent with the results of the first interviews when teachers reported they had tried hard to use ICT in their lessons for mutual lesson observations, inspection by senior teachers as well as the ESR. The term 'PowerPoint', which is almost equivalent to presentation software as perceived by teachers, was the most frequently mentioned software in the first interviews.

'Word Processing Software' received high responding rate in all the three surveys because teachers had already been using ICT in preparing exam papers, notes and administration documents in Phase 1. Therefore, only a little increase from Survey 1 to Survey 3 is seen but the percentages stand high at 70% and above. The use of the Internet also stands high in Phase 1 with only a little less than that for 'Word Processing Software'. It rises gradually to a percentage higher than the use of 'Word Processing Software' in Phase 3. The exponential increase of websites as shown in Figure 9-10, the rapid increase in speed of Internet connection and the big drop in prices of subscription to Internet services can justify the findings. This big change has influenced the ways of teachers' teaching and students' learning. However, Figure 9-10 might have under represented the situation if compared with that quoted in the BECTA ImpaCT2 report (DfES, 2002). Harrison (2011) quoted that there were 25 billion webpages on the Internet in 2011.

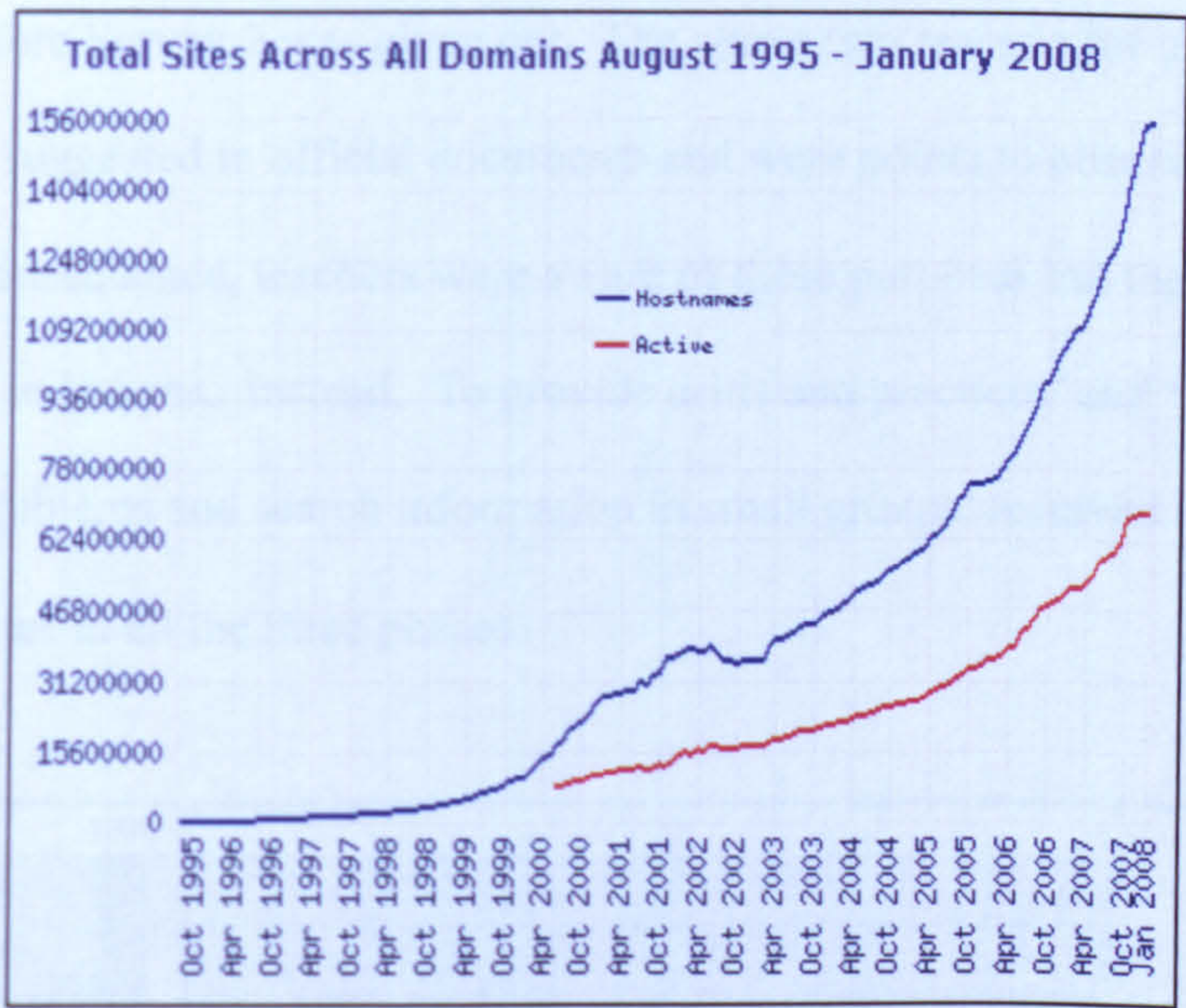


Figure 9-10: Total sites across all domains August 1995-January 2008
(Digital Inspiration, 2008)

In order to understand why teachers used ICT more frequently, their reasons for using ICT in teaching was included in the survey. Results of the three surveys are shown in Figure 9-11. Two reasons suggested by teachers in Survey 1 were added to the list for Survey 2 and Survey 3. ‘To facilitate teachers’ explanation / demonstration’ and ‘To provide suitable teaching materials and activities to facilitate the understanding of knowledge’ are two of the most important reasons for using ICT in their teaching. Both of them scored 100% in Survey 2. ‘To provide opportunities for creative work in order that students could learn better’ has shown steady increase throughout the three surveys and becomes the third popular reasons, which has selected by more than 60% of the teachers. It is worth noting that ‘To let students learn interactively’ and ‘To let students learn through communication with people over the world’ which were added to Survey 2 and 3 as suggested by teachers in Survey 1 received high responding rates in Survey 2 but with a drop in Survey 3. A possible reason for this is the ESR which was

carried out just before Survey 2 was given out. The above two reasons for using ICT were the purposes suggested in official documents and were points to observe by the ESR team. As a consequence, teachers were aware of these purposes but they were not easy to implement in lessons. Instead, ‘To provide drills and practices’ and ‘To let students analyse problems and search information in small groups’ received quite similar response rates in all the three phases.

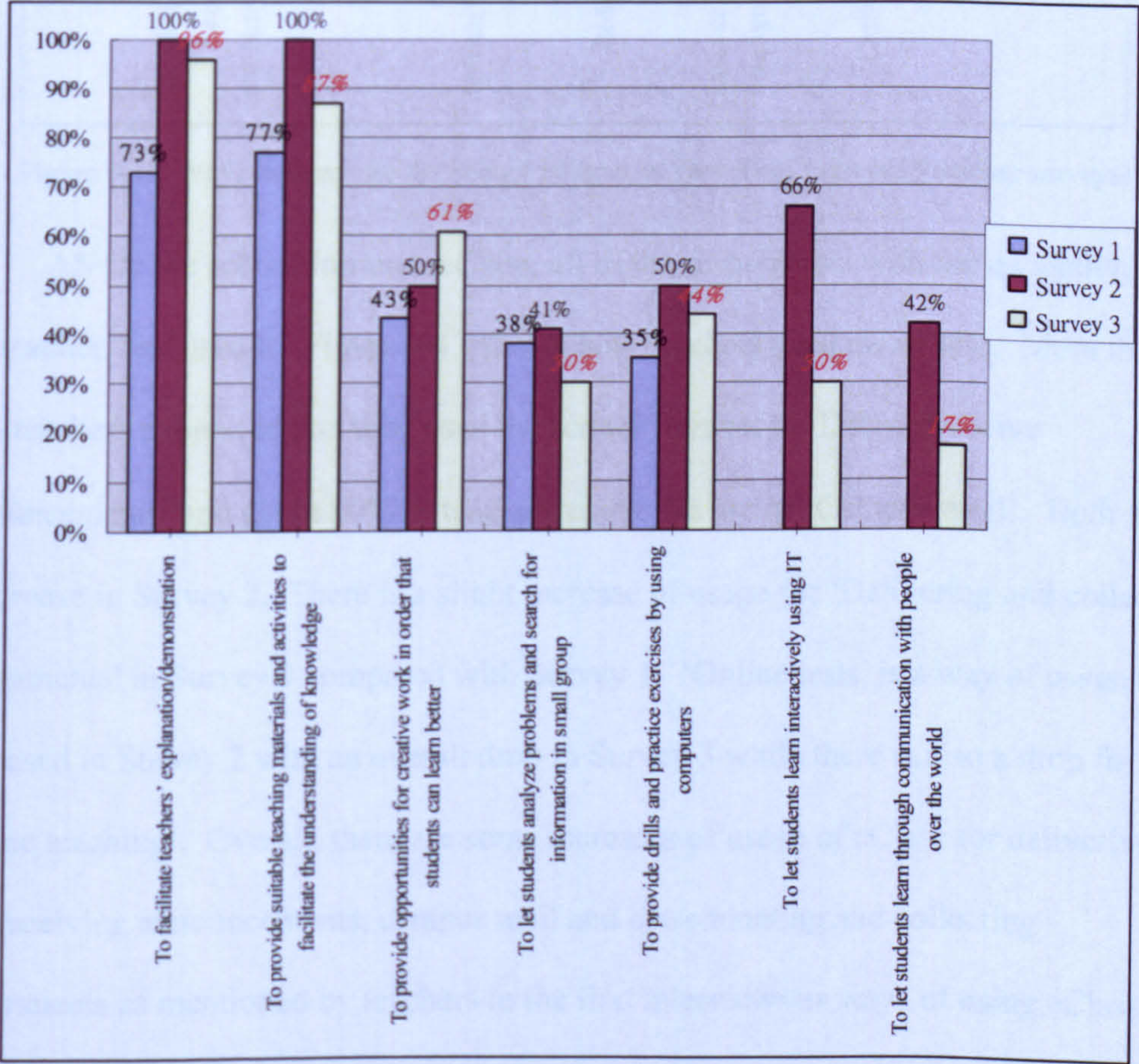


Figure 9-11 Reasons for using ICT in teaching (Data from the 3 teacher surveys)

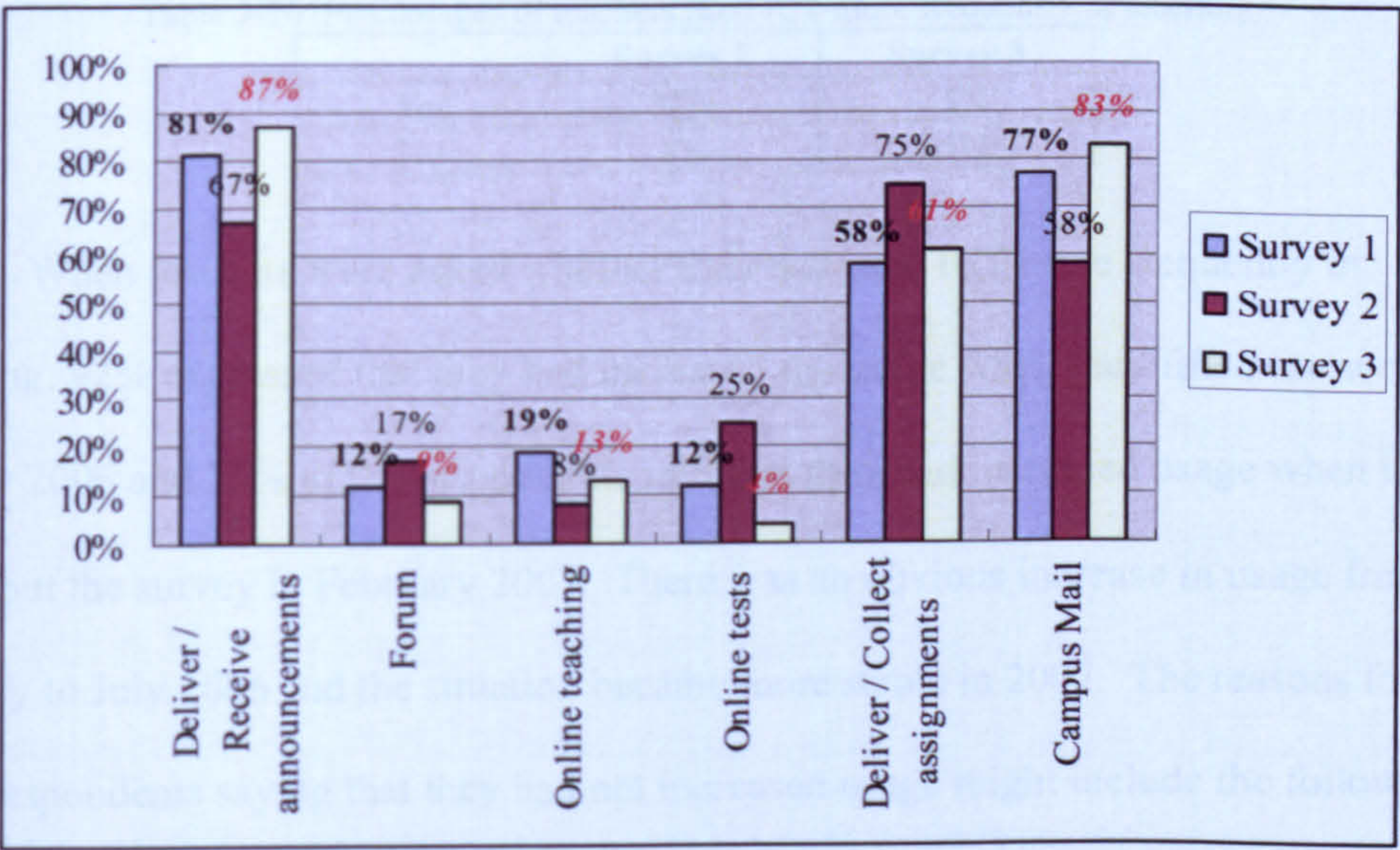


Figure 9-12: Ways teachers use the School Intranet, eClass (Data from the 3 teacher surveys)

AS for the school Intranet, eClass, all of the respondents with the exception of one teacher, had used it. Figure 9-12 shows how teachers used the eClass. More than 80% teachers expressed that they used the school Intranet to ‘Deliver/receive announcements’ and about 80% of teachers chose the use of ‘Campus mail’. Both show a decrease in Survey 2. There is a slight increase of usage for ‘Delivering and collecting assignments’ in Survey 3 compared with Survey 1. ‘Online tests’ is a way of usage that increased in Survey 2 with an overall drop in Survey 3 while there is also a drop for ‘online teaching’. Overall, there are some increases of usage of eClass for delivering and receiving announcements, campus mail and disseminating and collecting assignments as mentioned by teachers in the first interviews as ways of using eClass. However, there is a general decrease in the other usage such as online tests, online teaching and forum. This can be explained by the comment collected on the SEE day that the Intranet system was not stable and some teachers criticized its inconvenience of use.

Table 9-10 Percentages of teachers used ICT more frequently in teaching

	Survey 2	Survey 3
Yes	92%	35%
No	8%	65%

When teachers were asked whether they had used ICT more frequently in teaching, 92% expressed that they had increased the usage when they filled the survey in July 2006 and 35% of the respondents said that they had increased usage when they filled out the survey in February 2007. There was an obvious increase in usage from January to July 2006 and the situation became more stable in 2007. The reasons for 65% respondents saying that they had not increased usage might include the following. First, more than 10 new teachers joined the school for the school year 2006/07. Some of them already had the habit of using ICT in their teaching. They had no way of making comparison. Second, three teachers explained that they had used computers almost as frequently as in the previous terms and third, one teacher expressed that he/she did not have any lesson in the second term. Therefore, when asked whether they had increased the usage compared with the term before, the percentage was only 35%. Since names of the respondents are anonymous, there is no way to identify them and the reasons are uncertain.

Reasons why teachers increased usage of ICT in their teaching

Figure 9-13 compares the reasons why teachers used ICT more frequently from results of Survey 2 and Survey 3. In the figure, ‘More effective in delivering a lesson’ is the most popular reason chosen by teachers in both surveys. The percentage even reached 100% in survey 3. ‘The school provided me with a notebook computer’ is the next popular one with 88% in survey 3. The percentage of teachers who chose ‘This is

the policy of the school' is high at 73% in Survey 2 but dropped to 38% in Survey 3.

The reason is most likely due to the External School Review just before Survey 2 was given out. According to both the school and government policies, teachers were required to use ICT in their lessons. 'Using multimedia can make a lesson more interesting', 'Students learn better when IT is used in lessons' and 'There are many resources available on the Internet' are also popular choices as reasons for increasing their usage of ICT in teaching. The reasons 'More efficient in delivering and receiving assignments on eClass', 'IT facilitates communication with people over the world' and 'The IT support is better' are selected by some but less than half of the teachers as their reasons for increasing usage of ICT in teaching.

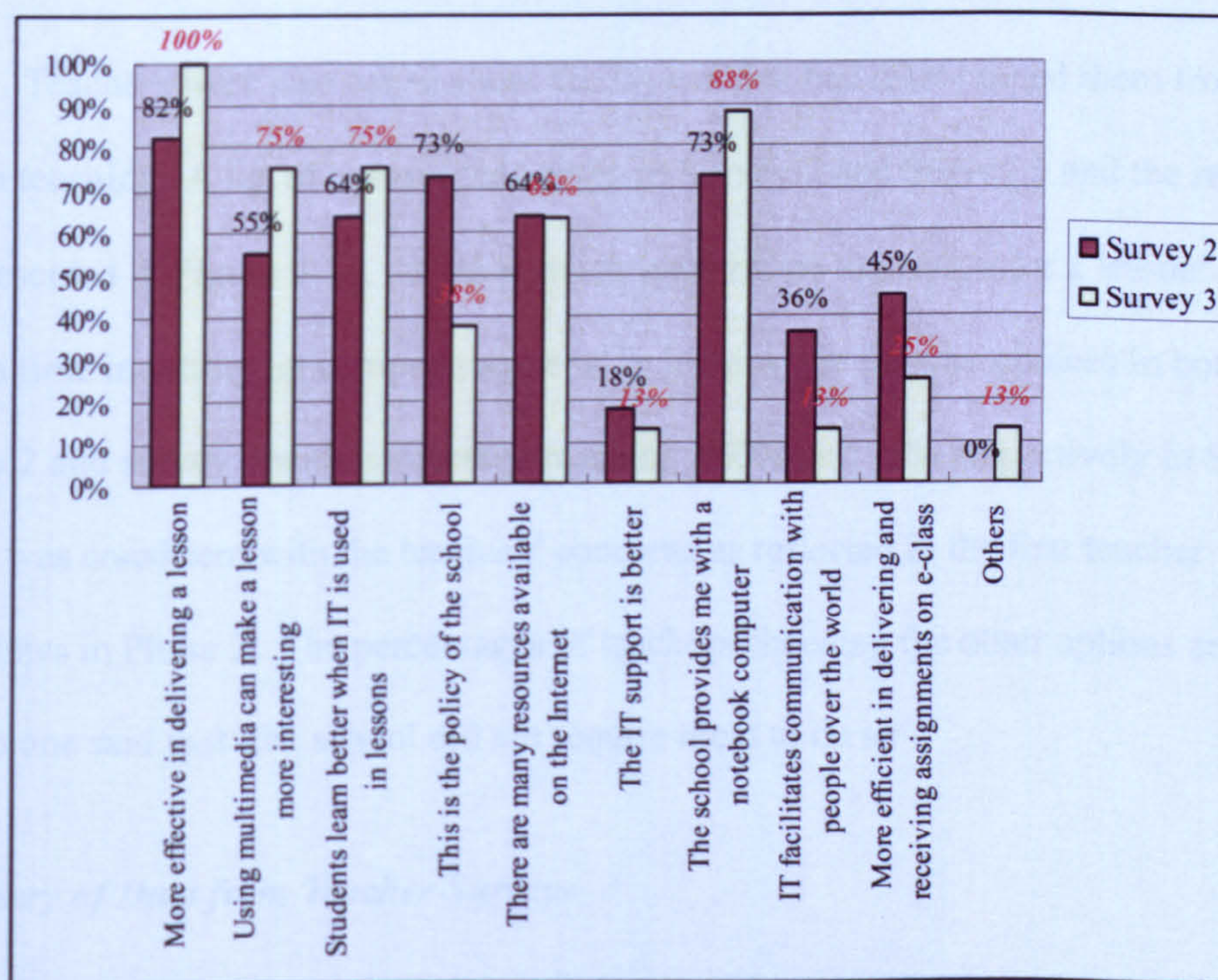


Figure 9-13 Reasons why teachers increased usage of ICT in teaching – Comparison of Survey 2 and Survey 3 data

