Conditions and Constraints of Sustainable Innovative Pedagogical Practices Using Technology

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ABSTRACT: Like many other countries, Hong Kong Special Administrative Region Government has invested heavily in the computer facilities of schools. It is expected that by using ICT, the quality of education will be enhanced through a paradigm shift in school pedagogical practices. However, some educational innovations resulted in disappointing outcomes and some of them did make the progress expected and failed to sustain their development. This research addresses such problems by presenting a model that provides guidance on how to facilitate effective and sustainable Innovative Pedagogical Practices Using Technology (IPPUT). The model was derived from an in-depth case study of one innovative primary school in Hong Kong. The research first investigated what an innovative classroom might look like, then by using the "Layer-Two" Model Instrument (Typology of ICT Uptake) (Newhouse, Trinidad, & Clarkson, 2002) and other Matrix Construction Techniques (Miles & Huberman, 1984), various conditions and constraints on the development of IPPUT were identified, subsumed and grouped into two "issue trees." It is particularly useful for the school leaders to formulate optimum strategies for implementing IPPUT by comparing their school's realistic situations with those factors in the two "issue trees". Finally, the whole-school system model was presented suggesting that given favourable conditions including visionary school leadership, whole-hearted collaboration and participation of all school stakeholders, with a systematic managerial methodology, it is possible to have true ICT integration and sustainable pedagogically-sound environments for students' learning.