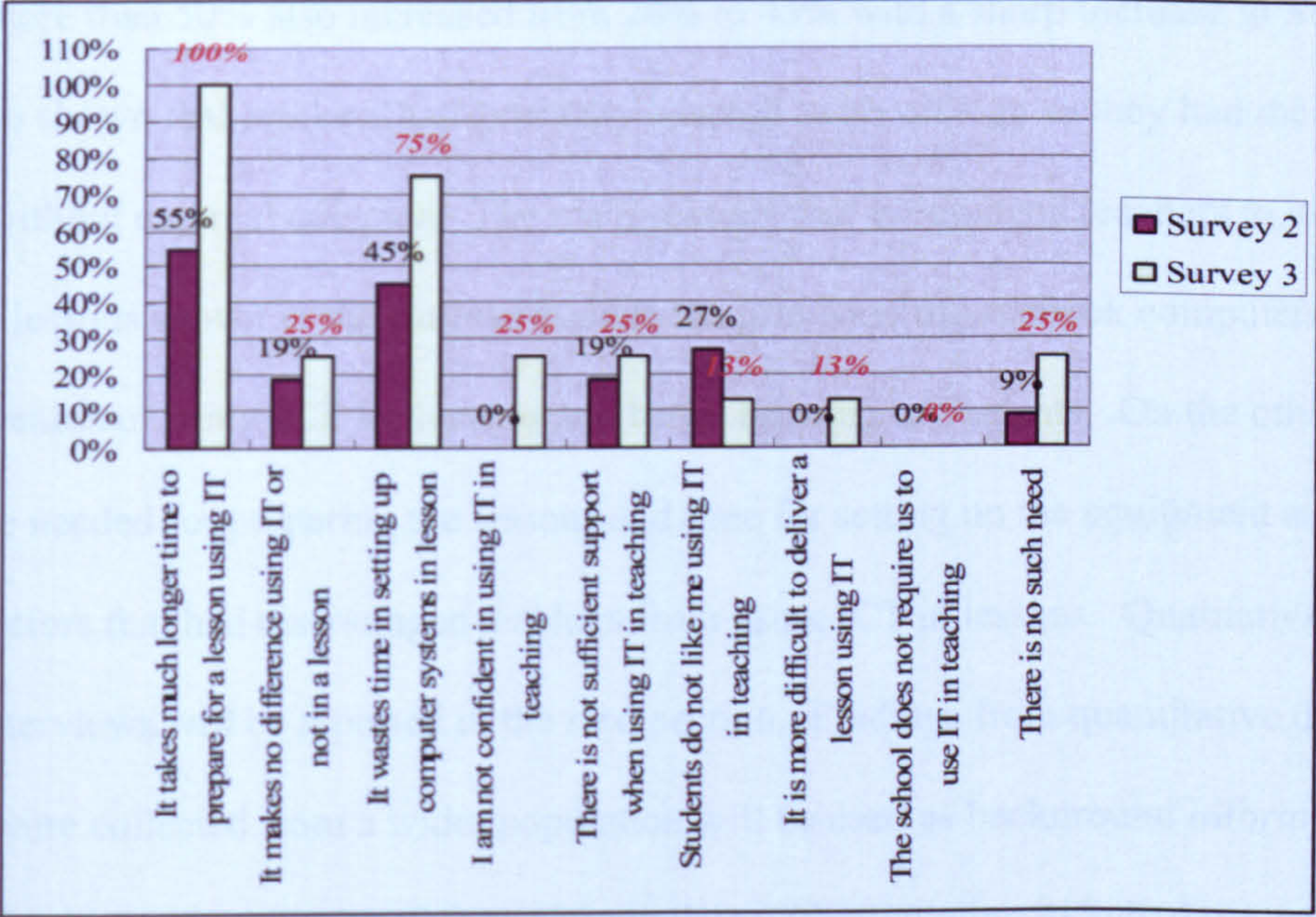


Figure 9-14 Factors that discouraged teachers from using ICT in teaching – Comparison of Survey 2 and Survey 3 data

Teachers were also asked about the factors that had discouraged them from using ICT in teaching. A list of reasons was given in Survey 2 and Survey 3 and the results are presented in Figure 9-14. ‘It takes much longer time to prepare for a lesson’ and ‘It wastes time in setting up computer systems in lessons’ are popular choices in both survey 2 and survey 3 with percentage reaching 100% and 75% respectively in Survey 3. These was consistent with the teachers’ concerns as reflected in the first teacher interviews in Phase 2. The percentages of teachers choosing the other options are low and no one said that ‘the school did not require them to do so’.

Summary of Data from Teacher Surveys

From the teacher surveys, it is found that there was an increase in use of ICT in teaching. The percentage of teachers using ICT for more than 30% of lessons increased from 47% to 78% from the beginning of Phase 2 to the end of Phase 3 and that of

using more than 50% also increased from 24% to 43% with a sharp increase in Survey 2. It is also shown that teachers had gradually adapted to the change so they had increased usage without external coercion. The main reasons that encouraged teachers to use ICT in their lessons shown in the surveys include the provision of notebook computers, the effectiveness of using ICT for lessons and better learning of students. On the other hand, the time needed for preparing the lessons and time for setting up the equipment are the main factors that had discouraged teachers from using ICT in lessons. Qualitative data from interviews will be reported in the next section. Findings from quantitative data which were collected from a wider population will be used as background information for the analysis of qualitative data and triangulate with each other to help draw more reliable conclusions.

9.2.6. Report of the Interviews with the Principal, Teachers and Student Groups

In this section, the interviews with Principal B, Teachers A, B, K and W as well as Form 1 and Form 5 student groups will be reported. The principal's interview data are an important source of information to show how and why the school policies were set up and the strategies to implement them. Since Principal B was new to the school, her views can be considered as objective description of the school situation in using ICT in Education. The teachers' interview data will be analysed to study the change process and identify the factors that might have encouraged and those that discouraged teachers to change. Group interviews with the Form 1 and Form 5 students will help to understand students' responses to using ICT in lessons and cross-check with teachers'

views. These results will triangulate with each other to help more accurately portray the situation.

Interview with the Principal

The interview with Principal B was conducted in Phase 3, more than a year after she took up the post of principal of the school and about a year after notebook computers were provided to teachers. The purposes of the interview were to collect the Principal's view on the school's ICT environment and teachers' use of ICT for teaching in the focal school, to understand her reasons for setting up the school policies for the use of ICT in teaching and learning and her strategies for implementing them. Since the interview was conducted more than a year after her policies were set up and enforced, her comments on the progress of the change in the school will be very useful in understanding the whole process and triangulating with the data from other sources. Record of the interview is attached in Appendix TP1.

In the interview, Principal B described the situation of the school before notebook computers were given to teachers as in the following:

"I was very surprised, because it was 2005, already it was the 21st century, yet, there were only 8 computers in a staff computer room which is very very small for more than 50 teachers to use. I think that no way can my teachers catch up with using IT in education extensively if they didn't even have a computer at hand. ... At that time (Sept-Nov 2005), I think only a few teachers, like those IT teachers or a few in one or two departments only used computers frequently. I think around 10 teachers" (TP).

"Compared with what I saw in my previous school and in other schools I knew, I would say it's very low" (TP).

She emphasized the need for suitable hardware and software and their ease of use in order to encourage teachers to use ICT in teaching. In her view, one of the most important factors for implementing the use of ICT in teaching and learning was “*money*”. She put acquiring notebook computers for teachers, installing computer systems into classrooms and upgrading computers high on the priority list in order to speed up the change process. All of these required extra money and she therefore applied for funding from the school management board to make her plans possible.

“Number one, I must get the whole school equipped with computers, and I must start with equipping my colleagues with computers and also help them learn the skills of using the computers in direct teaching. ... I don't just want one computer in each classroom. My dream or my plan is to have at least 6 to 8 computers or workstations in the classroom so students can have one computer for each group of say 5 to 6” (TP).

After one year of her service in the school, she found that teachers used ICT much more frequently in most departments. According to her plan, all teachers should use ICT in direct teaching in the first stage and all classrooms should be installed with computers in a later stage.

The second factor named by Principal B was ‘people’. She considered the vice principal, who was also taking charge of the ICT development in school and had worked hard to promote the use of ICT in the school, as an example. Principal B made it a requirement for teachers to arrange mutual observation of lessons using ICT. Teachers did try using ICT in their teaching and asked their subject head and other teachers to observe their lessons in order to fulfill the requirement in the second term of the school year. Principal B saw that teachers felt the pressure at the beginning but after going through the initial stage, both teachers and students experiencing the benefits of

using ICT were happy about the policy. She considered the low use of ICT for teaching and learning as one of the reasons why students' results in public examinations were not as good as they could have achieved. In her school report issued in 2006, she pointed out an improvement of students' performance in public examinations after the introduction of using ICT in teaching and learning. In the school report for 2005/06, an improvement was shown in the passing rate and the credit rate of both the Advanced Level and Certificate of Education Exams.

"It was my belief that using IT really can improve academic performance" (Appendix D8).

"I think we installed computers say in November and then when the exams were held, it was May, April for AL and May for CE. In that summer we saw a big jump in both passing and credit rate" (Appendix D8).

"Subjects like History, right, Miss Y and Mr. Z had used a lot of IT in classrooms since the purchase of computers and you can see a significant rise in the value-addedness" (Appendix D8).

"in Summer 2006, we found slight increase right and some big increase in most of the subjects" (Appendix D8).

Principal B also considered one of the factors that teachers used ICT in teaching was that they cared about students' learning.

"They cared the students and they have their intrinsic desire or motivation to improve their own teaching and ... determination to help students to learn better" (TP).

"... with pressure, then they worked hard and then they had motivation, may be intrinsic in this initial stage but they found that right it's really beneficial to student learning" (TP).

"... the strategies of implementing the policy are very important to the success" (TP).

What Principal B viewed as important in helping teachers change to use the technology included the availability of exemplars and colleagues who were more advanced ICT users to share their experiences. She thought that ‘this practice (mutual lesson observation) is most important’ in increasing teachers’ usage of ICT in lessons.

To summarise, the factors that Principal B rated important for the implementation of using ICT in teaching and learning were (1) resources available, including money, hardware and software, (2) teachers’ intrinsic desire to improve their own teaching and determination to help students to learn better and (3) having exemplars and sharing among staff. The final factor was the importance of monitoring and follow-through for the successful implementation of any policy of the school.

Lesson Observations and Second Interviews with Teachers

According to the data collection plan, the selected teachers would be interviewed again in Phase 3. The purposes of the second interviews are to see if there were any further changes in teachers’ practice and their views on using ICT in teaching and learning. Interviews were arranged for four of the six teachers in February 2007. The other two were not able to attend the interviews because one was seconded to the EMB and the other was too busy. The researcher invited Teacher A and Teacher B to allow their lessons to be observed. The researcher then observed a Form 5 and a Form 1 lesson conducted respectively by Teacher A and Teacher B before the second interviews were carried out. Some students of these classes were invited for group interviews after the lessons for collecting their views towards teachers’ use of ICT in teaching. Since the Form 5 class was preparing for their external exam, the group interview was

arranged after the exams in May. Group interview with the Form 1 students was carried out immediately after the lesson. Reports of lesson observations, interviews with teachers and group interviews with students will be reported in the following.

Report of Lesson Observations

Two lessons, one of Teacher A's and the other of Teacher B's lessons, were observed for the use of ICT in teaching. They were conducted respectively in a classroom and the Music Room. The lessons were observed before the second interviews. The main points observed are summarised in the following.

Teacher A's Lesson in a Standard Classroom

In Teacher A's lesson, a PowerPoint presentation was used throughout. The computer was set up before the lesson so there was no waste of time. In the first part of the lesson, Teacher A used PowerPoint to introduce to the students some basic concepts using line graphs. Different lines were moved up and down at different time in order to show the trend of change of values. It was then followed by a quiz in the form of Multiple Choice questions. Students were asked to guess the answer after each question was shown on the screen. The correct answer was then shown with explanations.

Students were attentive throughout the lesson and participated actively in the Question and Answer part of the lesson. With the help of diagrams and animation effects of the PowerPoint presentation, the concepts were taught clearly. The Multiple Choice questions at the end of each session did help Teacher A to check the progress and challenge students to respond. In the PowerPoint, Teacher A added some

cartoon characters that students loved to see. Students showed interest in the lesson anticipating something to happen in each step.

In this lesson, the PowerPoint was designed very carefully with the slides leading the flow of the lesson. Teacher A had designed every detail of the lesson anticipating the problems students would ask and guiding them to solve the problems with the help of diagrams, graphs with animations and questions and answers. The lesson was clearly one tailor-made for the class but not just copied from materials provided by the publisher or prepared by some other teachers.

Teacher B's Music Lesson

In Teacher B's lesson, not all students were attentive in the beginning. Some students sitting at the back of the Music Room had made noises and played around. However, when Teacher B invited the whole class to join in the Karaoke with a video played on the computer and the lyrics displayed on the screen, most of the students were attracted to it and started singing. Teacher B then displayed a spreadsheet with marks showing their performances during lessons. Students were excited and tried hard to volunteer their answers. Even the one who played around at the beginning started to raise his hand and answered questions. Marks were deducted from those who failed to bring their books and added to those who answered questions. There was a session with students taking turns to play their recorder in front of the whole class and then a session introducing different musical instruments. Teacher B played a short video to introduce the instruments and then gave them a quiz. In the lesson, students learnt how to identify the instruments by listening to the sound. They were given the image of the

instruments afterwards. Teacher B could shift quite efficiently from one screen to the other and the lesson ran smoothly. With the audio visual aid of the computer, students were motivated to learn and most of them were attentive during the lesson.

Reports of the Second Interviews with the Selected Teachers

The second interviews were carried out in February 2007, more than half a year after the first interviews. Length of the interviews was similar to those of the first interviews. Table 9-11 is a summary of the length of time taken in the interviews and the number of words in the translated records. Number of responses refers to the number of times the interviewees responded to the researcher and the number of words for reply refers to the number of words translated from the interviewees’ reply.

Table 9-11 Time and number of words recorded in Teacher Interview 1 and Interview 2

	Teacher Interview 1		Teacher Interview 2	
	Total	Average	Total	Average
Time (minutes)	177.5	25.4	98.5	24.6
No. of responses	290.5	41.5	146	36.5
no. of words	19436	2776.6	11132	2783
Reply only (words)	14124	2017.7	9028	2257

Teacher A (Refer to TA2 for the full record of the Interview)

Teacher A pointed out that she had used ICT very differently from what she did in the last year, that is using PowerPoint for presentations. Firstly, she used eClass, the school Intranet and eLearning platform much more frequently in this year. She uploaded notes on eClass for Form 6 and Form 7 students to make sure that they could all access to the resources. Secondly, she made big improvements in the design of PowerPoint presentations.

“There are some changes in the way how I use computers. For long they have been used to display things. After using them for a while I can think of the special effects they have” (TA2).

Her target was to make self-directed learning materials. Despite the time needed for the preparation and the limitations of the software available, she tried different ways to improve the learning materials produced. She found that different designs were needed for students of different abilities. She also emphasized the need to modify the materials to cater for students of different abilities and interests if it was for self-directed learning purpose as stated in the school plan. She had very careful thoughts on the design of self-learning materials for her students and she emphasized that the design should be student-oriented.

“... The first version won't work well it's difficult to achieve the desired outcome with the first version. The first version is an experiment you need to know what doesn't work and where to add some more instructions” (TA2).

However, she also pointed out the weaknesses of depending on computers for self-directed learning since not all students could have access to computers everywhere. For students of other levels such as the Form 4 and Form 5, she also used PowerPoint for presentations in almost every lesson. She found that the sense of novelty would give students more varieties in lessons. The Form 4 students attended to her lessons with anticipations but she stressed that she was not sure whether they really found the lesson interesting.

“... Just like the Form 4 class I taught last year, they came in with anticipation. Knowing that you will use PowerPoint they want to see what you are going to do, perhaps they are only interested in seeing the varieties, see what you are going to do this time” (TA2).

She agreed that using ICT could help students to learn but teachers should plan in more detail and from the perspectives of students in order to make the lessons effective. She emphasised the importance of the ideas behind the design of the teaching material. The advantage of using ICT was that she could save the teaching resources and only modify a little to tailor for different groups of students in the coming years. It was very time-consuming at the beginning but in the long run it could save time.

“In saying we need to appeal to five senses in learning, computers can draw pupils’ attention, increase their interest and motivate them more with more varieties in teaching, which is different from work like copying using pens and paper something that they don’t like” (TA2).

Teacher B (Refer to TB2 for the full record of the Interview)

Teacher B also showed different ways of computer usage for her teaching. She said that the eLearning platform, eClass, was used more frequently this year for submitting homework and uploading learning materials such as worksheets. It helped her to collect homework and keep the worksheets more conveniently. Students could easily download them from eClass even if they had lost them.

“If students are asked to do some worksheets and submit after some time but not the day after, some students will have lost them. Now, the files can be uploaded to eClass, the public file area. ... They can get them back. It’s more convenient ...” (TB2).

She found that computers could help her improve class discipline as well. She used the record keeping function to encourage students to answer questions and behave better in class.

“...then by this way, records are cancelled one for one so they become very active in answering questions in lessons, otherwise, they are reluctant to” (TB2).

“Because they are all looking at the mark sheet on the screen, they know what will happen as a consequence, nothing tricky, so it is helpful to some extent in this way of use” (TB2).

She also used computers to get and manage the resources for lessons so that she did not need to turn around to write things on the blackboard or use other equipment during the lesson. Besides, she required the junior forms to do presentations of their group projects using PowerPoint. She found the effects very good since all group members were required to prepare and do the presentations so they were involved in the activity thus making it more effective. The visual effects when ICT was used also helped those visual learners to learn better. However, she also recognized the importance of good design of usage, otherwise, students would find it boring very soon.

“Overall, it's useful for teaching since it is faster for retrieving information, more convenient for storage and others. ... it's really convenient for preparing lessons especially now that each of us has a notebook computer” (TB2).

“For students, they cannot be given the same kind of activity for long time or they will fall asleep. ... You need to shift between methods” (TB2).

When asked about the reasons for changing to use ICT, she expressed that the hardware available was most important. Furthermore, she was now more familiar with the tool and the positive effects in class were encouraging. Though there were still quite a lot of technical problems when ICT was used in lessons, she thought that it was more convenient than before when there was no LCD projector in the room and teachers needed to borrow computers for lessons.

Teacher K (Refer to TK2 for the full record of the Interview)

Teacher K was a low user at the beginning but he used it quite a lot this year. He could now manage the general applications like surfing the Internet for information such as songs and pictures for the lessons. He said that the improvement was through practice. The equipment was now more convenient to use so he used it more frequently.

“Yes, I have used information from the web. General operations, like setting up computers, starting up the system are smoother than before. Maybe due to the equipment of the school. They are now easy and convenient to use” (TK2).

“Much faster! ... and (it can) add varieties to the lesson. PowerPoints are normal, like those provided by the publishers, we just need to modify it a bit and it can be used in lessons” (TK2).

He used PowerPoint presentations, downloaded songs for themes related to national education and played excerpts of historical films for his lessons. He could get a variety of resources other than that provided by the publishers. He thought that it added varieties and made lessons more interesting, thus more effective and efficient. He could have more interactions with the students and through question and answer, students could learn better and their standard could be raised. When asked about the reason for his increase of usage, he said the comprehensiveness of information and the teaching effectiveness were the reasons.

Teacher H (Refer to TH2 for the full record of the Interview)

Teacher H said that in the previous phase, he mainly used PowerPoint presentations for lessons. He could now think of using computer in teaching Chinese Language not only as a computer assisted learning tool but also to record students’

presentation for feedback. With the storage capability of the computers, students could review their presentations after receiving comments from teachers which was good for their language development. Students could also improve their skills of speaking by reviewing the recordings of themselves or others. He thought that the modes of assessment introduced by the Examinations and Assessment Authority also encouraged the change.

"... Like in this lesson, due to the limitation of time, if the records made during the lesson can be put on the web then it will be very helpful. ... " (TH2).

"... I feel that, by using IT, we can point out the problems immediately and store the information, then do a simple evaluation and assessment by the end ... " (TH2).

During the interview, he showed pedagogical use of ICT for the improvement of his teaching. He found ICT helped teaching in at least three ways.

"Firstly, it is for attracting the attention of students for learning. ... Secondly, when we use computer in teaching, the visual and audio effects can help to produce some teaching materials with more varieties. ..., with IT, teaching can be more interactive. ... It is more efficient in terms of time. ... Third, ... with this computer design we can have a very good school based sample as part of our teaching ... " (TH2).

Teacher H pointed out that the encouragement of the school was important in making such big changes in his teaching. Good examples of teaching from his colleagues had provided him with models for change. However, technical problems were obstacles for the progress. Time constraint was another.

Summary of Data Collected in Second Interviews

Table 9-12 shows the frequency of the terms and key words used and they are compared with that collected in the first interviews. A simple tallying of the terms or words used by the teachers in the interviews related to their reasons of using or not using ICT in their lessons might have shown their concerns at different stages.

Table 9-12: Frequency of use of key words by teachers in Interview 1 and Interview 2

Words / Topics	Teacher Interview 1		Teacher Interview 2	
	Total	Average	Total	Average
Leadership	4	0.6	0	0
Policy / requirement / rule	83	11.9	8	2
<i>Subtotal</i>	<i>87</i>	<i>15.6</i>	<i>8</i>	<i>2.3</i>
Hardware (except notebook)	117	16.7	38	9.5
Notebook computer	25	3.6	2	0.5
<i>Subtotal</i>	<i>141</i>	<i>20.3</i>	<i>40</i>	<i>10</i>
Software (except publishers)	39	5.6	6	1.5
Publishers	5	0.7	3	0.8
PowerPoint	52	7.4	8	2
<i>Subtotal</i>	<i>96</i>	<i>13.7</i>	<i>17</i>	<i>4.3</i>
Convenience / convenient	15	2.1	6	1.5
Efficient	9	1.3	7	1.8
effective	6	0.9	2	0.5
<i>Subtotal</i>	<i>30</i>	<i>4.3</i>	<i>15</i>	<i>3.8</i>
External	14	2	0	0
Pressure	5	0.7	0	0
Support	3	0.4	4	1
<i>Subtotal</i>	<i>22</i>	<i>3.1</i>	<i>4</i>	<i>1</i>
Belief	2	0.3	0	0
Culture	8	1.1	0	0
<i>Subtotal</i>	<i>10</i>	<i>1.4</i>	<i>0</i>	<i>0</i>
Time	77	11	37	9.3
Problem	22	3.1	21	5.3
<i>Subtotal</i>	<i>99</i>	<i>14.1</i>	<i>58</i>	<i>14.5</i>
Usage	0	0	5	1.3
Self-directed learning	0	0	3	0.8
More frequently / often	30	4.3	16	4

By referring to Table 9-12, it is found that teachers did not mention words relating to hardware, such as ‘notebook computers’, software such as ‘PowerPoint’ and policy as often as they did in the first interviews. When factors affecting the usage of ICT were considered, ‘hardware’ was still mentioned often but ‘notebook’ was rarely used. This might have shown that hardware provision was most important in facilitating the usage of ICT in teaching and learning. Since all teachers already had notebook computers for more than a year, the lack of this type of hardware was no longer concern.

School policies, requirements and external forces were no longer as important as they had been in Phase 2. They had less effect on the usage of ICT in teaching compared with that in the first interviews. From the interviews, teachers showed their concerns on other matters such as the ways of using ICT for the improvement of their teaching.

In Table 9-12, time and hardware problems were still mentioned most frequently as obstacles for the development of using ICT in lessons. They were also of the top two concerns in the first interviews. The number of occurrences of 'Time' increased from 7 to 19 for Teacher A and dropped slightly from 18 to 14 for Teacher B and both mentioned the term very often throughout the interviews.

To summarise, all the four teachers who participated in the second interviews demonstrated great improvements in using ICT for teaching and showed pedagogical uses other than using it as a presentation tool. They all expressed that ICT could be an efficient tool to help them search for information from the web and add variety to lessons. They found the audio visual effects introduced by the ICT tools helpful for students to learn. All of them got some ways to make use of ICT to increase the efficiency and effectiveness of their teaching. Besides the advantages, they also mentioned certain kinds of technical problems they encountered or feared to have happened when they depended more on the computers for their teaching. All of them showed their concerns on how to fully utilize the ICT tools to improve teaching and learning. Their attitudes were very positive.

"... the resources are still not sufficient by now. In fact, still very limited ... If we explore something every day, then we can have a lot. It's thousand miles in one day in the outside world, at least we can have one mile (progress) in one day" (TB2).

Overall, the attitudes of the teachers towards the use of ICT in teaching and learning are important factors affecting their usage. Teachers all had carefully designed ways of using ICT for the improvement of their teaching even though the provision of hardware was still limited.

Student Data Collected in Group Interviews and on the SSE Day (Refer to Appendices SG1, SG2 and SX for the full records)

Students' views were important in understanding and cross-checking the situation as reported by the teachers. Purposes of the group interviews were to collect information about students' responses on lessons with ICT, their views on using ICT for learning and their comments on teachers' use of ICT for teaching. Students' responses collected in the group interviews will be summarised in the following. Written comments given by students collected on the SSE day will also be reported and used to supplement and triangulate with the data collected in group interviews.

Form 1 Group Interview after the Music Lesson taught by Teacher B

Three boys (B1, B2, B3) and two girls (G4, G5) randomly selected by the researcher were invited for a short interview immediately after the lesson. The adjectives they used to describe the lesson when they were asked how they felt about the lesson they just attended were 'not so boring', 'more interactive', 'more varieties'.

"If teachers teach by referring to the book directly, then it will be boring. But, if there is something on the screen then it will be more interesting and not so boring" (B2).

“More convenient. We can know what she (the teacher) was doing” (G4).

“I think if IT is used, then we can understand better not so confusing. ... because you can see and listen so it is clearer” (G5).

“... It’s now overused. ... It should be more balanced ...” (B1).

Though they thought that sometimes ICT was overused, they preferred to have ICT used in lessons. Their comments for Teacher B’s use of computer for recording marks were mostly positive. They could see some increase in ICT use in lessons in some other subjects and could also talk about the advantages. Since they were Form 1 students, they could not compare teachers’ usage of ICT with that of the previous years but they could compare their usage in the first term and the second. They found the increase about 70%.

“about 75%.” (B3) “60% to 75%”(B2, B3) “yes, used more frequently” (B1, B2).

When the use of ICT in Teacher B’s lesson was reviewed, students had mostly positive views.

“... because you can see the video on the screen. ... With the music, we can see how the instruments are played. So, we concentrated more to see how it works” (G5).

Group Interview with the Form 5 students taught by Teacher A

Three students invited by Teacher A attended the group interview in May, which was three months after the class observation. All these three students expressed that they were not good users of computers though two of them had more than one computer at home. They used computers mainly for checking email and writing blogs. They were not quite familiar with the school Intranet and found that it was not user-

friendly. They had encountered problems while using it to send internal mails or submit homework. One student found it more convenient to do writing exercise online but all of them found it not really educational for them to search for information on the Internet in order to complete their homework since they would just copy and paste the information but not actually think about the content. They could not learn from the exercise. However, they would search for exam papers and answers on the forums. When asked about their comments on teachers' use of ICT in lessons, they all agreed that teachers did use computers frequently in lessons but they also pointed out that teachers should not use it without a reason. To their knowledge, the school required teachers to use computers in lessons. However, they found that some teachers used it inappropriately and could not handle the tool well. Some teachers could use the tool suitably and this help them learn better.

"Don't use without a reason ... don't use inappropriately like that in some subjects..." (SH).

"For example, subject x and y. When it was not suitably used, ... it turned out that they could not handle them well. ... It was a waste of time. The teacher could not teach well with the computer and we could not learn well too" (SH).

".. but some are quite good. ... We loved to see the pictures and the teacher guided us to connect them to the content. ... We could guess and discuss together and we were happy about that" (SW).

When asked about the lessons conducted by Teacher A, they were very positive towards the use of ICT in her lessons.

"In fact , our class loved to attend the Econ lessons. When she(Teacher A) asked yes/no questions, we would all attend to it and ... " (SW).

"... we were excited and gave answers enthusiastically..." (SH).

“She had made a good PowerPoint presentation with diagrams and something we loved to see” (SE).

“The supply curve ... can move. She’s expert at making it” (SH).

Though there were advantages, they also found it could be a waste of time if there were technical problems.

“... such as problems with the connections. Sometimes, it could not show what was planned and time was wasted” (SW).

They all agreed that teachers had increased their usage of ICT in lessons. In the past few years they could recall, teachers used computers only when they had lessons in the MMLC but there were not more than 10 times in the past 5 years. Students were given the chance of using computers to learn but they had not done so seriously during lessons but sometimes only played there. They felt that it was neither helpful nor interesting to have lesson in the MMLC. In this year, they had a different experience using computers for lessons as described above. They could even talk about the different roles teachers should play when ICT was used.

“... not to teach directly but search with them and guide them to convert them to their own knowledge” (SH).

According to the experience of those students, teachers had increased ICT usage in lessons but some did it appropriately while some just did it as it was required by the school. They confirmed that Teacher A was a frequent user of ICT in her teaching. They also felt that teachers needed to improve their ICT expertise. Technical problems were the main cause of trouble and made the use of ICT a waste of time. They were also aware of the time needed for the preparation of lessons using ICT. When talking

about the eLearning platform, eClass, they all found many limitations and inconvenience in its use.

“... not only focus on the books. For example, what I'd just mentioned about viewing films for Chinese History, PowerPoint for Econ, pictures for Geography ... We use more visual and audio materials for learning ... ” (SH).

“It's better this year.... Improved a lot but still need improvement” (SW).

“Are they (teachers) required to use computers. Teachers are very busy” (SW).

Students views collected from School-Self Evaluation in 2006/07 (Refer to Appendix SX for the full record)

Written data were collected from students on the School Self-evaluation Day in 2006/07. Students pointed out a number of advantages of using ICT in teaching and learning. Form 1 students commented that ICT facilitated the communication between teachers and students and it did effectively improved student learning. They hoped that teachers could upload learning materials on eClass. They also suggested that teachers put up learning videos on eClass, video-tape lessons and upload them to eClass so that students could revise the lesson materials from home. If tests and notes are uploaded to eClass, it can help them revise and practice at home as well. Homework list and test syllabus could also be uploaded to eClass to ensure that students were all informed.

Form 2 students gave the suggestions that teachers could put highlights of the lessons on eClass to facilitate student learning and lessons preparation. They suggested the school to set up a forum for discussing homework or problems arisen from lessons.

They also suggested teachers to put up homework and information on eClass to increase the usage.

Form 3 students wrote that they could get information from teachers on eClass so that they had improved effectiveness of learning and saved time in searching for information. They also suggested that teachers could put extra information on eClass and required students to submit their homework on it.

Form 4 students pointed out that using i-mail on eClass could enhance communications and following the links given by teachers could help them search for information. They suggested teachers to put lesson materials and past papers on eClass to encourage the usage of it. Form 6 students suggested teachers to put supplementary materials and assignments on eClass to fully utilise it.

Summing up their comments, students in all forms suggested teachers to put learning materials, exercises, tests, past papers and useful links on the eLearning platform, eClass. They thought it would facilitate learning. They saw the advantage of getting updated information from the Internet and making lessons lively using PowerPoint and eBooks. They thus encouraged teachers to use computers in lessons and take students to the MMLC more frequently.

9.2.7. Summary

From the group interviews, students were positive towards the use of ICT for lessons. All the five Form 1 and three Form 5 students in the group interviews pointed out some advantages of using ICT in teaching and learning. All the Form 1 students

preferred the use of ICT in lessons. To students, ICT was a tool that helped them to learn and understand the subject content better. The following are some comments given by students on their experience of being taught with the help of ICT.

“I felt the information given by teachers is richer than before. Since teachers have their own notebooks, they will search more information for us. For example, history teacher searched much more information for DB, DG and more diagrams for us. There will be lots of information on the web for us to search” (SW in SG2).

“I have the experience that I myself search information about a topic, do a presentation and then ask somebody to teach me the topic. Then I learn much better than taught by somebody from the very beginning” (SH in SG2).

“... I feel that in Form 3 (school year 2004-05), teachers seldom used computer for teaching but in Form 4 (school year 2005/06), almost all lessons involve the use of computers. All teachers used computers, computers,..., Maybe, for just a little piece of information, the teacher used to just copy on the board, but now teachers would use Word to show it instead. Teachers used computers more frequently. More materials were given to students” (SH in SG2).

Students could think of a number of ways of using the eLearning platform, eClass, which was not yet well used. Lots of problems were encountered when teachers used eClass and thus discouraged them from using it. However, their creative suggestions deserved teachers’ careful consideration.

Summary of the Qualitative Data Collected in Phase 3

As stated in the data collection plan, data were collected from different sources in order to understand the situation of teachers’ use of ICT in lessons from different perspectives as well as triangulating the data collected. The lesson observations and student group interviews helped to confirm the situation of teachers’ usage of ICT for lessons.

It was reported by Teacher B that she used computers for almost all lessons not only for presentations but also for record keeping and playing the audio-visual materials more efficiently. From the lesson observation in the Music Room, it was shown that Teacher B did make good use of the ICT equipment for the lesson. She used ICT in a number of ways and utilized its capabilities to make the lesson efficient and effective though the class was not very cooperative at the beginning. She demonstrated the use of ICT to motivate the students and add variety. Students also gave positive feedback to her usage. The Form 1 students confirmed that teachers used computers more frequently in the second term than in the first.

Teacher A had conscientiously made use of ICT to design teaching materials and put lots of efforts in the design of self-directed learning materials for her students as stipulated in the school plan. In her Form 5 lesson, she showed skillful design of PowerPoint presentation. Students in her class did appreciate it and found it helpful for their learning. The design of the moving lines on the graphs was an example. They expressed the good points of using ICT in some lessons. However, they also pointed out that some teachers used computers just for the sake of using it as required by the school. As a result, some lessons were just a waste of time. They emphasized that the school could not force teachers to do so, otherwise, it had the adverse effect as in some lessons. Near the end of the interview, the Form 5 students expressed their concern of the work load of teachers since a large amount of time was needed to prepare the materials using ICT.

In the interview with Principal B, she recognized the willingness of teachers to improve their teaching and their wish to upgrade students' learning. Her firm belief

on the effects of ICT on teaching prompted her to put the improvement of hardware provision the first priority. Her strategies for enforcing her ICT policy in the school had proved to be successful. As expressed by some teachers, the notebook computers provided to them enabled them to use ICT for teaching with convenience. It was pointed out by almost all the teachers who attended the interviews that with the provision of the notebook computers and the requirement of the school, teachers were given both impetus and encouragement to try the new way of teaching using ICT.

Lesson observation was a way to encourage sharing among teachers. Through mutual lesson observations practice, a culture of using ICT was developed. Teachers had the initiative to explore and develop their own way of teaching. Teacher K and Teacher H, who were low users at the beginning, were examples. All of the teachers who participated in the interviews showed great improvement in using ICT in their lessons, not only in skills but also in pedagogies. Qualitative data collected in this Phase mostly validated and confirmed with each other.

The factors affecting teachers to change as viewed by Principal B matched closely with the teachers'. The only difference was that Principal B pointed directly to 'lack of money' as the main reason for the inadequacy in the provision of hardware and software but what teachers could see was the decision of the principal. Teachers' willingness to change and improve in their way of teaching for the good of the students was confirmed by the principal. Having exemplars and colleagues sharing experience, thus creating a culture for the change was also mentioned in the first interviews with teachers. Teachers' reasons for changing to use ICT in their teaching also matched with

what Principal B said in the interview.

9.3. Activity System 3 (AS₃): The Focal School at Phase 3

Similar to that for Phase 1 and Phase 2, the situation of using ICT in teaching and learning in the school is represented in an activity system as shown in Figure 9-15. The components of the system are drawn from both the qualitative and quantitative data collected in this phase.

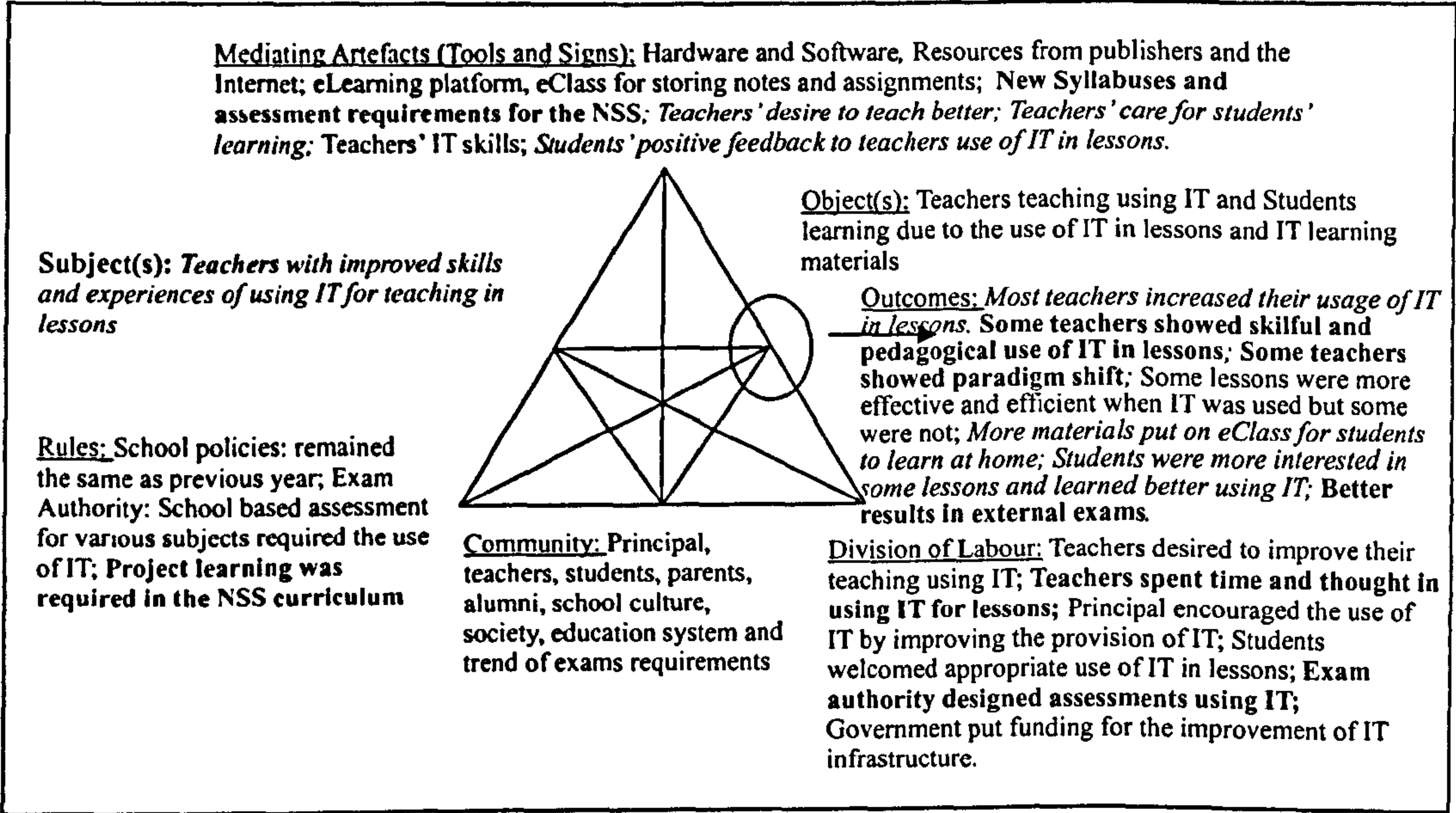


Figure 9-15 Activity System 3 (AS₃) – the school at Phase 3 of the study
 Legend: Words in standard font: elements identified; Words in bold: new elements introduced;
 Words in italic: changes identified

The School at Phase 3 of the Study

There was no big change for the school plans or policies concerning the usage of ICT in teaching and learning in Phase 3. Just before this phase, Principal B had successfully urged the school board to allocate money for the provision of

workstations in all classrooms and it was planned to be completed early in the school year 2006/07. However, due to the delay of the tendering procedures, the preparation of the venues and furniture as well as the installation of computers, the systems were ready for use almost half a year behind schedule. As a result, changes in the provision of hardware and software as well as rules and policies of the school were minimal at this phase. This period could therefore be a good time to check whether the changes were sustainable or not.

From the data collected in this phase, the implementation process was moving forward though the policies that accounted for the changes in the first and second phases were no longer emphasised and the requirements of using ICT in lessons were not further enforced. There remained increased need for using ICT for doing and reporting assessments for the external examinations, in particular, for the New Secondary School (NSS) subjects. Despite the relax in school's requirement, there was no sign of reverting back to the previous stage. Most teachers continued their practices of using ICT for teaching and learning. From the second interviews with the teachers, it was noted that some teachers showed a paradigm shift in their teaching. Some teachers had used computers in one way or another for almost every lesson. Even the low users in the beginning became frequent users and put many efforts in designing the lessons using ICT. Although much time was needed for preparing the lessons, the teachers who attended the second interviews were not deterred.

Subjects, Objects and Outcome

The subjects of the system were the teachers of the focal school. All of them had already had some skills and experiences of using ICT for teaching since it was required by the school in the previous year. Most of them held positive attitudes towards it and some had the desire of improving. The objects of the system were the teachers and students. Both had improved ICT skills and were more competent in using ICT for teaching and learning. In the outcome, some teachers showed a paradigm shift in using ICT for teaching and some teachers made lessons more effective and efficient using ICT. Their skills of using ICT had been improved. Some teachers could use ICT skillfully in different ways to meet the needs of the lessons. Students had better interest and learn better in some lessons when teachers used ICT appropriately. Some lessons were more effective and efficient with the use of ICT while some were not as good and wasted lesson time. Principal B considered the use of ICT in teaching a factor leading to the improvement of external exam results. However, technical problems were still of concern.

The mediating tools of the system at this phase were the resources provided by the publishers, teaching and learning materials saved in the school Intranet and from the Intranet. The requirement of using ICT for the school based assessments, especially for the NSS subjects, was also one of the mediating tools. Teachers' motivation and desire to teach better was a psychological tool to make the changes. Students' positive feedback was also one important psychological tool that had mediated the change.

Community, Rules and Division of Labour

The school principal had not emphasized the requirements but many teachers had already built up the habit of using ICT in teaching whenever possible. The government ICT policies remained in place and extended over the years with little change. The project for the improvement of the infrastructure of the school and the installation of wireless systems purchased with government grants was completed in Phase 2. The technical support staff and ICT team of the school helped to maintain the ICT facilities and explored resources to improve the environment. Requirements for the school based assessment for the language subjects and the New Secondary School curriculum to be launched in the school 2009-2010 was a rule.