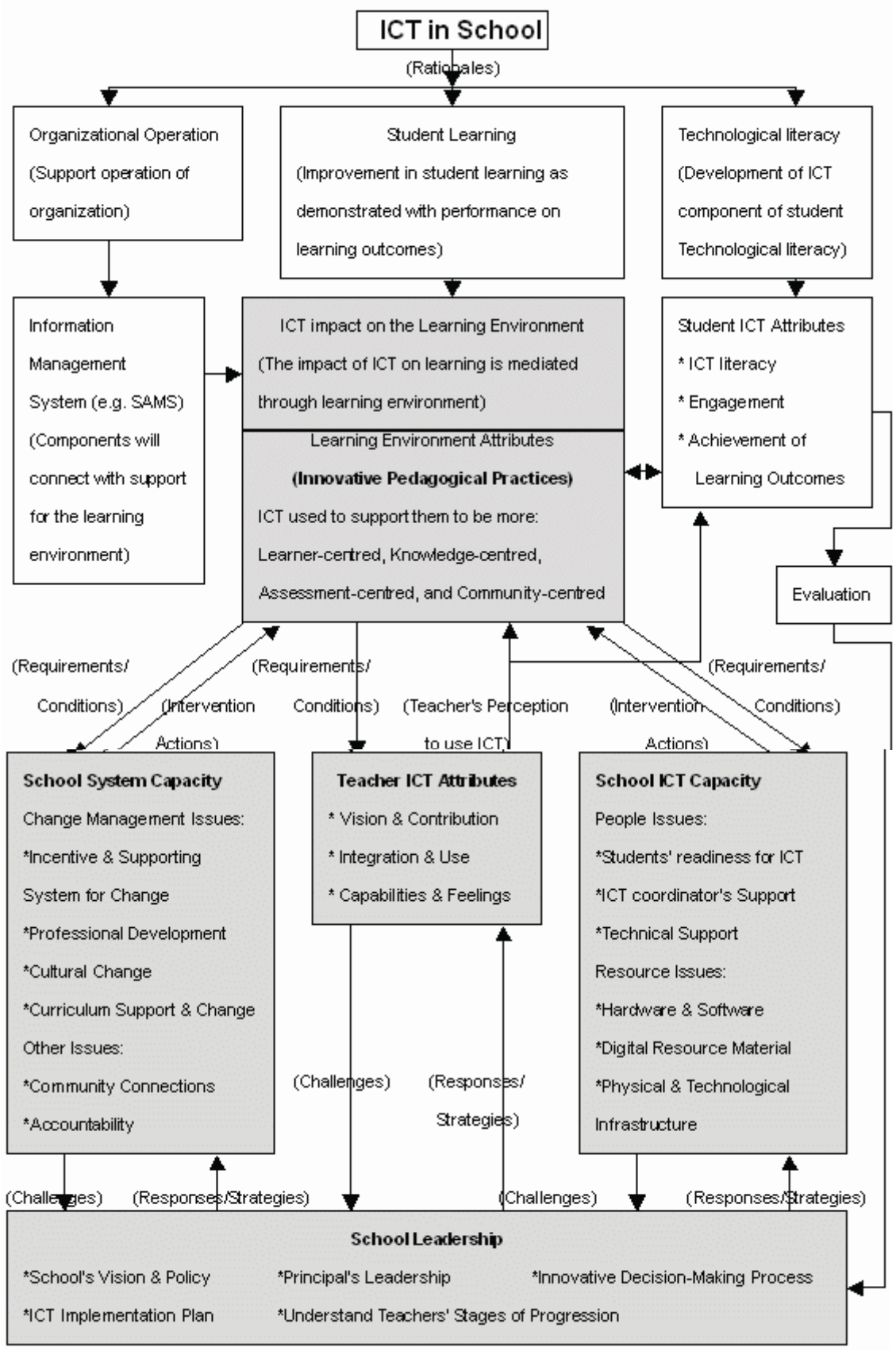
Introduction

The development of Information and Communication Technologies (ICT) and the increasing pace of globalization has transformed the structure of society from an industrial to an information society, or what Lepani (1995) calls the knowledge economy There is a need to change our school system to a more dynamic one, which can provide life-long employability (Mercer, 1999), thus, many countries have invested heavily in the development of ICT in schools and also have launched educational reform policies and initiatives. Hong Kong is no exception. In November 1998, the HKSAR Government issued a policy document “Information Technology for Learning in a New Era: Five-year strategy 1998/99 to 2002/03" (Education Manpower Bureau, 1998). It was proposed that through a paradigm shift in school pedagogical practices the quality of education would be enhanced and to prepare children to cope with 21st century challenges (Education Manpower Bureau, 1998).

This was based on the premise that ICT plays a critical role in shaping and influencing pedagogical practices, which can in turn enhance school education quality. However, despite the huge investments and zealous efforts on introducing ICT into education across the world, there are many examples showing traditional curricula and teaching methods have remained dominant, and as teaching tools, computers are still marginal (Johnston & Johnston, 1996; Mrchinkiewicz, 1994; Papert, 1996). Within the Hong Kong situation, Law, et al. (2000) mentioned that most schools were simply sing new technology to teach and learn in old ways with classroom practices largely unchanged in structure or content. Deeper changes failed to emerge because only the medium of delivery was technologized For example, teachers made use of ICT mainly for drill and practice or presentations in their classrooms. It seemed that they could not fully utilize the true capabilities of ICT to enhance a pedagogically-sound environment (i.e., constructivist learning environments).

The Research

This study investigated the likely factors and those needed to produce pedagogically-sound environments to facilitate effective and innovative curriculum change while using ICT in Hong Kong, as well as investigating the constraints and those factors inhibiting innovations. It explored the relationship between four core interrelated aspects including Teacher ICT Professional Attributes, School ICT Capacity, School System Capacity, and School Leadership, and examined how far these factors can influence the teachers perception and willingness to use ICT in their classrooms. The graphical representation of the conceptual framework of such interrelationships is presented in Figure 1. The research attempted to explain why some teachers adopt innovative pedagogical approaches but other teachers remain with their traditional curricula. The results of the research provided a tree diagram showing the conditions and constraints on innovative pedagogical practices with ICT at the school system level.