Contradiction as driving force for the system

In this phase, the contradictions mainly came from teachers' willingness to change and to improve. The expectations of the teachers themselves and other stakeholders, the trend of rapid ICT development of the world might have driven the system to continue changing towards using ICT in teaching and learning. The increasing requirement of the Examinations and Assessment Authority to use ICT for assessments was also a driving force for the development. Students' interest and need of new styles of learning pushed teachers to change from their traditional way of teaching to the more interactive way of teaching with ICT. Teachers' determination to improve their teaching and help students learn better were drives that could not be ignored.

9.4. Summary of Phase 3 Study

In Phase 3, the hardware and software provision to the school which had been an important tool mediated the significant changes in teaches to use ICT in lessons showed no more progress. The government and school policies which imposed requirements to teachers that pushed them through the change process were in the implementation stage and there was no further requirements were added. However, changes in the ICT environment of the Hong Kong society, in Mainland China and worldwide was very fast. An example was the change from the dial-up connection to broadband connection, which was 100 times faster. Both teachers and students were facing these changes in the wider environment, thus should have made corresponding changes using ICT in their daily life, in particular for communication. Resources from the web were rapidly increasing. The impact these developments have on the way of ICT usage in teaching and learning could not be ignored.

By representing teacher change in this phase as Activity System 3, these are considered to be the mediating tools which were the lever for the changes. It was demonstrated by the extensive use of web materials for teaching as reported by almost all the teachers who attended Interviews 2. Another tool that had mediated the change is a psychological one which could be identified from the interviews with the teachers. All of them tried hard to find ways of using ICT in their teaching because they wanted to improve their teaching and wanted their students to learn better. These were mentioned in all the teacher interviews including the interview with the principal. Though some teachers had not used ICT appropriately in lessons or did not have

sufficient skills in managing the ICT tools in lessons, they did try to use it. The drive for doing so might be their fear of being left behind and their felt need to change. Though they were not confident on using it, they still tried. This is the contradiction that had moved the system forward.

In the interviews with the teachers and students, both teachers and students found that lessons were more effective and efficient when ICT was used. They also agreed that students were motivated and found fun in learning. Students could even give suggestions to improve communication with ICT. Principal B, in her annual report, pointed out that the external exam results had been improved and the use of ICT was one reason.

CHAPTER 10 Capturing the Complexity of ICT

Implementation at the School Level: An Evaluation of the Activity System Approach

10.1. Introduction

Chapters 7, 8 and 9 reported the results obtained from the data collected in the three phases. The focal school was represented as an activity system in each phase to facilitate the analysis of data collected. In this chapter, these activity systems will be put in a chronological frame as shown in Figure 10-1 in order to trace the development of the use of ICT in teaching and learning at the focal school. The components of these activity systems will be compared to identify the signs of change in teachers' use of ICT and the factors affecting them. The results and findings will be compared and contrasted, and the value of using an Activity Theory approach in this study will be evaluated with reference to similar studies from the literature reviewed.

To answer the research questions of this study, the focal school at the three phases will be represented two-dimensionally as a series of activity systems in the chronological frame for analysis. In the following sections, the components of the activity systems at the three phases will be compared in order to locate anything that might have led to the changes throughout the research period. In this way, factors facilitating and those inhibiting the change towards the use of ICT in teaching and learning will be identified. An analysis of these factors can contribute to a better understanding of how and why teachers change.

10.2. Chronological Frame of Analysis

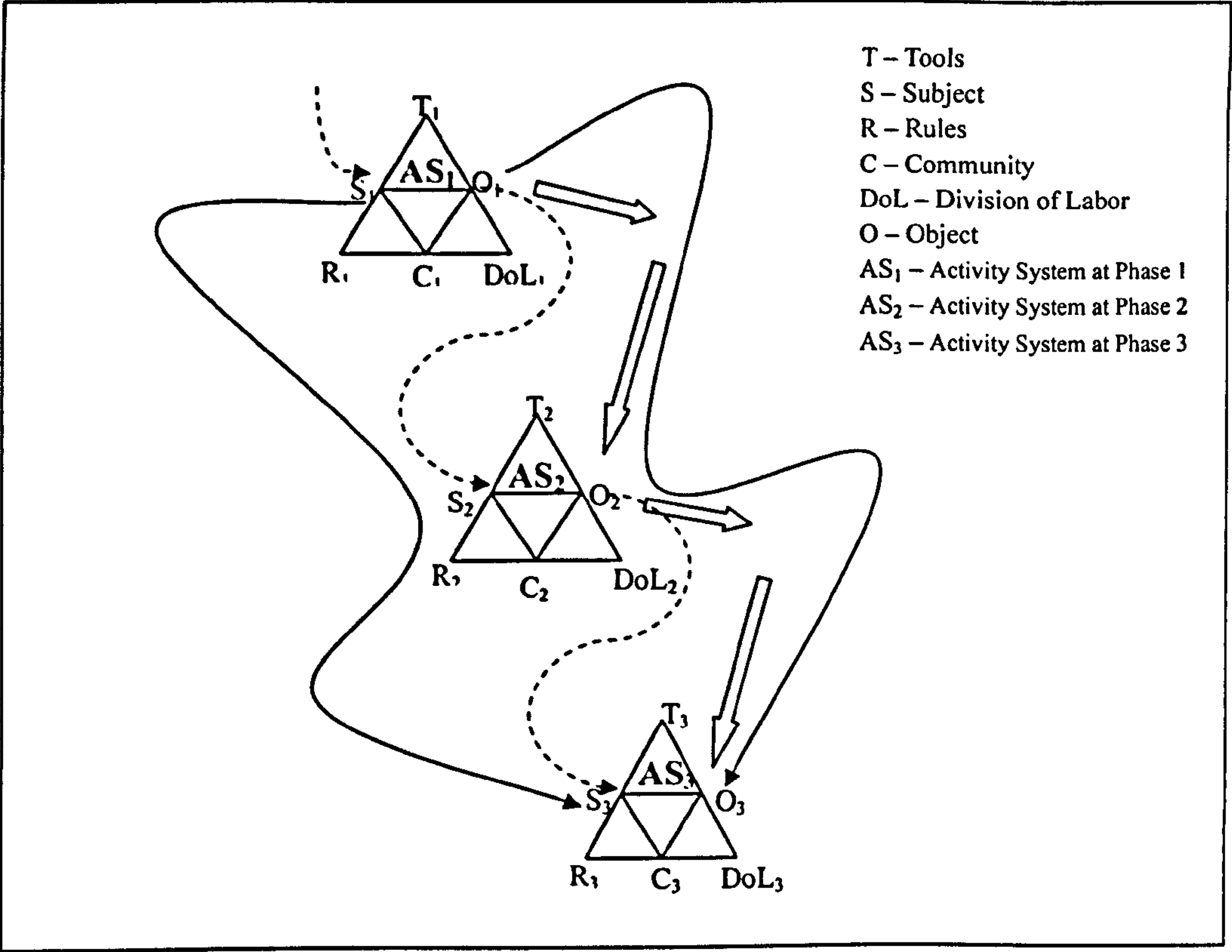


Figure 10-1 Representation of the evolving system (AS_i) of the present study. AS₁, AS₂ and AS₃ respectively represent Phase 1, Phase 2 and Phase 3 of this study. (modified from Hung et al., 2006: p.44)

Figure 10-1 shows the evolving nature of the activity system where various instances of the history of the system (AS_i) are depicted as mentioned in Chapter 3. This is modified from the historical frame of analysis by Hung et al. (2006). In the present study, AS₁, AS₂ and AS₃ are three snapshots of the activity system taken respectively in Phase 1, Phase 2 and Phase 3. The solid arrows in the figure show the change of the outcomes and thus the development of the system throughout the different phases. Dotted curves are added to connect the outcomes of each phase to the subjects of the next phase since they have close relationships. The outcome of each activity system describes the progress of the use of ICT in teachers' teaching and students'

learning at the end of that phase of study. The subject of the activity system of the next phase is the same group of teachers whose situation of use of ICT in teaching has just been described in the outcome of the previous one. The development throughout the three phases will be discussed, taking into consideration the context in which it is situated as well. Change or development of the focal school cannot be studied in isolation since it depended on the Hong Kong government for funding and was under its supervision. The policies of the Hong Kong Government were in turn influenced by the ICT development of the nearby cities in the fast changing world of the 21st century.

10.3. Cross-phase Analysis of Activity Systems AS₁, AS₂ and AS₃

In order to understand how and why teachers' change to using ICT in teaching and learning, the changes in hardware and software provision, human resources, school and government policies as well as changes in ICT development in other cities will all be taken into consideration. New elements that emerged or were introduced throughout the three phases may have also played their parts to influence the development of the activity system under study. With Activity Theory as the framework for analysing teachers' change, the components of the activity system at the three phases, AS₁, AS₂ and AS₃ are tabulated in Table 10-1 highlighting the new elements and changes identified.

Throughout the research period, different education reforms and policies were declared by the EDB. The curriculum reform 'Learning to Learn: The Way Forward in Curriculum Development' issued by the Curriculum Development Committee of the Education Department of Hong Kong (CDC HKSAR, 2001) paved the way to

integrate ICT into the curriculum. IT for interactive learning was one of the four key tasks in the curriculum reform and IT skill was one of the nine generic skills to be developed as a strategy for the curriculum reform. Two ICT policies were launched during this period. Both the first 5-year IT strategy, 'Information Technology for Learning in a New Era' and the second ICT initiative, 'Empowering learning and teaching with information technology' came with funding for the improvement of ICT infrastructure of schools. The 'Digital 21 Strategy' of the Hong Kong Government shows its commitment to keeping Hong Kong in the forefront of information and communications technology development.

To implement the first ICT policy, the government invested a considerable amount of money to build the basic ICT infrastructure and connectivity into schools. Another funding was available for schools for the provision of additional staff to facilitate the change. The second ICT policy was a strategy which called upon concerted efforts of schools, higher education institutes, ICT industries and non-government organizations (NGOs) to nurture an ICT-rich teaching and learning environment (EMB HKSAR, 2004a). The EDB and other tertiary institutions jointly organised conferences in Hong Kong bringing experts from over the world to share their experiences of practices and talk about the opportunities they could find to transform or reform teaching and learning with the use of ICT. There were also visits organised by the government to cities such as Singapore, Shanghai and other countries such as Australia and the UK to exchange experiences, learn from them and explore the possibilities and ways of development.

This study extended over the period from 2003 to 2007, when the governments of Hong Kong and other cities had put forward policies and resources for ICT development in their schools with the beliefs that ICT could transfer teaching and learning that are essential in preparing their younger generation to meet the demands of the global society in the 21st Century (ED USA, 2004; BECTA, 2005; MOE 1997, EMB HKSAR, 1998). The ICT policies of both the Hong Kong and other governments around the world play an important role in teachers' beliefs and practices in ICT usage. The change of teachers' use of ICT in teaching in the focal school should be studied in this context.

10.3.1. Components of the Activity Systems

To identify and investigate the factors affecting teachers' change to using ICT in teaching in the focal school, a cross-phase analysis of the activity systems is done in this section. Corresponding components, subject, object, outcome, mediating artefacts, rules, communities and division of labour, of the three activity systems, AS₁, AS₂, and AS₃ are put side by side in Table 10-1(a) and 10-1(b) for comparison. Contradictions within and between the systems will also be compared and analysed.

Table 10-1(a) A comparison of the components of the activity systems AS₁, AS₂ and AS₃

	AS ₁ Before September 2005	AS ₂ September 2005 to August 2006	AS ₃ September 2006 to August 2007
Subjects	Teachers of the focal school –all of them had reached at least basic level of IT competency; some fulfilled the requirement of using ICT in at least 25% of their lessons.	Teachers of the focal school – <i>had some experiences of using ICT in lessons</i> ; Junior Form English teachers had lessons in MMLC.	Teachers of the focal school - <i>with improved skills and more experiences of using ICT for teaching</i> ; New teachers acquired the ICT skills before they started teaching at the focal school.
Objects	Teachers' teaching: with limited use of ICT in lessons; Students' learning: F1-3 students used ICT in the MMLC for some English lessons.	Teachers' teaching: use ICT with <i>more varieties</i> ; some became <i>more effective and efficient</i> with the use of ICT; Students' learning: <i>some improved with the use of ICT</i>	Teachers' teaching: <i>ICT was extensively used</i> ; Students' learning: some students had the experience of using ICT outside school hours for learning and for entertainment.
Outcomes	Teachers learnt ICT skills and tried to use ICT in lessons; F1-3 English teachers had some experience of using ICT tools in the MMLC for teaching; Students sometimes felt lessons more interesting when teachers used ICT but sometimes boring.	Most teachers used ICT more frequently in lessons; <i>Some used ICT for almost all lessons</i> ; Teachers' skills and confidence of using ICT were improved ; <i>Some teachers' teaching had more varieties and were more interesting</i> ; <i>Some taught more effectively with the use of ICT, catered for learner diversity and demonstrated paradigm shift</i> ; All teachers used eClass for communication and administrative work ; <i>Some students learnt better with the help of visual effects provided by ICT</i> ; <i>Some students were more attentive and interested in learning</i> ; Some learnt with materials on the web and the school Intranet, eClass	Most teachers increased their usage of ICT in lessons; Some teachers showed skilful and pedagogical use of ICT in lessons and some showed paradigm shift; Some lessons were more effective and efficient when ICT was used but some were not; <i>More extensive uses of the web and school Intranet, eClass for communication, homework dissemination and submission & uploading materials for students to learn at home</i> ; Students were more interested and learnt better in some lessons; Improvement of External Exam Results.

Legend: Words in standard font: elements identified; Words in bold: new elements introduced;
Words in italic: changes identified

Subjects, Objects and Outcomes

The focus of this research is on ICT and teacher change. The subjects were the teachers of the focal school in their different stages of development of using ICT in teaching. Though the subjects of the activity systems at the three phases were more or less the same group of teachers, they were different in teaching practice, ICT skills as well as knowledge and attitudes towards the change. The objects were teachers' teaching and students' learning using ICT in the focal school. As indicated in Figure 10-1, the development of the subjects was closely related to the outcomes of the activity systems in this study. The teachers' confidence and attitudes towards the use of ICT changed continuously as they developed and extended their repertoire of practices. Some new teachers, who joined the school in Phase 3, had prior knowledge and

experiences of using ICT in teaching. Situations of implementation at the different phases were represented by the outcomes of the activity systems. Following the arrows connecting the outcomes in Figure 10-1, the process of change could be traced. Along the row labelled outcomes in Table 10-1(a), the changes in teachers' teaching and students' learning are located and summarised.

Change in teachers' practice and attitudes towards the use of ICT

Outcomes across the three phases show that teachers developed from having limited ICT skills in teaching and incidental use of ICT in lessons in Phase 1 to increased use of ICT in teaching in Phase 2. Most teachers' technical skills and confidence of using ICT improved throughout Phase 2. Some teachers became frequent and skillful users. In Phase 3, some teachers showed skillful and pedagogical use of ICT and some even demonstrated a paradigm shift in their lessons. Teachers' way of usage changed from using software packages purchased from the market, like the English CAL programs in Phase 1, to using varied resources including PowerPoint presentations provided by publishers, teaching materials downloaded from the Internet or designed by teachers themselves in Phase 2. Some teachers developed into using resources from the Internet and multimedia materials tailored for their lessons. Some students expressed that they had learnt better with the help of the visual effects when ICT was used. Some also expressed that they were more interested in learning when teachers used ICT in lessons. The majority of students preferred their teachers to use ICT in lessons but some students also commented negatively that some teachers were not using ICT appropriately and wasted lesson time. Some teachers, with examples of Teacher A and Teacher B, showed skillful and pedagogical use of ICT in their

lessons in Phase 3. Teacher A produced self-directed learning materials for students. These demonstrated a big leap in teachers' skills of using ICT for teaching throughout Phase 2 and Phase 3. According to both teachers' own comments and students' opinions, at least some teachers' lessons became more efficient and effective when ICT was used. Principal B even pointed out that there were some improvements in external exam results after the increased usage of ICT in lessons.

Improved skill in using the school Intranet as a tool for communication and a platform for disseminating and receiving homework as well as storing and sharing teaching and learning material was also an outcome of AS₂ and AS₃. Teachers were required to use the Intranet to check school notices and emails in the middle of Phase 2 after they were provided with notebook computers. They started with passively using the platform in Phase 2 to tactically using it for communications and for teaching and learning in Phase 3 despite the many limitations of the system pointed out in the interviews and given on the school self-evaluation days.

Change in students' attitudes towards the use of ICT

Started with only Form 1 students having English lessons using computers once in alternate weeks in Phase 1, students from Form 1 to Form 3 had similar experiences in the beginning of Phase 2. That is, only Form 1 students had limited experiences of learning English using CAL programs in the MMLC in Phase 1 and such experiences were extended to all Form 1 to Form 3 students in the beginning of Phase 2. In Phase 2, students expressed that teachers used ICT more frequently in lessons in the second term of the school year. Some students said that they sometimes learned better with the

help of the visual effects when teachers used ICT. Some lessons were found to be more interesting when ICT was used but some were boring or wasting time when teachers could not use ICT appropriately or when there were technical problems.

Gradually, more lessons were taught using ICT in classrooms after teachers were provided with notebook computers in the middle of Phase 2. In Phase 3, when teachers more extensively used ICT in lessons, students found some lessons more effective. As reflected in the student questionnaires and group interviews, students found the lessons using ICT more interesting and more effective though they also found some teachers wasted time due to inappropriate use of it. They generally welcomed teachers' use of ICT in lessons since more varieties were introduced. Students' learning was not limited to the classrooms but they could learn from home as well.

On the School Self Evaluation day in Phase 3, students gave suggestions for using the communication capability of ICT for further improving the use of ICT in teaching and learning. They suggested advanced and creative uses of ICT in teaching and learning such as putting up lesson materials and videos on the school web for easy access from anywhere. This also demonstrated that students held very positive attitudes towards using ICT in teaching and learning and they were ahead of teachers in the development. These advanced and creative ideas might have come from their experiences of usage not only for learning but also for entertainment and communications as shown in the student questionnaires 2 and 3 (Appendices S2a, S2b, S3a, S3b).

Stages of Implementation

The development of using ICT in teaching and learning in the focal school can be seen along the row of ‘outcome’ across the columns of the three phases in Table 10-1(a). With reference to the three broad phases of the change process suggested by Fullan (2001), outcomes in Phase 1 showed signs of early ‘adoption’ and that in Phase 2 indicated that the school was at the stage of ‘adaptation’ with some signs of early ‘implementation’. In Phase 3, some teachers demonstrated skilful and pedagogical use of ICT in teaching which showed that the focal school was moving towards the ‘implementation’ stage.

Table 10-1(b) A comparison of the components of the activity systems, AS₁, AS₂ and AS₃

	AS ₁ Before September 2005	AS ₂ September 2005 to August 2006	AS ₃ September 2006 to August 2007
Mediating Artefacts	Hardware provision and connectivity; Setting up of the MMLC; Setting up of wireless network; LCD Projectors installed in all classrooms; Notebooks for loan to teachers; School based ICT training courses offered; Training courses offered by the EDB; Recruitment of Technical Support Staff and ICT coordinator; School policy for piloting the use of MMLC for junior form English lessons; Training on technical and pedagogical use of the CAL programs.	Hardware - Notebook computers for all teachers; Improved network; Software-PowerPoint provided by publishers; Other learning materials available; <i>More ICT teaching and learning materials available in the market and promoted to schools</i> ; School Intranet system, eClass was set up: for communications, dissemination of homework, test, and other teaching and learning materials; Mutual Observations by teachers; External School Review by EDB; New Assessment systems using ICT; <i>New school policies and principal's requirements for using ICT.</i>	Hardware and Software- <i>Resources from publishers and the Internet</i> ; eLearning platform, eClass; New Syllabuses and assessment requirements for the New Senior Secondary Curriculum.
Mediating Artefacts (Psychological)	Fear of being left behind in the ICT development; Need to meet the requirement by the government (use ICT for at least 25% of lessons); Support from the Principal; ICT skills learnt from training programs.	<i>'Felt need' of the change; Knowledge and confidence for change; Firm Belief of the Principal; Pressure and support from the Principal and colleagues; Students' positive feedback on teachers' ICT usage; Encouragement due to improved effectiveness and efficiency when ICT was used; Support from IT staff, colleagues and principal.</i>	Teachers' desire to teach better; Teachers' care for students' learning; Teachers' confidence of using ICT; Students' positive feedback to teachers' increased use of ICT in lessons; Teachers see the interest and need of students.
Rules	School policies: required departments to include plans for using ICT in teaching; 1 st and 2 nd IT Policy declaration by the HK government; EDB requirement: 225% usage for teaching, 4 levels of ICT competency for teachers	School policies: set up IT seed teachers; required teachers to set up CPDG and have mutual lesson observations; Lesson observation by senior staff; EDB policies: requirements for implementing the IT initiatives; External School Review by the EDB.	School policies: remained the same as previous years; Exam Authority: School based assessment for various subjects required the use of ICT.
Communities	School community: BoM, Principal, parents, teachers, students, alumni; School culture, ICT use in the Society and nearby cities.	School community: BoM, Principal, parents, teachers, students, alumni; <i>School culture</i> ; society, nearby cities- Singapore, Tai wan, Mainland China	School community: BoM, Principal, parents, teachers, students, alumni; School culture, society, education system and trend of exams requirements
Division of labour	Principal appealed for donation for LCD projectors; Alumni donated money; Publishers produced ICT teaching materials; English teachers piloted the use of ICT in the MMLC; Students welcomed to have lessons in MMLC; Government provided the basic ICT infrastructure to schools; EDB set up requirements for teachers; ICT coordinator; Technical Support Staff.	Principal-led the change, set up policies for use of ICT in teaching & learning; applied for funding, BoM-approved funding; <i>Publishers-produced teaching materials; Teachers used more ICT in teaching; Students welcomed and participated in lessons</i> ; EDB set up policies and conducted External School Review; Lowered costs of hardware; <i>Increased production of software and e-platforms for teaching & learning</i>	<i>Teachers spent time and thought in using ICT for lessons</i> ; Principal encouraged the use of ICT by improving the provision of ICT; Students welcomed appropriate use of ICT in lessons; Exam authority designed assessments using ICT; Government put funding for the improvement of ICT infrastructure; Parents provided ICT facilities at home.
Contradictions (Internal)	Students' fondness and habit of using ICT in their daily life vs teachers' insufficient skills in using ICT; Teachers' fear of technical problems vs students lost of interest with chalk and talk lessons;	Students' need of varieties in lessons vs teachers' confidence of using ICT in teaching; Teachers feared of lagging behind seeing others developing so fast; Need to use ICT for mutual lesson observations vs fear of technical problems.	Demand of time for preparation vs teachers' eagerness to improve; Expectations of other stakeholders vs current situation of ICT usage.
Contradictions (External)	Comparison with the progress in nearby cities; <i>'Felt need'</i> : the rapid development and wide-spread use of ICT for education in the 21 st century created a need for the change in teaching and learning; Urge to upkeep the image of Hong Kong as a modern society; Mission to develop the younger generation into individuals competitive with that of other countries.	Rapid development and usage of ICT in nearby cities - fear of falling behind; Irreversible trend for the society and in broader view, the world, to move towards an information age using ICT as a tool for life; <i>Requirement of government and school vs teachers status of usage</i> ; Comparison with other schools; desire to improve the image of the school.	Globalization and Information explosion made it a must to use ICT for acquiring information and knowledge; <i>Challenges for a change due to the availability of ICT resources for learning and teaching on the market or easily assessable online.</i>

Legend: Words in standard font: elements identified; Words in bold: new elements introduced;
Words in italic: changes identified

Mediating Tools

The development of an activity system is mediated by tools, which are levers of change. By looking at the systems representing the focal school, not only physical or technical ‘tools’ but also ‘psychological tools’ could be identified. All of them were found to have some roles in mediating the changes in teachers. The psychological tools identified in Phase 3 might have even had greater effect on the whole system than the technical tools. A summary will be drawn from studying the items across the columns along the two rows labelled ‘Mediating Artefacts’ in Table 10-1(b).

Before 2003, the ICT infrastructure of the school had already been greatly improved with the government funding from the launch of the first and second ICT initiatives. The basic ICT infrastructure included the school networks and broadband, a total of more than 100 computers in the school, LCD projectors installed in laboratories and special rooms and 24 notebook computers to be shared among teachers. The MMLC with 45 computers with equipment for teaching and learning languages was also available since 2000. As soon as the first ICT in education initiative was launched in 1998, trainings and sharing sessions were organised by the school, the government and tertiary institutions during holidays and afterschool for teachers. Besides, the school also got funding for the recruitment of ICT support staff and ICT coordinators from the government through QEF projects. These were the ‘tools’ that had mediated changes in teachers’ practice and philosophy of using ICT in teaching and learning.

Tools Mediating Change in Phase 1

After the second ICT in Education initiative was launched in 2004, the government supported schools to set up wireless networks and elearning platforms, upgrade the old model computers and provide training to parents. In Phase 1 of this study, the ICT environment of the focal school was further improved with the installation of LCD projectors into all classrooms with the donations from the alumni in the school year 2004/05. The focal school subscribed service for the first school intranet in 2003 due to the outbreak of SARS and prepared teachers and students for learning from home. The school successfully obtained funding from the government with a matching grant from the QEF and donations from stakeholders of the school. On the manpower side, the focal school continued to employ a technical support staff and an ICT coordinator. There were staff development programs and skills training courses organised by the government or the school development team throughout this phase of study.

The use of ICT in teaching and learning in the MMLC in Phase 1 was an outcome mediated by school policies and the availability of equipment and software in the MMLC. The use of ICT in more than 25% of their lessons was another outcome mediated by the government policy. Different kinds of support such as technical support given by the technical support staff and ICT coordinators, training and staff development are psychological tools mediated changes in this phase. Fear of lagging behind is another psychological tool leveraging the change. It is worth noting that the progress of change to ICT usage in teaching and learning in Phase 1 was described as 'very low' in the principal interview and teacher interviews conducted in Phase 2.

Although the hardware and software provision as well as the MMLC were available early in Phase 1 of the study, only very limited usage of these was reported in the surveys and interviews. Though slow adaption of the use of ICT was found in teachers in Phase 1, both technical and psychological tools listed above had mediated changes in their readiness and prepared them for the change in Phase 2.

To summarize, the levers for change in Phase 1 included hardware provision, teacher training as well as government and school policies. Besides, the psychological tools such as the fear of lagging behind, the need to fulfil the requirement of the government and school policies and all kinds of support given, had played their roles in mediating the change in this and the following phases. It was commented by teachers that the ICT equipment such as the 24 notebook computers and LCD projectors in all classrooms were in fact important in laying the foundation for the change exhibited in Phase 2.

Tools Mediating Changes in Phase 2

In Phase 2, the mediating tools identified through teacher surveys and interviews include the notebook computers and the improved network in the school, software and teaching materials available, technical support given, the External School Review, the government and school policies as well as the psychological tools such as the felt need of the change, knowledge and confidence for the change, students' feedback and observed improvement in effectiveness for teaching and learning.

The most frequently mentioned reasons why the teachers change their practice were the provision of notebook computers and the school policy which required them to use ICT in their lessons and peer lesson observation practices. The provision of teaching materials by publishers and educators was considered an important factor facilitating the change in practice since the teacher did not have enough time to prepare the teaching materials themselves. The school policy which required teachers to form Continuing Professional Development Group (CPDG) and have mutual lesson observations, check e-notices and communicate on the school Intranet, as well as the new assessment systems which required the use of ICT by the HKEAA and the External School Review by the EDB, were all mentioned as important factors that had ‘mandated’ the change in practice. Technical support given by the ICT staff reduced teachers’ fear of malfunction of the ICT tools and encouraged them to change. The psychological factors identified were considered important in mediating teacher change in this phase as well.

Tools Mediating Changes in Phase 3

In Phase 3 of this study, ICT in teaching and learning remained a major concern of the school but no additional requirement was given. There was little change in hardware provision as well. In the teacher interviews and surveys, the new syllabuses and assessments for the New Secondary School System (NSS) which required teachers to use ICT for recording and reporting were mentioned as reasons for using ICT more frequently in their teaching. It is worth noting that the resources on the Internet grew abundantly as shown in Figure 9-10 (Page 253) throughout the years.

Although no extra physical tool was provided in this phase, changes, big and in-depth, were found in teachers. The outcomes given in the previous section showed that change in Phase 3 was significant and that the change was not simply the increase of number of hours of usage but the improvement of quality of use. What might have mediated the change could be the psychological tools such as teachers' desire to teach better, teachers' care for students' learning and students' positive feedback to teachers' ICT usage as well as the positive feedback given by the principal.

Analysis of Changes Mediated by the Tools

Comparing the mediating tools in the three phases, it is found that in the initial stage of implementation of the change, physical or technical tools were of utmost importance. They were mentioned frequently in the Phase 1 and Phase 2 data. Government and school policies were also found to be important in mediating the change. These were even described to have 'mandated' change in the focal school due to the inspection by the External School Review conducted by the EDB.

Besides the notebook computers provided to teachers, there was little change in the hardware and software provision in Phase 2 compared with that in Phase 1, but there were big changes in teachers' ICT usage. Therefore, the provision of notebook computers to all teachers and the school policy requiring teachers to use it followed by lesson observations as well as the ESR could be considered as major mediating tools for the development in this phase. As a result, the school had moved into the 'adoption stage' in Phase 2.

After all teachers started the practice of using ICT in their lessons and gradually adapted to it, the next step was to implement the change as stated in Fullan's three broad phases of implementation (Fullan, 2001). To move teachers over the hurdle into the 'implementation' stage, both technical and psychological tools were found to be important in this case. Psychological tools might have played important roles in urging and encouraging teachers to change. Principal B pointed out that the important reasons for teachers to change were their love for the students and their desire to teach better. Teachers were eager to improve their ICT usage when they found their students more interested in learning and even learnt better using ICT. Teachers' improved confidence of using ICT and students' positive feedback were also important factors mediating the change. Improvement of hardware and increase of web resources were mediating artefacts named by teachers. However, without teachers' eagerness and urge to improve, these could not have made a difference just like the situation described by some teachers before Phase 2. Though the resources were already there for some years, teachers had not utilized them until policies requiring them to do so had been instigated.

Training and staff development that were considered by some researchers as necessary for teacher change (Guskey, 2002) had not been mentioned frequently in the interviews. However, their importance could not be ignored since teachers' confidence of using ICT depended very much on the training for the basic skills of using ICT in their teaching. These had little immediate effect on the change process but teachers did mention that their skills and confidence of using ICT were important in making the change possible. During the change process, support from colleagues, ICT staff and the

principal played important roles in moving them past the obstacles. They can therefore be considered as the psychological tools that had mediated the change.

To conclude, a number of mediating tools were found acting on the activity system throughout the three phases. They had existed in different forms and all levered the change in one or the other way. At the initial stage, the physical tools and signs, such as the basic infrastructure and training were essential in laying the foundation and igniting the change process. At the onset stage, the government requirement, which existed as a sign tool, gave it a push though the progress was still slow. Faster progress was found when the physical tools, the notebook computers, together with the signs such as the school policies and external review by the Education Bureau, made up a big push on the system. When the system started running on the right track, the psychological tools which included the positive reinforcement on the teachers and their love for students, acted as the fuel to keep it moving forward and upward.

Communities

The basic structure of an activity system is a triangle with the tools mediating the development of the subject for the outcomes. The second generation of the Activity Theory suggested by Engeström (1987) helped to investigate the situation and more fully understand the development by expanding the triangle to include rules, community and division of labour into the system. When the focal school is considered as an activity system, the community, that is, the environment in which the activity is carried out should include all the stakeholders of the school and the Hong Kong education system, the Hong Kong society and the nearby regions such as Mainland China,

Taiwan, Singapore and other cities that had connection with Hong Kong. It was stated in Fullan's seventh lesson of change that 'connection with the wider environment is critical' (Fullan, 1993: p.21). This case study also showed the importance of the influences of the different parties of the community on creating the environment and culture for change in the focal school.

Different personnel of the school community and the EDB had contributed to the change of practice of the focal school throughout the three phases of this study. Some schools in Hong Kong had already achieved higher level of ICT usage and were labelled as 'more advanced in using ICT in teaching'. Those schools shared their experiences in seminars and workshops and opened their schools for visitors. The EDB had also taken the lead to create a culture of sharing among schools in order to promote the use of ICT in teaching and learning in the second ICT policy launched in 2004. Therefore, a culture encouraging risk taking in order to explore innovative ways of teaching and learning was gradually built up and success stories were shared among schools throughout the years when the government put forward the ICT strategies. With no exception, teachers in the focal school were exposed to this cultural change. They learnt from the more advanced schools, felt being left behind and thus got the urge to change to meet the needs of their students. Teachers in the focal school were also encouraged to take risk and change when they saw their colleagues used ICT actively in lessons and learnt that students gave positive feedback to the change. Teachers were actually sharing their experiences through mutual lesson observation, thus building a learning community in the focal school in Phase 2 of this study. As mentioned by a teacher in the interview, the school did not have the 'culture' of using ICT in teaching in Phase

I but the 'culture' was gradually built up and he felt supported but not isolated when he tried to change his practice in Phase 2. When using ICT in teaching and learning became a culture, an environment facilitating the change had been created.

The rapid development of ways of communication on the Internet created another culture of sharing in society. In a report published in March 2009, Hong Kong had moved quickly in providing over 75% of all households with access to broadband connectivity. It also reported that broadband Internet subscriptions had well and truly surpassed dial-up subscriptions by the end of 2005 (BuddComm, 2009). The number of websites had increased exponentially from 2005 to 2007. On the SSE day in Phase 2, students of the focal school suggested putting videos of lessons on the web and discussing homework problems on the school Intranet or the blogs. With the drop in price and growth in speed of Internet connections offered by the Internet service providers (ISPs), students had lots of experience of online communication and searching for information on the web. In Student Questionnaire 1, only a few students reported that they had no computer at home or could not connect to the Internet. In Student Questionnaires 2 and 3, students reported that surfing the Internet was their most popular use followed by playing online games. This culture urged the teachers to use ICT more extensively in their teaching and communication with students. Teachers were pushed to think about using more ICT in teaching in order to make lessons more interactive and effective.

From the above findings, it can be concluded that the culture of ICT use in society, the culture of using ICT for games and communication among students and the culture of developing innovative ways of teaching built in the community of

teachers all have considerable contributions to the fast development of ICT usage for teaching and learning in Phase 2 and Phase 3. Besides, other stakeholders, such as the school management board members, parents and alumni, all had contributed to the creation of an environment favourable for the change. These stakeholders' comments, both positive and negative, on the school, their donations and support were all gestures showing their expectations thus creating an environment that helped teachers see the need and motivated them to take a step forward to change.

Rules and Roles

In the discussion of mediating tools, the government and school policies were considered signs mediating the change and even made it mandatory. Findings from this case showed that both government and school policies did have significant effects not only in mediating the change but in some sense mandating the change. These were in fact the rules drawn up to meet the expectation of the community which included the stakeholders of the school and even the Hong Kong citizens. Therefore, these policies can also be considered as rules of the activity system.

When the row labelled 'Rules' in Table 10-1(b) is studied, the term 'School policies' is put high on the list in all the three phases and 'EDB Requirement' can be found in the first two phases. From the reports of the interviews in Phase 2, teachers all considered 'school policy' as one of the main reasons for them to implement the use of ICT in their lessons. From the school documents, the school had policies for using ICT in teaching and learning in all the three phases. 'School policy' was mentioned very frequently in the teacher interviews in Phase 2. Principal B had set up the policy

and drafted a clear strategy for enforcing it. This was a requirement for teachers to use ICT in their teaching. Teachers were also required to share with colleagues their practice of either using ICT or reading in lessons through mutual observations. The first and second ICT in Education initiatives and the requirements stated in these government policies were also rules influencing the change process. Teachers mentioned it in their interviews as reasons why they change their practice. The External School Review (ESR) program of the school near the end of Phase 2 was one of the rules requiring teachers to change as expressed in the teacher interviews. One of the aims of the ESR team was to see how the school operated, how EDB policies were carried out, how the school set up policies and implemented them in order to achieve the aims of education and the aims of the school. Since the implementation of the use of ICT in teaching and learning was one on the ESR checklist, the change in teachers' practice therefore became 'mandatory'.

The first 5-year IT strategy declared in 1998 was in fact part of the Digital 21 Strategy of the Hong Kong government based on the aim to make Hong Kong 'a leading digital city in the globally connected world of the 21st century' (ITBB HKSAR, 1998). The requirement of not less than 25% of lessons using ICT was a rule in the first ICT initiative. It had, to some extent, started teachers' practice of using ICT in their teaching as reported by some teachers in the Phase 2 teacher surveys and interviews. School policies and ESR were considered by the teachers as the most important factor making teachers increase their usage of ICT in their lessons in Phase 2. The school requirement of teachers using ICT in their lessons and having observations by senior teachers and peer teachers was also a rule, which in some sense, mandated the change of practice.

The ways of doing assessment as required by the HKEAA was another rule that made the change towards the use of ICT compulsory. It was expressed in one teacher interview in Phase 3 that teachers were required to use computers to record and review on students' speaking skills for the school based assessment.

When the rules put on the system at the three phases were compared and analysed, it was found that external forces had significant effects on making the change implemented into classrooms. The strategies used by the government and the school to enforce policies and monitor the progress were crucial for successful implementation of the educational change.

Division of Labour

From the above sections, hardware and software, training and staff development, all kinds of support, government and school policies, culture of the focal school and the society were all levers of change in the focal school. In this section, roles played by the different parties will be analysed. Across the row labelled 'Division of labour' in Table 10-1(b), the terms principal, alumni, publishers, government, teachers, parents and students appeared in all the three phases. That is, they all played some roles in influencing the change in these three phases. 'Principal' was put high on the lists as they played important leading roles in the focal school. In Phase 1 and Phase 2, Principal A and Principal B had respectively set up policies and strategies to implement the use of ICT in teaching and learning. Both appealed for funding for the procurement of additional hardware to facilitate teachers' use of ICT in their lessons. Principal A appealed for donation from alumni for installing LCD projectors in all classrooms

where it would otherwise be impossible for teachers to use ICT in lessons except those in the MMLC. Principal B asked the school management board to allocate money to purchase notebook computers for all teachers of the focal school. In the reports of the teacher surveys and teacher interviews in Phase 2, 'principal' was amongst the top three reasons for teachers to change to use ICT in their lessons.

The school policies set up by Principal A and Principal B respectively in Phase 1 and Phase 2 were also important reasons for teachers to change their practices. The strategy used for enforcing and monitoring the policies in Phase 2 was found to be more effective than that in Phase 1. Both principals played important roles in enabling the change in the school by appealing for funding and setting up policies although bigger changes were found in Phase 2. Teachers who were in the front line played their roles in learning the skills and fulfilling the requirements in Phase 1 and increasingly used ICT in lessons in Phase 2 of this study. Some teachers played active roles in exploring and developing ways of teaching using ICT as revealed in the interviews with teachers. Students played important roles in influencing teachers' intention to change in their teaching by responding to teachers' use of ICT in lessons, giving feedback and suggestions. Examples were found in reports of the student group interviews and comments given by students on SSE days in Phase 2 and Phase 3.

In the teacher interviews and teacher surveys, some teachers pointed out that publishers had played important roles in promoting the use of ICT in teaching by producing supporting materials for teachers. The availability of teaching materials such as PowerPoint presentations produced by the publishers had encouraged teachers to start using ICT in their lessons by resolving the problems of lack of time to prepare ICT

teaching materials by teachers themselves. The extensive experiences and skills of using computers helped the students to learn faster using ICT than ever before. Students who were good to expert users even suggested very creative and effective way of using ICT for lessons through comments given on the SSE days. The support and contributions of their parents could not be ignored. Figure 9-1 on page 237 shows that there was a sharp increase in websites on the Internet throughout the years 2005 to 2008. Teacher interviews in Phase 3 of this study showed that the large resources on the web provided teachers with useful materials for the lessons and thus encouraged them to try using ICT for teaching. In this aspect, the ISPs should be given the merit of making the connection fees affordable to the school and to most families. The great increase in speed of access was another crucial point encouraging the usage.

To round up, the government, the society and stakeholders of the school all had played important roles to support the development of using ICT in teaching and learning. The government played an important role in granting money and the different departments, the EDB and the HKEAA, the ESR team of EDB played roles in putting forward policies, supervising schools and giving support for the change. Publishers contributed to the provision of ICT materials and the Internet service providers worked out plans to make access to the Internet affordable to the school and families. The school management board approved money for the purchase of ICT equipment which were necessary for the development, the principals set up policies and supervised the implementation, the teachers who were in the front line tried hard to make use of ICT to improve their teaching, students responded positively to teachers' usage and gave useful feedback, comments and suggestions, parents gave invaluable support to their

children's learning and the alumni donated money and gave support for the development of the focal school. Fullan's eighth lesson of change, 'every person is a change agent' (Fullan 1993: p.21) was proved to be true in this case study.

10.3.2. Contradictions: the Driving Force for Development

Il'enkov (1977, 1982) conceptualized that change is to be driven by internal contradictions which are the driving force for the change and development of activity systems. In the studies by Hardman (2005), contradictions were also considered as the dynamic forces of change. Though it cannot be explicitly seen in the activity triangles, its importance can never be diminished. After looking at all the components of the activity system at different phases of this study, the contradictions which might have been the driving forces for the development will be discussed below.

As mentioned in the previous section, the rapid development and wide-spread use of ICT in society and the world in the 21st century had created forces for the development of the focal school. Facing the changes both at school and in society, teachers who were reluctant or not confident to change their practice to using ICT in teaching were urged to resolve the internal contradictions. This force, together with their 'felt need' to change for the benefit of their students, drove teachers to learn and try different ways of using ICT in teaching despite the large demand of time and the risk of failure.

Another contradiction resulted from the comparison with the ICT development in nearby cities had driven the government to invest money on speeding up the development of ICT use in Hong Kong in order to maintain its leading position in the far east. With the mission of developing the younger generation into individuals competitive with that of other countries, the government increased its investment in education to more than five times in the early 21st century. Accompanied with the large amount of money invested for infrastructure, hardware, software and human resources, Hong Kong schools were moved onto the fast track of development.

In the visits to schools in other places, such as Singapore, Mainland China, Australia and the U.K, both government and educators in tertiary institutions had an urge for faster development of ICT usage in schools. The first and second ICT policies launched respectively in 1998 and 2004 were the strategies the Hong Kong government used to resolve the contradictions between her will and the actual condition. The education and commercial sectors of Hong Kong gave their support in various means to help schools establish an ICT-rich environment and prepare people who know how to use ICT to achieve the aim of making Hong Kong ‘a leader, not a follower, in the information world of tomorrow’ (EMB HKSAR, 1998).