ICT in School
(Rationales)
Organizational Operation
(Support operation of organization)
Student Learning
(Improvement in student learning as demonstrated with performance on learning outcomes)
Technological literacy
(Development of ICT component of student Technological literacy)
Information Management System (e.g. SAMS)
(Components will connect with support for the learning environment)
ICT impact on the Learning Environment
(The impact of ICT on learning is mediated through learning environment)
Learning Environment Attributes
(Innovative Pedagogical Practices)
ICT used to support them to be more:
Learner-centred, Knowledge-centred, Assessment-centred, and Community-centred
Student ICT Attributes
* ICT literacy
* Engagement
* Achievement of Learning Outcomes
Evaluation
(Requirements/ Conditions)
(Intervention Actions)
(Requirements/ Conditions)
(Teacher's Perception to use ICT)
(Intervention Actions)
(Requirements/ Conditions)
School System Capacity
Change Management Issues:
*Incentive & Supporting System for Change
*Professional Development
*Cultural Change
*Curriculum Support & Change
Other Issues:
*Community Connections
*Accountability
Teacher ICT Attributes
* Vision & Contribution
* Integration & Use
* Capabilities & Feelings
School ICT Capacity
People Issues:
*Students' readiness for ICT
*ICT coordinator's Support
*Technical Support
Resource Issues:
*Hardware & Software
*Digital Resource Material
*Physical & Technological Infrastructure
(Challenges)
(Responses/ Strategies)
(Challenges)
(Responses/ Strategies)
(Challenges)
(Responses/Strategies)
School Leadership
*School's Vision & Policy
*Principal's Leadership
*Innovative Decision-Making Process
*ICT Implementation Plan
*Understand Teachers' Stages of Progression

Adapted from Newhouse, Clarkson & Trinidad (2002).

Figure 1. Graphical representation of the interrelationship between innovative pedgogical practices and various factors at the school system level

This meso-level analysis of the school contextual factors may help school leaders understand the likely criteria that would create the ideal pedagogically-sound environments for student learning. From here they can make use of those criteria for fine-tuning or e-engineering their school system capacity as well as put management strategies in place in order to provide such learning environments within their schools. Finally, the research findings provide a possible whole-school system model of ICT integration in innovations to other schools for reference. This may help policy-makers or school leaders to reinforce the integrating of ICT into their schools as well as maintaining the momentum for such innovations. Therefore the research aimed to address the following questions from a micro-level (i.e., classroom practice) to meso-level (i.e., school system and context) and then finally the macro-level (i.e., policy recommendation). The major research questions were as follows:

1. How do innovative teachers in a Hong Kong school use ICT and what are their perceptions towards innovations that might influence their pedagogical practices?
2. What are the conditions and constraints of implementing innovative pedagogical practices with ICT within a Hong Kong school?
3. How do you sustain favorable conditions for supporting innovative pedagogical environments for Hong Kong schools in the future?

The Research Methodology

Data Collection Procedure and Instruments

An in-depth qualitative case study of a primary school in Hong Kong was undertaken. The data collection procedure included:

1. Three classroom observations looking at three innovative teachers and their pedagogical practices.
2. Applying Newhouse, et al. (2002) "Layer-Two" Model Instrument (Typology of ICT Uptake) to collect relevant data from the three teachers.
3. Semi-structured individual interviews with the same three innovative teachers and another three teachers using traditional pedagogies.
4. Semi-structured individual interviews with the ICT coordinator and the school principal.
5. Documentation analysis (including the school's vision and mission, school IT policy and implementation plan, staff development plan, etc.).

Data Analysis

The data gathered from the three classroom observations and the various interviews was initially analyzed using Newhouse, et al.(2002) "Layer-Two" Model and then written up as three case reports. Those reports included several main dimensions including background information, summaries of the innovation, teacher's perception towards innovation, teachers' professional ICT attributes, and problems and solutions related to the innovation. Then the Matrix Construction Techniques of Miles and Huberman (1984) were used to methodically analyze the data. Such a technique can be used to conceptually cluster particulars from various data sources and subsume them into the general concepts. This system provided a sound organizational framework for analyzing the data and finally led to the creation of a "dendrogram" (i.e., a tree diagram) (Krippendorff, 1980) of conditions and constraints on innovative pedagogical practices with ICT. The data analysis framework is shown in Figure 2:

Class Level & Subjects Involved	Curriculum Topics	The Tasks and Technology Used
P.6 Computer Study & General Studies See Case 1	History of Coastal Defence in Hong Kong	Students are required to search information about the topic through surfing the Internet and visiting the Museum, and they produce their own web pages about the topic b y using some multi-media production software (i.e., Flash, Dreamweaver, etc.)
P.6 Computer Study & English See Case 2	My First Story	Students are required to learn the relevant language items and then think up the ideas for writing their stories. They can present their stories by using multi-media software (i.e., Flash)
P.3 Art & Chinese See Case 3	My Father's Day Card	Students make use of a drawing program (i.e., Painting Pad) to design a Father's Day care and they have to type a short passage in Chinese characters to express their feelings of appreciation for their fathers.