In Phase 2 of this study, the ‘contradiction’ between the fear of being left behind and the aim of improving the image of the school created the driving force for Principal B to ask for funding and the school board to approve and support the plans. The school allocated money for the provision of notebook computers to all teachers and upgrading the hardware of the school to meet the challenge. In line with the ICT policy of the government, the EDB proposed changes in the curriculum and ways of assessment

which also included the use of ICT. The fear that maintaining the status quo would have dragged the school behind and left its youngsters uncompetitive in this fast changing world made teachers feel the need to change their ways of delivering lessons and consequently changed their teaching styles. Another ‘contradiction’ that were expressed by teachers is the urgency to change and their reluctance to change due to the large demand of time to learn and prepare the materials. Teachers also needed great courage to take risks and overcome the fear of incompetence and technical problems. The internal driving force resulted from their felt need to change, their eagerness to improve, and their care and love for their students were the reasons why teachers found time to learn and try the new practices as reported in the teacher interviews in Phase 2 and Phase 3. Some teachers even demonstrated skilful and pedagogical use of ICT in their teaching and a shift of teaching paradigm although there was no further obligatory requirement from the government or the school in Phase 3.

To summarise, contradictions described above had created dynamic forces that move the school through the change process and thus develop ICT usage for teaching and learning. Contradictions were found to be essential in making changes happen by influencing the different parties to play their roles such as putting money, drawing up policies as well as finding time and courage to learn, explore and change their practices. These driving forces could therefore be viewed as the fuel needed for starting the engine and keeping the system moving. These driving forces resulted from contradictions were essential in sustaining the change as well.

10.4. Factors Affecting Teacher Change: Summarised From the Cross-phase Analysis of the Activity System

In an attempt to answer the research questions stated in Chapter 4, data from the cross-phase analysis are summarised into factors facilitating and factors inhibiting teachers change to using ICT in teaching and learning in this section.

10.4.1. Factors Facilitating Teacher Change

Factors facilitating teacher change can be identified from the components of the activity systems throughout the three phases. The mediating tools, roles and rules of the different components of the community and contradictions which had driven teachers to change described in the previous section are the factors facilitating change in this study.

Availability of Resources

This study involved the use of technology in teaching, availability of resources is therefore important. In the data collected, the provision of hardware and software was put high on the list of important reasons for teachers to change to using ICT in their teaching. The improvement of the ICT infrastructure, such as the upgrading of computer systems, setting up of the MMLC and the wireless network on campus, installation of LCD projectors into all classrooms and the provision of notebook computers to all teachers were frequently mentioned as factors mediating teacher change to using ICT in their teaching. The availability of software and teaching materials, such as PowerPoint presentations from publishers or those designed by other school teachers either available on disk or online, was also considered by teachers as

a reason for their change in practice. The resources named above were the physical tools that had mediated change in Phases 2 and 3 of this study but these were not sufficient to guarantee change as reported in other research such as that by Purnell (2002) in Tasmanian schools and Buettner (2006) in Switzerland. The situation in the Phase 1 of this study also posed the question whether the presence of hardware would lead to change as a consequence.

Teacher Training and Professional Development

Teacher training and professional development were perceived by many researchers as crucial factors for teacher change (Fullan, 2001; Fishmana et al., 2003, Putnam & Borko, 2000; Guskey & Huberman, 1995). However, these two terms were not frequently named by teachers in this study as factors affecting their change. In fact, there were skills training for ICT usage offered both by the school and the government in Phase 1. Professional development programs were also given by the government and the school from time to time throughout the three phases. As pointed out by the teachers interviewed in Phase 2, training had been organised for them and that they were equipped with the basic skills of using ICT in Phase 1. In Phase 2, mutual lesson observations, which were considered as effective professional development for teachers, were also found to have encouraged teachers to practice ICT usage in their lessons, get feedback from colleagues and evaluate their outcomes. By reflecting on their own teaching, teachers' practice and belief in ICT usage had changed favourably. Therefore, results from this study agreed that teacher training and professional development were important factors facilitating teacher change.

Support and Pressure

A review of the first IT in Education strategy suggests that support from multi-level leadership in school is crucial for the success of implementing IT in teaching and learning (EMB HKSAR, 2004a). The two ICT in Education Strategies launched by the EDB and the ICT policies set up by the principals were mentioned most frequently and put high on the list of reasons for teachers to change their practice. They were important factors both requiring and facilitating teacher change in the focal school. Support of the government in form of money for the procurement of hardware and software as well as the recruitment of support staff are factors making the change possible.

The external school review by the EDB, school based assessments by HKEAA and lesson observations were strategies used by the EDB and Principal B to create certain external pressure on teachers to ensure the successful implementation of policies launched. In order to meet the requirements, teachers attended training courses or development programs that helped them to learn the skills, change their beliefs and cross the barrier to try out the new practice. As a result, teachers adopted the change in order to ease the pressure.

Leadership

According to the report given in the evaluation of the 1st strategy for ICT in Education, the success depended mainly on ‘the support of school heads as visionary leaders and agents for change, and teachers as practitioners of appropriate pedagogies’,

and that ‘multi-level leadership in school is crucial for the success of IT in Education’ (EMB HKSAR, 2004a: p.4). In many studies, leadership was considered a major factor affecting change. In the focal school, principals’ leading role was found to be an important factor affecting teacher change as well.

Both Principal A and Principal B of the school played their role as an administrator in procuring funding from the government and other parties for the set up of facilities and recruitment of ICT staff. Principal A appealed for donation from alumni to install LCD projectors in all classrooms and this enabled teachers to use ICT for teaching in lessons without taking the students to designated rooms such as the MMLC. Principal B successfully influenced the school board to allocate money for purchasing notebook computers for all teachers. This was mentioned as one of the top three reasons for teachers to change their practice.

Pressure and support of the two principals were important in mediating teacher change in the focal school. The policies set up and strategies to follow through, such as mutual lesson observation, use of Intranet for internal communications were mentioned by teachers as important reasons for changing their practice. Provision of facilities, ICT support staff, recognition of success such as improved exam results were support given to teachers.

Technical support from ICT staff and colleagues were important in helping teachers improve their skills and confidence in using the new technology. Support and pressure from multi-level leaders was also found to be essential. Therefore, pressure and support given through the implementation strategies, such as training courses,

requirement of certain levels of ICT competency and the use of certain amount of ICT in lessons, turned out to be facilitating factors for teacher change in the focal school. Findings from the teacher surveys and interviews showed that teachers were forced to cross over the barrier to try the new practice due to the requirement of the government and the policy of the school. Feedback from students and positive feeling on the use of ICT in their teaching as a result encouraged teachers to carry on and even to take an active role in implementing the change.

Existence of Other Factors Favouring Teacher Change

External factors, such as the advanced use of ICT in teaching and learning of nearby cities, expectations of private businesses and local or world-wide organizations, expectations and support of stakeholders all made up an environment favouring change. Comparison with the ICT usage in Singapore, Taipei, Shanghai, Australia, the U.K. and the U.S.A. resulted in urges for the Hong Kong government to put resources to meet the challenge in order to maintain its status as a modern city. This also pushed the business and professional organizations to invest in research, training as well as developing hardware and software resources to support teaching and learning using ICT. Their mission and expectation were factors facilitating the change.

Favourable Conditions

Teacher factors were crucial in implementing change. Teachers in the focal school felt the need, were clear about the change and saw it in practice in the lesson observations. They expressed that using ICT in teaching was an irreversible trend and

that they were willing to try and to learn how to do it. The society, the government, the school community, the principals and the teachers themselves all found it necessary for the change and showed their support in different ways. Furthermore, Principal B regarded the use of ICT in teaching as one of the reasons for the improved students' results in external examinations. With the positive feedback from the principal and students, teachers were motivated to use ICT in teaching. Some teachers also gained confidence after practicing it. These made up the favourable conditions for change as described by Fullan (2001).

10.4.2. Factors Inhibiting Teacher Change

The factors inhibiting teachers change in this case can be identified from the data analysis reports as well. Time constraint, lack of confidence, insufficient technical and psychological support, inconvenience of use of the hardware and software, unstable network and hardware, culture not yet built, negative feedback from students are all inhibiting factors expressed in the interviews, surveys and questionnaires.

From teacher interviews and teacher surveys, teachers were concerned about the large amount of time needed for the preparation of lessons when ICT was to be used. Some teachers pointed out that time needed to set up the computers in the classrooms discouraged them from using ICT for lessons. Some students commented that it was troublesome and a waste of time when teachers used ICT during lessons. Time constraint was found to be the main obstacle for teacher change in the focal school. Besides, some teachers were not confident to use ICT in lessons. They found that the equipment was not stable and they could not get immediate help during lessons.

The 'culture' of using ICT in teaching was not yet built in the school in Phase 1. This was considered by some teachers to be the reason for slow implementation. Further, it was also pointed out that some teachers did not have the 'concept' of using ICT in their teaching. Negative feedback from students and teachers were also inhibiting factors. For example, some students felt bored when ICT was used and some students caused trouble in the MMLC. Time constraints, technical problems and unfavourable conditions listed above were reasons mentioned by teachers of the focal school explaining why they were not willing to use ICT in their teaching.

10.5. Using the Chronological Frame of Analysis

Fullan (2001) suggests that an innovation, if successfully introduced should pass through the three phases of adoption, implementation and institutionalization. Weert (2004) states that education is a continuous process of change. When a school initiates a change, it is a concern whether the school only adopts the change but not implement it (Fullan, 2003; Sergiovanni, 2000). It is also a concern of this study to find out whether the changes that occurred in the focal school are just incidental or sustainable.

By looking at the changes exhibited in the different phases, the school has been identified as having adopted the change and was moving towards the stage of implementation during the period of this research. Changes were found when the situations of the activity systems in different time frames were compared. In this chronological frame of analysis, whether the change is incidental or sustainable can also be checked out if the study can be carried on for a sufficiently long period of time.

10.5.1. A Framework Suitable for Analysing Change

To understand more fully how teachers change to using ICT in teaching and learning of the school, it will not be sufficient only to look at the factors facilitating or inhibiting the change. The context in which the school is situated needs to be considered holistically since no one ‘factor’ works on its own. They are dynamically influencing each other and influenced by the historical factors, the culture and expectations of all stakeholders of the school, the Hong Kong society and even the fast changing world. In this case study, the Hong Kong education system, the ICT development in the cities around it and the fast changing technology in the 21st century all played roles in influencing the changes in the focal school. To present the school as activity systems at different time frames within the wider context helps to look at the change more holistically, taking into consideration the historical factors and the characteristics of the community. That is, we cannot study change in isolation but should also study the community and anything around that might have an effect on it. Connection with the wider environment is critical for success is one of Fullan’s eight basic lessons of the New Paradigm of Change (Fullan, 1993).

The chronological frame used in this study helps to display the changing system three dimensionally taking the third dimension, time, into the two-dimensional layout of the activity system at a particular time. It is proved to be a framework suitable for the study of change. Comparison of the components of the activity systems at the three phases has helped to locate the changes and identify the factors mediating them thus facilitating the study of the process of teacher change.

10.5.2. Advantages of Using a Series of Activity Systems

There are advantages in representing the school as a series of activity systems over the three phases of the research period for understanding the process of implementation of ICT in Education. Some of the conditions might have been overlooked if we merely consider the factors reported by teachers or from the surveys. For example, the provision of notebook computer is ranked high by teachers as an important factor facilitating their usage of ICT in lessons. The principal's belief and strategy for the change, which is essential for making the provision of the notebook computers to all teachers happen, might have been overlooked. Furthermore, Principal B was given the merit for successfully implementing the change but it had not revealed the whole picture. If the LCD projectors in the classrooms were not available, using notebook computers in classrooms would not be so convenient that teachers might not like to use ICT in lessons. Therefore, Principal A, who appealed for donations for the installation of LCD projectors in all classrooms, should also be given the merit. However, it was not mentioned explicitly in any of the data collected. When carefully looking at the changes by comparing the conditions of the activity systems in Phase 1 and Phase 2, that is AS_1 and AS_2 , the installation of LCD projectors in all classrooms with a funding from the alumni was very important. In fact, teachers could borrow notebook computers for use in classrooms before they were each provided with one in Phase 2. However, teachers seldom used this resource in Phase 1 even though training and support given to them were quite sufficient because they still needed to borrow notebook computers and do the set up. Therefore, it was found that convenience of usage and compulsion are both important conditions facilitating change.

Whether the innovation is just adopted superficially or implemented in the focal school and whether the change is sustainable or not can also be uncovered with the use of this chronological frame. The focal school represented in a series of activity systems has helped to analyse change over time. From the results of this study, it was found that some teachers of the focal school had adopted the change in Phase 1. The school moved into the stage of adoption in Phase 2 when most teachers changed their practice, at least for some lessons, when all teachers were provided with notebook computers, Principal B set up policies and there was the External School Review. When the conditions of AS₂ and AS₃ were compared, there were not many changes in policies and the ICT infrastructure of the school. However, it was observed and confirmed in teachers' interviews that some teachers started changing their concepts and pedagogy of ICT usage in teaching. Though there was no further push from the principal and no extra external pressure given in Phase 3, teachers' usage was not reversed but some teachers demonstrated more skillful and pedagogical usage instead. The stage of implementation of the focal school will be discussed in Chapter 11.

10.5.3. Summary

This case study has proved that educational change is a complicated process which is affected by many conditions including the physical and psychological tools, the historical and social environment, different personnel and their roles and rules as well as different levels of contradictions as driving forces. The Activity Theory provides a tool for representing the system in a two-dimensional way at different times to facilitate micro-level analysis and thus better understanding of the change process. Presenting

the school as a series of activity systems in a chronological frame is proved to be suitable for analysing change over time.

Comparison of AS₁ and AS₂ has shown that both Principal A and Principal B had set up policies to require teachers to use ICT in some of their lessons, at least to reach the requirement laid down by the government, which is 25% of the lessons in Phase 1. The reasons for the ‘slow adoption’ in Phase 1, as commented by Principal B and some teachers in the focal school, could be that the school had not seriously enforced and followed up the policies. On the other hand, mutual lesson observation and observation by the principal and senior teachers in Phase 2 were the strategies to make sure the policies were carried out. The External School Review at this period required teachers to be accountable to the EDB in implementing its policies. External monitoring was a reason mentioned very frequently by the teachers in the interviews for increasing their ICT usage to almost every lesson in Phase 2. Both the government and school policies named above had created sufficient pressure for making teachers adopt the change. It was also found that principal’s leadership is of great importance in facilitating changes. Their ‘power and influence’ are important in getting resources available and ready for use. ‘Pressure and support’ given in different forms from different stakeholders also ranked high on the list of reasons facilitating change in this study.

To recap, factors facilitating teacher change found in this case include (1) Leadership of the principal; (2) Provision of hardware and software; (3) Government policies and external factors; (4) Pressure and support; (5) Felt need and desire to improve. Obstacles to the change include (1) the absence of favourable conditions; (2)

Lack of time to prepare and reflect; (3) Lack of skills and confidence and (4) Lack of support and (5) negative feedback.

By comparing the components of the activity systems across the three phases, the process of change was described with the factors analysed in fine details. Not only a list of factors but also their dynamic relations are found as a result of the comprehensive description of the change process. By looking at change over time, the focal school is found to have been moving away from the adoption stage towards the stage of implementation of the change through the three phases.

CHAPTER 11 Review of Findings: Challenge and Support from Similar Research

11.1. Introduction

In Chapter 10, the school was represented as a series of activity systems in the chronological frame giving a holistic view of the process of implementation of using ICT in teaching and learning. Throughout the process of constructing the activity systems, various factors and conditions that might have facilitated or inhibited the implementation were identified and presented. The cross phase analysis of the components of the activity systems has shown to be a powerful tool in tracing changes and uncovering a range of factors, including physical, psychological, historical, social and operational, that might have affected the implementation. When the change process was analysed over time, the focal school was found to have been moving from the initiation or adoption stage towards the implementation stage throughout the three phases of this study.

In this chapter, the above findings will be reviewed and compared with those found in other research. The strengths and weaknesses of using a series of activity systems for analysing change over time will be discussed with reference to similar research. The three broad phases of the change process suggested by Fullen (2001) will be used as a guide for measuring the *level of implementation*. The five successive ICT implementation models suggested by Mooij and Smeets (2001) will be taken as

reference points for identifying the position of the school in the ladder of implementation of ICT usage in teaching and learning.

11.2. Use of a Series of Activity Systems for Analysing Change

This study used Activity Theory as the framework for analysing the process of teacher change in the use of ICT in teaching and learning. In the data analysis chapters, the focal school at each phase was presented as an activity system. The three activity systems were then analysed in a chronological frame which facilitated the process of change to be evaluated. Factors facilitating teacher change and those inhibiting it were found when the components of the activity systems were compared across phases and analysed in the activity triangles.

The concepts of mediation and contradiction were found to be useful and helpful in identifying factors facilitating change and evaluating their effects on the process of change. The activity triangle enabled the analysis of change by looking at the system holistically in a 2-dimensional way, taking into consideration the components including subject, object, mediating tools, community, rules and roles. Presenting the school as a series of activity systems in a chronological frame assisted the study of the change process from a third dimension thus resulting in a fairer and more accurate description of it.

Components of the Activity System and the Concept of Mediation

Displaying the activity systems two-dimensionally facilitated the analysis of different components. Mediating artefacts, both physical and psychological, rules

imposing on the school and roles of different stakeholders at each phase were identified from the corresponding representation. Signs of changes were found by comparing the outcomes of different phases. Differences in the mediating artefacts, rules and roles located in each phase, including new elements introduced and changes of existing elements, suggested reasons for the change. In addition, contradictions that were believed to be the drives that motivate teachers to change or develop were also found from the activity systems. The analysis not only led to the identification of factors that might have facilitated change and those that might have inhibited it, but also contributed to a better understanding of how these factors related to each other and to the system. Fullan relates 'change' with the words 'complexity, dynamism, and unpredictability', and points out that identifying all factors that influence a problem does not produce the expected outcomes because other 'unplanned' factors dynamically interfere (Fullan, 1993:p.20).

Physical tools identified in the activity systems included hardware and software provision, teaching materials and trainings while psychological tools included supports from the principal, technical support staff and colleagues, teachers' confidence of using ICT, positive feedback from students, improved effectiveness and efficiency in teaching and teachers' desire to teach better. Most of them were the same as those found in other research such as that done by Guskey and Huberman (1995) and Buettner (2006). However, even though the existence of factors such as the basic hardware and software provision and the requirement of the two principals throughout the three phases were the same, the extent of use of ICT in lessons were very different. The increase of usage of ICT in teaching could then be explained by other factors such as the different

strategies used by Principal A and Principal B. The different leadership styles of the two principals and the support and pressure given by them were possible reasons that had contributed to the different pace of change. The importance of the principals' support found in this case study also agreed with the findings of other researchers (Guskey & Huberman, 1995; Buettner, 2006; Yee, 1998) as well as the report of the SITE M2 study (Yuen et al., 2003).

The extended triangle with the components of community, roles and rules added proved to be useful in guiding the search for factors encouraging change by taking into account the context in which the system was situated. Different parties and stakeholders of the focal school included in the 'community' of the activity system were found to have played important roles in influencing the change. Their contributions might have been overlooked if they were not viewed as part of the activity system. It was also found that the rules set up by authorities and leaders as well as expectations of the stakeholders played important parts in commissioning the change.

By investigating the roles played by the leaders of the focal school which included the principals and school management board and the rules they set up, leadership was found to be most important for the implementation of educational changes. Requirement of both the government and the school were rules that, to some extent, 'mandated' the change. The monitoring role of the EDB and the ESR had some influence on teachers' change of practice since IT skill was one of the nine generic skills, and interactive use of IT was one of the four key tasks needed for the curriculum reform in force in Hong Kong secondary schools during this period of time. Because the EDB had exercised their supervision over the schools, the change could be said to be

mandated. However, rules imposed had moved teachers into the adoption phase only but did not guarantee that they actually implement them. Teachers, such as Teacher A and Teacher B, who actually implemented the use of ICT in their teaching commented that the principal's requirement was not the main factor making them change but the effectiveness of students' learning was an important reason instead. This agreed with Fullan's first lesson of change which says that one cannot mandate what matters (Fullan, 1993).

Besides the government's investment and requirement, the principals' enforcement of rules and the teachers' intention to change both played important parts in moving the school forward. Student feedback, as well as the alumni's and school management board's support of respectively donating and approving money for the procurement of additional hardware and software, were also found to have significant contributions to the change. The component of community in the activity triangle helped to uncover the roles played by different parties and proved Fullan's eighth lesson of change that 'every person is a change agent' (Fullan, 1993:p.22).

Contradictions

The concept of contradiction in the Activity Theory is key in helping to understand change in this study. Contradictions are considered the driving forces for change or development of the system. Hardman (2005) focused on contradictions as dynamic forces in her study of how the introduction of computers led to transformation within her mathematics classroom and found it a useful tool for analysing change. In

this case study, contradictions were found consistently working through them within and between elements resulting in change and development.

Mooij and Smeets (2001) have identified dissatisfaction with the status quo as one of the reasons for teacher change. Teachers in the focal school felt uncomfortable with the status quo when they saw the advanced development in other schools and those in nearby regions from the examples brought in through international conferences, forums and exchange programs supported by the government or tertiary institutions. The ‘felt need’ for change due to the discrepancies between expectations of stakeholders and the stage of ICT usage in the school was instilled in school teachers. This contradiction became a driving force for teachers to change and develop. Another contradiction came from the discrepancies of the requirement of the government and the practice of teachers. The involvement of the external change agencies, such as the ESR teams, created ‘contradictions’ and thus the ‘felt need’ for change in teachers of the school, and consequently moved the school another step forward. Overall, contradiction, which is an important concept of Activity Theory, was found to be valuable in helping to understand change in this study.

11.3. Factors Identified to have mediated Teacher Change

For the implementation of using IT in teaching and learning in classrooms, Fullan (1993) emphasizes the process of change and the need to address the key factors such as characteristics of the innovation, commitment and support, professional development and leadership of the principal. Yee (1998) points out that principals are leaders of changes, supporters of teacher development and modelers of ICT use.

Yuen et al. (2003) in their case study of eighteen schools in Hong Kong report that instituting the change strongly depended on school leaders' vision and understanding of the role and impact of ICT in the curriculum as well as their goals and objectives for the implementation. They also emphasize the effect of the background, history and culture of the schools on implementing the change. Their findings affirmed that principals have the most significant influence on the implementation and institutionalization of changes.

Principals' Leadership: An Important Role Played

In the present study, principals played crucial parts in the implementation process. Both interview data and result of teacher surveys frequently mentioned and highly ranked the principal's leadership, policies and support as reasons for teachers to change to using ICT in teaching.

Power and Influence

James and Connolly (2000) assert that principal's 'power and influence' is central in leadership. In Hong Kong, school principals have the power of setting up and enforcing policies in their schools. Principals need to submit plans and budgets to apply for government funding for special purposes such as the improvement of ICT infrastructure and the provision of hardware and software. They need to submit reports regularly. Therefore, both Principal A and Principal B exercised their power to assign staff to draft the plan and budget and supervised the progress. The allocation of school funding for extra resources needed to be approved by the school management board.

Besides, Principal A successfully persuaded other stakeholders to donate money to support the improvement of the ICT infrastructure of the school. The installation of LCD projectors in all classrooms from the donation of the alumni is an example. The notebook computers and visualizers available for loan to the teachers in Phase 1 actually encouraged some teachers to try out using ICT in their lessons. Principal B used her power and influence to successfully obtain approval from the school management board to use the school fund to purchase notebook computers for all teachers and later install workstations in all classrooms. This had been a very important factor for moving teachers forward in the implementation process in the focal school.

Both Principal A and Principal B demonstrated that they had exercised their power and influence to call upon the concerted effort of different stakeholders to fund the tasks, such as the improvement of infrastructure and the procurement of hardware and software. The targets were met, even exceeding the standard. Therefore, it can be concluded that the leadership of both principals with their ‘power and influence’ played a significant role in facilitating the implementation of this educational change.

Pressure and support

Fullan (2001) points out that pressure without support leads to resistance, and support without pressure leads to waste of resources. Purnell (2002) also stresses the importance of a supportive environment for teacher change. However, it needs an impetus to start the change process.

In this case study, both principals used pressure and support to move their teachers on the track of the educational change. The main reasons expressed by teachers for changing to use ICT in their teaching were fulfillment of school policy and meeting the principal's requirements. Principal B's belief had a strong influence on her strategies for the implementation of the change. She put pressure on teachers by requiring them to demonstrate the usage of ICT in mutual observation and appraisal observation by department heads. The impact of the External Schools Review was exceptionally powerful on the teachers and thus made them seriously try using ICT in their teaching. Findings from their case studies by Wilcox and Gray (1996) also confirm that inspection by OFSTED did play a role in the process of change. They noted that "*change can (and often do) result in the process of preparing for an inspection*" (p.82). Furthermore, findings from their research indicate that feedback from the inspection team have positive effects on intentions to change. Hence, the pressure from Principal B and ESR team in this case was then an impetus for the change process.

Comparing the leadership of Principal A and Principal B, the biggest difference was their ways of enforcing policies. Principal B tended to use pressure through lesson observation by both senior teachers and peers in order to enforce the policy while Principal A put emphasis on giving support by providing resources and making room in the time table for teachers to try using ICT in the MMLC. Besides, Principal B's policy coincided with the External School Review, which added to the pressure for using ICT in teaching thus resulting in a remarkable increase in ICT usage in lessons. This could

have explained why the progress of development in Phase 1 was commented as very slow but that in Phase 2 as very fast.

On the other hand, both principals gave support to teachers, support in the form of extra resources such as hardware and software, ICT training or staff development as well as technical support. Teachers expressed that they already had the basic hardware and received sufficient training in Phase 1, yet they seldom practiced the skills before they were required to use the skills to prepare lessons for observation in Phase 2. This has agreed with Fullan's saying that 'Support without pressure leads to drift or waste of resources' (Fullan, 2001: p.92). Teachers were ready for the change in Phase 1 but they needed a push to ride over the barrier to adopt it. It can be concluded that 'pressure' and 'support' are both essential in facilitating change.

Professional Development and Teacher Change

Teacher change is considered to involve change in teachers' beliefs and practices. There were debates on whether change in belief comes before practice or vice versa as discussed in the literature review chapter. It does not matter which comes first, but they are both involved in the change process and are closely related. Fullan (1993, 2001), Guskey (1986), Cuban (1988), Richardson and Placier (2001) all addressed the close relationship between teachers' beliefs and their change in practices.

In Guskey's (2002) modified model of teacher change, professional development was part of the life cycle for teacher change. Kadel-Taras (1996), Day (1999) and Fishmana et al. (2003) considered professional development necessary for bringing

about teacher change. Furthermore, the research has found that teacher change consists of not only change of knowledge and skills but also beliefs and attitudes (Fishmana et al., 2003, Guskey, 2002). Professional learning communities which give teachers opportunities to share their vision and experience and to get support to transform their practices are considered important for teacher change (Putnam & Borko, 2000).

Improved outcomes of learning are taken as results of teacher change in practice and, at the same time, the factors that change teachers' beliefs and attitudes (Guskey, 2002).

Furthermore, positive feedback and improved outcomes can motivate teachers to further develop and change in their teaching (Richardson, 1996).

It has been reported in the review of government documents in Chapter 6 that the Hong Kong government injected quite large amounts of money not only for the infrastructure, hardware and software as well as employment of support staff, but also for the provision of training to teachers. Courses, seminars, workshops and conferences were organised jointly by the EDB and tertiary institutions for teaching and sharing both skills and pedagogies in using ICT for teaching. The Centre for ICT in Education Centre (CITE) was set up with the QEF by the University of Hong Kong to build and develop a community to share, learn, explore, experiment and research on the use of ICT in teaching and learning. Teachers in the focal school reported that they had received training from both school-based programs and those offered by the EDB or tertiary institutions.

In Phase 2, Principal B's belief on the power of ICT in teaching and learning was an important reason for her determination to put implementing the change highest on the priority list as soon as she started her principalship at the school. Her firm

belief also made her fight for the funding for the provision of notebook computers to teachers and set up strategic plans for making the teachers change in their practices. Thus, teachers speeded up their change process because of the requirements of the principal. They were gradually aware of the advantages of using ICT in teaching and received some positive feedback from their students, and hence changed their attitudes despite some negative feedback from students and high demand of time and effort. The ESR helped to maintain the momentum of change in the focal school at its early stage of adoption and pushed teachers to jump over the barriers.

Looking back on the change process, it can be described that teachers in the focal school started with some basic training acquired in Phase 1 and speeded up their change in Phase 2. There were school policy and EDB policy requiring teachers to change early in Phase 1 but the speed of change was relatively slow. The strong emphasis on the need to change due to the school policy imposed on teachers, the ESR and their 'felt need' to change in Phase 2 had moved the teachers forward to further adopt the change. After trying the use of ICT in teaching, they gradually changed their beliefs and attitudes when they saw the improved effects and thus resulted in further change in practice. In addition, Principal B put improved result in external exams in the school annual report as a consequence of the increased usage of ICT in teaching and learning. This further reinforced teachers' incentive to adopt the change.

Though teachers seldom mentioned the effect of professional development programs on their change in the surveys or interviews, its influence could not be ignored. Peer lesson observation and observation by senior teachers were in fact a form of professional development where teachers shared their experience, gave comments

and suggested ways for improvement. Therefore, the pattern of teacher change in the focal school could be explained by the model of teacher change proposed by Guskey (2002), but the order of change was proved to be cyclical, not linear. This pattern also agrees with what literature says about teacher change disregarding the order of change in belief and change in practice. Thus, professional development plays a critical part in mediating teacher change by providing them with an environment to learn and share, and hence, leading to change in practice accompanied with change in beliefs and attitudes which will further enhance change.

Hardware and Software Provision

It was found from literature that studies in the nineties inclined toward research in the hardware, infrastructure and access. Governments took student-computer ratios as indicators measuring their readiness for the change. Both Buettner (2006) and Purnell (2002) reported that the integration of ICT use in teaching and learning was still rather low even in the 21st century despite the massive expenditure on technology, equipment and connectivity, software and in-service teacher education,.

In this study, the importance of ‘provision of hardware and software’ was mentioned very often and ranked very high as factors facilitating the implementation of the change involving ICT. Comments collected from teachers either on paper on SSE day or from teacher interviews showed that hardware problems were major obstacles and had discouraged them from using ICT. On the other hand, the provision of the notebook computers to all teachers was mentioned most frequently and given the merit of enabling teachers to change. Teachers’ request of installing computers into

classrooms was also frequently found in the interviews or written opinions collected on SSE days. The availability of ICT materials such as PowerPoint presentations provided by publishers or other teachers was a reason given by teachers for using ICT more frequently in lessons. The provision of hardware and software in this case appeared to be an enabling and facilitating factor for the change.

One possible reason for the discrepancies from other research could be the stage of implementation of ICT in the focal school. Since its starting point was very low as described by Principal B, readiness of resources was still of great importance. As pointed out by a teacher, the facilities were already there before Phase 2 of the study but teachers had not actively used them. Back to Fullan's (2001) saying that support without pressure leads to drift or waste of resources, what actually mattered could be the lack of pressure for the change in Phase 1. There was little pressure to make teachers change though the conditions were ready for it. In Phase 2, teachers used the notebook computers in their lessons as required by the principal. Readiness of the PowerPoint presentations from the publishers and other resources online were named reasons for increasing their usage of ICT in lessons. Therefore, teachers in this case considered hardware and software to be a very important mediating tool for their change.

Other Factors Mediated Teacher Change

Fullan (1993) argued for the formulation of a common vision as a critical step in the implementation process. However, in this case study, the principals' policies were set up even before their visions were communicated to the teachers. Both principals had not taken time to build a common vision amongst the staff. It was never mentioned

in any of the interviews, surveys, questionnaires or field notes. Instead, teachers were informed of or felt the need to change from people and the environment around them. The principals led by finding funds to provide teachers with necessary hardware and software as well as training and staff development. The steps to build a common vision did not seem to be so crucial. The leadership of the principal, the felt need of change, the provision of hardware and software and the empowering of teachers were critical steps for the implementation. These can be found in Fullan's list of critical steps for change (Fullan, 1993).

In Hong Kong schools, the need for change was imposed as a consequence of the government's investment in the ICT policies. In the focal school, need might also have come from the school management board who approved money for the procurement of notebook computers and alumni and parents who donated money for the improvement of the ICT infrastructure of the school and installation of LCD projectors in all classrooms. The rapid development of ICT and the increase of ICT usage by the students made teacher feel the 'need of change'. The feeling of incompetence and need to change had created a drive for teachers to learn and practice the use of ICT in lessons and thus resulted in improvement of their usage. Therefore, the felt need, desire to improve their teaching, positive feedback from students and improved exam results are the driving forces for teacher change and development in this case as discussed in Chapter 10.

11.4. Factors Inhibiting Teacher Change

Factors that were found to be obstacles to change in the implementation of ICT were summarised from other research into five areas in the Literature Review chapter. They are (1) Lack of confidence of using the new technology (Smeets et al., 1999; Li et al., 1999; Richardson, 1998); (2) Lack of time and energy to change (Richardson, 1998; Li et al., 1999; Mooij & Smeets, 2001); (3) The cost for sufficient hardware, software and training (Richardson, 1998); (4) Lack of technical support (Richardson, 1998; UNESCO, n.d.) and (5) Lack of leadership in the change of using ICT in teaching and learning (Fullan, 2003; Richardson, 1998; Mooij & Smeets, 2001).

In this case study, these factors were mentioned in the interviews but they were not explicitly stated in the analysis of the activity system in the three phases. Since the components of activity system mainly focused on the tools and conditions mediating change, those that had inhibited it were not identified explicitly. This could be one of the limitations of using Activity Theory to answer the research questions stated in Chapter 3. For example, the demand of time for the change was mentioned frequently in the interviews and teacher surveys but was not fitted in any component of the activity system for analysis. However, most of the factors inhibiting change identified in other research named above are just the reverse of the conditions favourable to change found in this research. That is, lack of favourable conditions of change is a factor inhibiting change.

Absence of Favourable Conditions for the Change

The obstacles to change named in other research are mainly the lack of favourable conditions for change as discussed in the previous section.

Lack of Time

Professional development and teacher learning are considered essential in bringing about teacher change (Richardson, 1996; Purnell, 2002). Teachers need time to learn, reflect and prepare new materials for change (Guskey & Huberman, 1995). Lack of time was mentioned most frequently as reasons for not willing to adopt change in this and other studies. A study in Switzerland schools (Buettner, 2006) reported that teachers were reluctant to change despite the readiness of hardware, software and teacher development. A possible reason is the need to learn new things and new skills in roughly every five years. Purnell (2002) also points out that the huge demand on teachers' effort, time and work is a possible reason for teachers not willing to change. Time required for preparing teaching materials and time for setting up the equipment were given by teachers of this case as reasons for not willing to increase the usage of ICT in lessons.

Lack of Skills and Confidence

Lack of confidence and lack of support were named by Li et al. (1999) as problems commonly found in Hong Kong schools. In this case, some teachers reported that technical problems at times discouraged them from using the technology

for teaching. For example, the school server was not stable and the school Intranet was not easy to use and had problems at times.

Negative Feedback

In other research and literature, positive feedback from students was important in motivating teachers to change (Richardson, 1996). Conversely, negative feedback would have discouraged teachers to change as a consequence. In this case, negative feedbacks were given by students in student interviews and written comments. Students commented that some teachers used ICT inappropriately and wasted time in setting up the equipment. Some students commented that teachers had not changed their role but remained as instructors when ICT was used. Some teachers reported that students did not behave well during the lessons when ICT was used. These could have been reasons that had hindered teachers from developing their usage.

11.5. Summary of Factors Affecting Teacher Change

Factors facilitating change found in this case include (1) principals' leadership; (2) power and influences of the principal; (3) pressure and support; (4) professional development and teacher change; (5) readiness of hardware and software; (6) felt need and culture favourable for change. Characteristics of the focal school matched with some of those found in schools with successful integration of ICT into their curriculum as reported by Dhanarajan (2002) which included good leadership, staff professional development, technical support and ICT coordinators. Readiness of hardware and software was the concern of many research in the nineties. However, research

results showed that readiness and sufficiency of hardware and software might not guarantee any change in practice but rather, a waste of resources if they were not appropriately used. Instead, impetus and pressure were found to be necessary and effective in initiating and sustaining the change process. Findings in this study more or less agreed with those results in similar research.

In this case study, teachers' internal motivation for change was found to be important but without the external push such as the principal's requirement and the ESR, the change in the school could not be as fast. Principal B's strategy of implementing the change by supervising the progress through lesson observation proved to be successful in pushing teachers across the hurdles. It appears that policies, if enforced seriously, can mandate changes.

Throughout this study, teachers' reasons for not implementing the change into their classrooms can be found in the teacher surveys and teacher interviews and they include (1) the absence of favourable conditions; (2) lack of time; (3) lack of skills and confidence; (4) lack of support and (5) negative feedback from students and other stakeholders.

11.6. Stage of Implementation of the Focal School

In Chapter 10, the outcomes of the focal school at each phase were analysed. They were used to locate the different levels of implementation of the educational change this research attempted to study throughout the three phases. The 'three broad phases of the change process' suggested by Fullan (2001) and the 'five successive

ICT implementation models' suggested by Mooij and Smeets (2001) were used as scales for measuring the levels of implementation. The characteristics exhibited in the focal school were compared with that described in each of these check lists.

Three Broad Phases of the Change Process

Fullan (1992) identified 'three dimensions of change' in the implementation of using computers in school which are 'the use of new hardware and software materials', 'the adoption of new activities, behaviours or practices' and 'the changes in beliefs and understanding' (p.29). These three dimensions fit in the 'three broad phases of the change process' for measuring the implementation level. The characteristics specified in the three dimensions helped to identify the position of the school according to the different standards. In the first dimension, the use of new hardware and software materials can be considered the signs of initiation, mobilization, or adoption. This is called Phase I. The adoption of new activities, behaviours or practices are the characteristics demonstrating initial use or early implementation which involves the first experience of attempting to put an idea or reform into practice. These are the characteristics of Phase II. The changes in beliefs and understanding are important features showing that change gets built in as an on-going part of the system which is Phase III in the implementation process.

From the findings, the focal school demonstrated significant changes in the first two dimensions and some signs of the third across the research period. Among the three dimensions of change, the first two can be observed directly from teachers' daily use of ICT material and their practices in the classrooms. The third one is difficult to

measure but changes in beliefs and understanding can be found in what teachers did, how they did it and their perceptions as expressed in interviews. The following are the characteristics found in the focal school during the research period showing that it has satisfied the first two dimensions of implementation and exhibited some signs of the third. In other words, the school had passed through Phase I and Phase II of the implementation stages specified in Fullan's three broad phases of the change process and just showed some characteristics of Phase III.

In Phase 1 of this study, both students and teachers reported some extend of ICT uses in English lessons in the MMLC, in Science and other practical lessons in laboratories and special rooms such as the Lecture Room, Home Economics Room and Design and Technology Workshop as well as a small number of lessons in classrooms. Data from IT seed teacher meeting and teacher surveys in early Phase 2 showed that teachers had some uses of computers, visualizers and LCD projectors in their lessons starting from Phase 1. Teachers had used software from publishers, materials designed by other school teachers or from the Internet. Some teachers even designed ICT materials for themselves. Signs of initiation, mobilization and determination of adoption, which belong to the list of descriptions for Phase I of the process of implementation, could be found. Therefore, the characteristics of 'use' of the technology and a certain extent of 'adoption' were exhibited in Phase 1 of this study.

In Phase 2, all teachers and students reported the use of new hardware, the notebook computers with the LCD projectors in classrooms. There were increased ICT resources from the Internet and the publishers. Teachers reported great increase in usage in the later part of Phase 2. Teachers who participated in the interviews

expressed that they used ICT in almost every lesson. In Phase 2, survey data showed that teachers used the school Intranet very often for checking internal mails, notices and for disseminating and collecting homework from students. Teachers demonstrated frequent use of the hardware and software for most of their lessons. They also used ICT for communication and administrative work. These are the characteristics of the first two dimensions of change proposed by Fullan (1992). That is, both 'use' of the technology and software and 'adoption' of the practices were demonstrated. Further, teachers' lessons in this phase also demonstrated signs of implementation which involved attempts to change their teaching practice with the use of ICT. It can be said that the focal school had reached Phase II implementation defined by Fullan (1992) but not yet moved to Phase III. In the ESR report, ICT usage of the focal school in lessons was described as mainly direct teaching with very little interaction. Some teachers were not good enough in designing ICT usage in their teaching. Most of them, with the exception of a few, mainly demonstrated practical level of change but had not yet shown changes that involved pedagogical or role changes. Only some teachers showed changes in beliefs and understanding and could have both practical and pedagogical use of ICT in lessons. There was insufficient evidence showing this change in other teachers in Phase 2 of this study.

Teachers continued their practices of using ICT in lessons with improvement and further development into Phase 3 of this study. From interviews with teachers and students, it had been found that some teachers showed change in beliefs and had quite good understanding of the concept and pedagogy of using ICT in teaching and learning. It was pointed out in the analysis report of Phase 3 data that some teachers

demonstrated skillful and pedagogical use of ICT in their teaching. It can therefore be concluded that the school had shown most of the characteristics of the first two dimensions of change specified by Fullan (1992) and showed some signs of changes in dimension three, which involved change in beliefs and understanding. In the report of Phase 3 data, there is no further change in school policies and no additional external pressure but teachers continued their practice of using ICT in lessons. Interviews with teachers showed that some of them moved towards pedagogical use of the ICT tool and demonstrated role changes in some lessons reflecting that they had gradually changed their beliefs and understanding. This change to ICT usage had become a built-in routine in most teachers' daily teaching practices in this phase. Therefore, the school can be described as being in Phase II of implementation on Fullan's scale and moving slowly into Phase III of implementation during Phase 3 of the study with some signs of continuation and routinization found in a few teachers.

Five Successive Phases of Implementation suggested by Mooij and Smeets

An attempt is made to measure the level of implementation of the school against the scale given by Mooij and Smeets (2001), who described and arranged the characteristics of implementation at different stages into five models of successive phases of implementation. Mooij and Smeets (2001) claimed that these models could *"create insight into conditioned substantive, material, financial or other prerequisites:"* and would *"enable other schools, in turn, to climb the innovation ladder"* (Mooij & Smeets, 2001: p.274).

By comparing the potential intervention actions for school management in the five models suggested by Mooij and Smeets (2001), the focal school showed most of the characteristics listed for Model 1 and Model 2 throughout the research period. Data in the Phase 1 of the study showed that the school had demonstrated incidental and isolated use of ICT by individual teachers such as the use of ICT by the science teacher in the laboratory as reported in the interview with him in Phase 2. There were organised uses of the MMLC for junior form English classes by that time showing that the school had already moved away from Model 1 to Model 2. Further, the school had installed more than 100 computers all connected in a LAN and to the Internet. Later a wireless network was set up so that both teachers and students can have access to the network anytime and anywhere on campus. According to the descriptions of the models by Mooij and Smeets (2001), the school had shown most of the characteristics of Model 1 and Model 2 and some of Model 3 during Phase 1 of the study.

In Phase 2 of the study, the school had been improving its hardware and software provision. Almost all teaching staff showed increased usage of ICT in their teaching. Both individual teachers and departments showed awareness of ICT usage. Mutual observation both within and across departments as well as observation by senior staff helped the school to establish the characteristics in Model 2. All teachers were required to think of the ICT relevance for the subjects they taught and for the school at various levels. ICT facilities in the whole school were further improved with the provision of notebook computers for all teachers and coordination of use was improved with the introduction of the school Intranet. As a consequence of extensive ICT usage, the school had put emphasis on ICT co-ordination and hardware within the school

which was described as a characteristic in Model 3. That is, the school had exhibited most characteristics of Model 3 schools by the end of Phase 2 of the study. In Phase 3, a few teachers showed pedagogical changes in teaching with some attempts to move away from direct teaching towards student-centred learning models showing some didactic innovations, that is, some signs of Model 4 schools are emerging.

Summary

It is found that the characteristics exhibited in the three phases of this study matched quite closely the three broad phases of implementation suggested by Fullan (2003) in order. The characteristics of Phase I of implementation suggested by Fullan are mostly found in the school in Phase 1 of this study while that of Phase II can be found in Phase 2 of the study and some characteristics but not all of Phase III of implementation were present in the focal school in Phase 3. The progressive development of the school from Phase 1 through Phase 3 matched the characteristics of the three phases of implementation. The three dimensions of change is helpful in understanding the level of implementation of an educational change.

When comparing the five models of implementation suggested by Mooij and Smeets (2001), the focal school had fulfilled most of the characteristics of Model 1 and Model 2 and covered some characteristics in Model 3 in Phase 1 of the study. By the end of Phase 2, most of the characteristics of Model 3 could be found and towards the end of Phase 3, some characteristics of Model 4 were also emerging. The five models of implementation suggested by Mooij and Smeets (2001) did provide some guidelines for understanding the position of ICT implementation of the schools.

The characteristics and prerequisites for Models 1 to 4 are quite similar to those of the three phases of implementation suggested by Fullan as described earlier in this section but with more detailed descriptions. Both the three broad phases of implementation proposed by Fullan (2003) and the five successive phases of implementation suggested by Mooij and Smeets (2001) helped to locate the focal school along the levels of implementation by checking against the list of characteristics or features given. When the practices of the focal school were compared with the actions described in the 5 level implementation models, they matched almost in the same order. Therefore, it can be concluded that the five models of implementation suggested guidelines for setting aims and drafting plans for climbing up the ladder as they claimed. However, since it is not the aim of this case study to evaluate these tools, the reliability of these models need further study.

CHAPTER 12 Discussion: Issues Addressed and Areas to Explore

This research was designed to be carried out as a case study in the school the researcher was working in. Issues such as researcher biases and subjectivity had been addressed in the methodology chapter. The research design is of multi-phase mixed methods. Both quantitative and qualitative data were collected throughout the three-phase study. The data collected were then analysed and reported by representing the school as an activity system at each phase of the study in Chapters 7, 8 and 9. A comparison of the components at the three phases was given in Chapter 10 in order to explore the changes that had occurred and the factors affecting them. Activity Theory was proved to be a suitable framework and an analytical lens for understanding teacher change in this case study. In this chapter, the issues raised will be addressed and areas for further exploration will be suggested.

12.1. Issues addressed

The issues raised in the previous chapters will be addressed below. The first one is the strengths and weaknesses of the case study to be carried out by an insider who is at a senior position of the focal school. The second is whether the Activity Theory is suitable for studying teacher change and identifying factors that have facilitated or inhibited the change and its limitations.

12.1.1. Case Study Carried Out By An Insider: Strengths and Weaknesses

This research used a single case study method to look closely into the process of implementation of ICT usage in a secondary school by representing the chronological development of the school as a series of activity systems. The researcher was an insider of the focal school being present at the school as a full time teacher throughout the research period. Data were collected using mixed methods in the three phases.

An Insider as the Researcher of the Case Study

The researcher, being an insider and at a senior position of the focal school, had the advantage of being aware of any incidences, unexpected but related to the study, and thus could collect the relevant data at the right time even though these were not in the original plan. For example, when the data collection plan was drafted, the school self-evaluation day was not on the school calendar and the school was not yet informed of the External School Review. The researcher seized the opportunity to collect teachers' comments on the ICT environment of the school, in particular the provision of the notebook computers and the school Intranet, eClass, as well as their uses of ICT in teaching and learning. The change of principalship in the focal school was another situation that was not in anticipation when the plan was drawn. However, Principal A was not invited for any interview before he left and his comments on the situation was not included in the data collected. The flexible nature of case study had made it a suitable research method for studying change over time.

Another advantage for the researcher being an insider at a senior position of the

focal school was that the researcher had the knowledge of any possible sources of data that would contribute to the discovery of information related to the study and could easily retrieve the school data with the permission of the principal. The researcher had long years of service at the school and had built up trust with her colleagues. She was elected to be a representative to express their opinions to the school management board. The rapport built among the staff enabled her to easily invite teachers to participate in the research and have them freely express their ideas. Teachers did not feel additional demand on their time when the researcher observed their lesson since it was done routinely anyway. All these facilitated better understanding of the process of change in the focal school. Nevertheless, the threat that teachers would have inclined to give positive feedback due to the position of the researcher had been addressed to. Anonymous teacher surveys collected online, comments given by Principal B and students as well as the change observed in lessons triangulated with each other to maximize the reliability.

With the approval of the principal, the researcher could have access to the government and school documents which were essential in understanding the school background. However, some old government documents and circulars which would have shown the history of ICT development in the focal school could not be retrieved. The part of the history of the ICT development in Hong Kong schools was a retrospective account of the events by the researcher herself who was the one in charge and followed through the development of computer education at the focal school from its very beginning in the eighties.

Multi-phase Mixed Method Research Design

Multi-method research has been proved to be suitable for this case study. Data collected from various sources by different means in the three phases provided a rich set of data for this study. This facilitated a detailed description of the use of ICT in the focal school. The three-phase design facilitated the study of the chronological development of ICT implementation of the school by providing snapshots of the system at the different times.

12.1.2. Using a Series of Activity System as a Suitable Framework for Studying Change

Factors that were found to have facilitated or inhibited the development in this study are similar to those found in other studies with little exceptions. The representation of the school as an activity system provided a holistic view of all those factors and their dynamic relationships with each other and the context in which the school was situated. For example, both teacher surveys and interviews showed that the presence of notebook computers was a major factor for making teacher change to using ICT but after analysing the activity system as a whole, the principal's leadership and the ESR had significant influence on teachers' change as well. The readiness of many other conditions in the focal school is also important. The application of representing activity system on a chronological frame proposed in this study thus have facilitated the understanding of the process of change and identifying the reasons why teachers adopted or resisted it by looking at the different components of the system in a particular period and taking into consideration the historical development of it.

The five successive models suggested by Mooij and Smeets (2001) and the three dimensions of change suggested by Fullan (1993) did present a checklist of characteristics for locating the focal school according to the different scales in measuring the levels of implementation. However, there are some reservations to the claim that the five models could be guides for schools to climb up the ladder since the checklist did not say anything about the conditions for getting there. Since change is dynamically complex and is non-linear (Fullan, 1993), it is impossible to follow a checklist for implementing change. Rather, it is an instrument to understand the present situation and to use the characteristics on the checklist as check points for planning further development. It is important to know how to prepare an environment favourable for change and have a tool to evaluate the situation and facilitate the planning for a step forward. The chronological frame of study by the Activity Theory proposed in this study could be a tool for this purpose.

12.1.3. Limitations of the Proposed Framework for Studying Change

The use of a series of activity systems on a chronological frame of analysis has shown to be a framework suitable for understanding the process of teacher change and a tool for identifying factors affecting it with the concepts of mediating tools, community and roles and rules. The factors identified and discussed from the analysis of the activity systems are mainly those that had mediated the change towards development but those factors that had inhibited it have seldom been addressed during the analysis of the activity triangle. It may be a limitation of this framework for answering the research questions with the aim of identifying both factors facilitating and those inhibiting the

development. Further study in this area will be useful for the usage of this framework for similar studies.

12.2. Areas to explore

After carrying out this study, further exploration of the influence of the principal's leadership on teacher change and sustainability will be proposed with a view to fully understand the implementation process of the change. The framework suggested for studying the chronological development of ICT implementation can be used for understanding other educational changes. The factors identified to have contributed to the implementation of using ICT in lessons could also serve as examples for other schools though it was emphasized in this study that factors should be studied together with the school context as a whole. The results of this case study in the focal school are not to be generalized but the research methodology and the framework used to understand change will be useful as a reference.

12.2.1. Continuation of the Study in the Focal School

After this case study ended in August 2007, there were not many changes in the ICT policies of the school and Principal B had not put much effort in following through the implementation. Principal B resigned after the school year 2007/08 and Principal C took her office in September 2008. Principal C had not emphasized ICT in teaching in her policies but teachers seemed to have become used to the change and there was no sign of reverting back to the previous stage. In a short interview with teacher A, who was involved quite a lot in the Phase 2 and Phase 3 study, it was found that using ICT

had become a ‘habit’ and new teachers were already trained to use ICT in teaching in their pre-service training. There was a sign that some teachers continued to be changing in their practice as well as their teaching pedagogy but some remained in their present status. Therefore a continuation of the study in the focal school can be proposed in order to have a more complete picture of how teacher change by looking at the change process of individual teachers. The study could also continue with Teacher A and Teacher B as individual activity systems for analysing change in different teachers.

12.2.2. Principal’s Leadership for Teacher Change

Since leadership is found to have played an important part in influencing the implementation of an educational change, it would also be a valuable chance in exploring how the leadership of different principals influence change and how is an educational change fully implemented in a school. The continuation of the study proposed above could put the principal’s leadership one of the focus of the study. It was a very special situation of the focal school that there were changes of principals throughout the research period. The school changed to a new principal when the study moved from Phase 1 to Phase 2. Immediately after Phase 3, another new principal took the office. If the study could be continued into Phase 4, the effects of the principals’ leadership on the implementation could be further explored.

12.2.3. Concluding Remarks

This case study can serve as an example of studying the implementation of an educational change in a school in a continuous time line throughout the development. It helps to do evaluations and planning as well. Though results of this single case

study cannot simply be generalized to other schools, it can help the continuous development and improvement of the school and working as an example for others. As the progress towards implementation of the school matched quite well with Fullan's three broad phases of change process (Fullan, 2003) and Mooij and Smeets' (2001) five successive models of implementation, those models can be useful guidelines for setting aims and plans for implementing an educational change as well as understanding the stage of implementation.

Fullan (2001) points out that successful implementation of educational change requires an understanding of the process and the factors that determine its success or failure. This study of teacher change using a chronological frame to study the focal school by representing it as an activity system at different phases is shown to be useful in understanding the change process and identifying the factors mediating the change through detail analysis of the components suggested by Activity Theory. It has also been shown to be a tool for evaluating and understanding the stage of implementation of the educational change in the school, thus helping to plan for further development and growth of the system. I argue that Activity Theory is suitable to be used in a micro-level study of change of individual teacher as well as macro-level of change of an educational system.

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Glossary of Terms & Acronyms

BECTA	British Educational Communications and Technology Agency: the UK government agency leading the national drive to ensure the effective and innovative use of technology throughout learning (2002-2010).
CDC	The Curriculum Development Council: a free-standing advisory body appointed by the Chief Executive of the Hong Kong Special Administrative Region to give advice to the Government on matters relating to curriculum development for the local school system.
CHAT	Center for Activity Theory and Developmental Work Research: a research unit at the University of Helsinki in Finland. They conduct research in work, technology and organizations going through transformations.
CITE	Centre for Information Technology in Education: established by the Hong Kong University in 1998 for the promotion of the use of ICT for quality education.
DfES	The Department for Education and Skills: a department established with the purpose of creating opportunity releasing potential and achieving excellence for all in the U.K.
EC	The Education Commission was set up in February 1984 as a non-statutory body to advise the Government on the overall development of education in the light of the community's needs.
EDB	Education Bureau of the Hong Kong Special Administrative Region of the People's Republic of China from 2008 onwards.
EMB	Educational and Manpower Bureau: the name of the Education Department of Hong Kong Special Administrative Region of the People's Republic of China from 2003 to 2008.
ESR	External School Review: a process of validation by an external agent (ESR team) of authority (EDB) to see if the school's self-evaluation is consistent with the evaluation made by the external agent.
HKEAA	The Hong Kong Examinations and Assessment Authority: a statutory body established in 1977 by the Hong Kong government to provide valid, reliable and equitable examinations and assessment services to the primary and secondary school level and examinations for university admission and adults seeking professional qualifications.
HKEdCity	Hong Kong Education City: a professional educational portal in Hong Kong. It incorporates information, resources, interactive communities and online services, and promotes the use of information technology in improving the effectiveness of teaching and learning.

HKSAR	The Hong Kong Special Administrative Region of the People’s Republic of China
HKSARG	The Government of the Hong Kong Special Administrative Region of the People’s Republic of China.
ICT	Information and Communication Technology: a term defined as “diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information.” (from Wikibooks, the open-content textbooks collection) In this thesis, IT and ICT are interchangeable and carry the same meaning.
IEA	The International Association for the Evaluation of Educational Achievement: an independent, international cooperative of national research institutions and governmental research agencies.
IT	Information Technology: a term commonly used in the nineties and has been replaced by the term ICT in the late nineties when connectivity becomes an important usage of IT. In this thesis, IT and ICT are interchangeable and carry the same meaning.
ITEd	Information Technology in Education
Microsoft	Microsoft Corporation: a multinational computer technology corporation
OFSTED	Ofsted is the Office for Standards in Education, Children’s Services and Skills. We regulate and inspect to achieve excellence in the care of children and young people, and in education and skills for learners of all ages.
QEF	Quality Education Fund: it is established in 1997 for the promotion of quality education in Hong Kong. The QEF mainly caters for worthwhile non-profit making initiatives within the ambit of basic education, i.e. pre-primary, primary, secondary and special education.
SARS	Severe Acute Respiratory Syndrome: a viral disease which affects the respiratory system. Hong Kong reported an outbreak of SARS in 2003 with more than 1000 people infected and almost 300 killed over a four month period. Schools were suspended for over one week during this period.
SITES	Second Information Technology in Education Study is organised by the International Association for the Evaluation of Education Achievement (IEA).
SSE	School Self-evaluation: a school-level self-evaluation mechanism for school improvement and development.

UNESCO United Nations Educational, Scientific and Cultural Organization: an international community that has a mission to improve the quality of education and to facilitate policy dialogue, knowledge sharing and capacity building. The website for ICT in Education: www.unescobkk.org/education/ict

List of Figures

Label		Page
Figure 2-1	A model of teacher change	32
Figure 3-1	First generation Activity Theory model	66
Figure 3-2	Second generation Activity Theory model	67
Figure 3-3	Third generation Activity Theory model	68
Figure 3-4	Nested nature of Activity Theory dynamics	69
Figure 3-5	The hierarchical structure of activity	73
Figure 3-6	The four levels of contradiction	76
Figure 3-7	The evolving nature of learning communities where various instances of the history of system (AS ₁) are depicted.	81
Figure 5-1	Design versus data collection: Different units of analysis	123
Figure 6-1	First representation of the Activity System – the focal school	142
Figure 7-1	Number of lessons in MMLC	166
Figure 7-2	Number of English lessons in MMLC	166
Figure 7-3	Methods used for English lessons in MMLC	167
Figure 7-4	Students' attitude towards lessons in MMLC	167
Figure 7-5	Advantages of having lessons in MMLC	167
Figure 7-6	Disadvantages of having lessons in MMLC	167
Figure 7-7	Teachers' role in the MMLC lessons	168
Figure 7-8	Roles students wish teachers take on in MMLC	168
Figure 7-9	Activity System 1 (AS ₁)-the school at Phase 1 of the study	173
Figure 8-1	A graph to compare the cumulative percentage of teaching time using ICT (Phase 2)	193
Figure 8-2	Types of software used by teachers (Phase 2)	194
Figure 8-3	Reasons for using ICT in teaching (Phase 2)	195
Figure 8-4	Ways how teachers used the school Intranet, eClass	196
Figure 8-5	Reasons why teachers increased usage of ICT in their teaching	198
Figure 8-6	Reasons for not using ICT in teaching	199
Figure 8-7	Activity System 2 (AS ₂)- the school at Phase 2 of the study	219

Label		Page
Figure 9-1	Comparison of teachers' use of ICT in lessons and students' use of ICT for learning as reported by students	237
Figure 9-2	Students' report of teachers' ways of using ICT for teaching	238
Figure 9-3	Students' report of their ways of using ICT in learning	239
Figure 9-4	Comparison of teachers' and students' ICT usage	240
Figure 9-5	Comparison of students' views on the advantages of using ICT for teachers' teaching and that of students' learning	241
Figure 9-6	Students' views on the disadvantages of using ICT in learning	242
Figure 9-7	Roles teachers played and roles students expected of teachers when ICT was used for lessons	243
Figure 9-8	Percentage of teaching hours using ICT (Data from the 3 teacher surveys)	249
Figure 9-9	Ways of using ICT for teaching (Data from the 3 teacher surveys)	251
Figure 9-10	Total sites across all domains (August 1995-January 2008)	253
Figure 9-11	Reasons for using ICT in teaching (Data from the 3 teacher surveys)	254
Figure 9-12	Ways teachers use the School Intranet, eClass (Data from the 3 teacher surveys)	255
Figure 9-13	Reasons why teachers increased usage of ICT in teaching – Comparison of Survey 2 and Survey 3 data	257
Figure 9-14	Factors that discouraged teachers from using ICT in teaching – Comparison of Survey 2 and Survey 3 data	258
Figure 9-15	Activity System 3 (AS ₃) – the school at Phase 3 of the study	284
Figure 10-1	Representation of the evolving system (AS _i) of the present study.	291

List of Tables

Label		Page
Table 5-1	Plan for choosing teachers to be interviewed and lessons to be observed	126
Table 5-2	Key events and schedule of data collection in the 3 phases	130
Table 6-1	Policies and events related to the development of ICT in Education in the focal school	153
Table 6-2(a)	Aims and purposes of data actually collected in Phase 1	155
Table 6-2(b)	Aims and purposes of data actually collected in Phase 2	156
Table 6-2(c)	Aims and purposes of data actually collected in Phase 3	157
Table 8-1	Basic information about the two teacher surveys given out in Phase 2	193
Table 8-2	Percentage of teaching time using ICT from the 2 surveys in Phase 2	193
Table 8-3	Cumulative percentage of teaching time using ICT (Phase 2)	193
Table 8-4	Information about teachers selected for Phase 2 study	201
Table 8-5	Basic information of interviews with the selected teachers in Phase 2	202
Table 8-6	Frequency of use of the key words in the interviews in Phase 2	203
Table 8-7	List of labels used for teacher interviews in the Appendix	204
Table 8-8	Order of importance of the factors affecting teachers' ICT usage in lessons	212
Table 9-1	Record of data collected in Phase 3	236
Table 9-2	Record of respondents to Student Questionnaire 5	237
Table 9-3	Students' report of teachers' use and students' use of ICT for teaching and learning	237
Table 9-4	Students' report of teachers' way of usage of ICT for teaching	238
Table 9-5	Students' report of their usage of IT in learning	239
Table 9-6	Students' expressed feelings towards the use of ICT in lessons	244

Label		Page
Table 9-7	Basic information about the questionnaires given out in Phase 3	245
Table 9-8	ICT usage of secondary school students in Hong Kong compared with the UK data	247
Table 9-9	Basic information about the three teacher surveys	249
Table 9-10	Percentages of teachers used ICT more frequently in teaching	256
Table 9-11	Time and number of words recorded in Teacher Interview 1 and Interview 2	266
Table 9-12	Frequency of use of key words by teachers in Interview 1 and Interview 2	273
Table 10-1(a)	A comparison of the components of the Activity Systems AS ₁ , AS ₂ and AS ₃	295
Table 10-1(b)	A comparison of the components of the Activity Systems AS ₁ , AS ₂ and AS ₃	300

Appendices
are printed on a
separate booklet