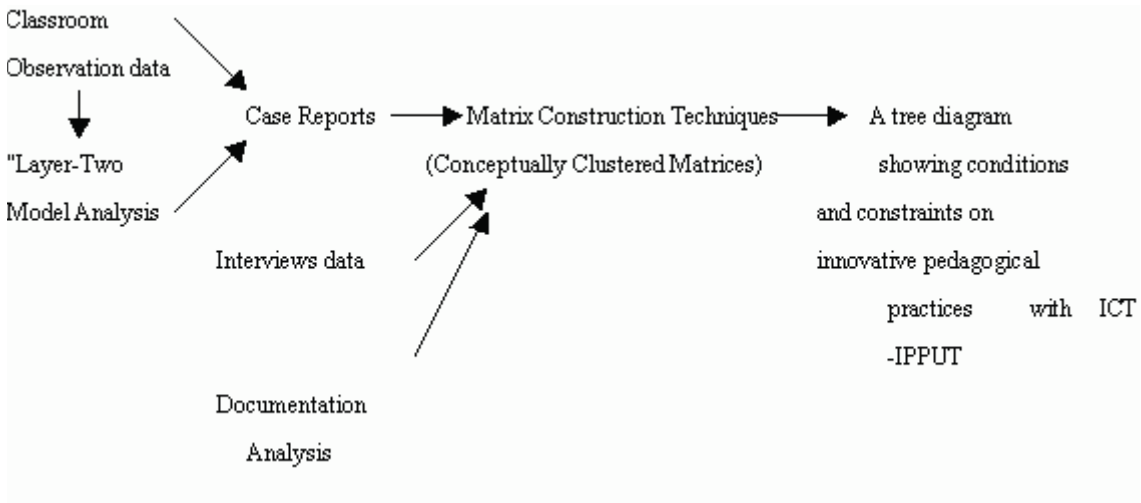


Figure 2. Conceptual Framework for Data Analysis

The Findings

Scenarios of Innovative Pedagogical Practices (IPPUT)

1. The term "innovative pedagogical practices using technology" (IPPUT) cannot be defined precisely. Nevertheless, it was found that, to some extent, it had one common feature in central: that the students learnt things by doing. Undoubtedly technology played a significant role in this aspect. Technology or ICT not only acted as an instrument for students to complete the tasks, but it could also be a part of the learning environment. However, what might an innovative classroom look like in Hong Kong? It was found that the new learning environment supported by ICT had more degrees of the following characteristics than the conventional one. Extracts of the case reports of three classroom innovations' descriptions are provided in Table

Table 1 Summary of Three Selected Innovations.

The selected innovations found in these classes are discussed under these categories:

1. Multiple learning goals and outcomes
2. Student-centredness and the teacher as scaffolder
3. The technology was embedded
4. Cross-disciplined

5. Authentic task contexts
6. Interactive and connective, and
7. Assessment-focused.

1. Multiple Learning Goals and Outcomes

In conventional lessons, the learning goal or outcome is usually one-dimensional and subject-specific. However, it was found that multiple generic skills were accentuated in the innovations and students were expected to develop such skills through accomplishing the learning tasks. Taking Case 2 as an example, in this innovation, students had to search information about stories. They were expected to develop data collecting and analysis skills in this activity. Then they needed to develop their ideas and organize the main themes of their stories, so this involved mental processing skills and cognitive skills. Finally the students presented their stories to the whole class in which presentation skills were required. Moreover, during the innovation the students needed to share information, interact and make compromises with their peers. Undoubtedly, social and collaborative skills could be sharpened. The whole process of writing stories was a good opportunity for students to express their creativity and originality. Therefore, the English lessons were not only for learning language items but also integrated other generic skills for students to learn. Indeed, technology expanded the possibility of multiple learning goals. As the innovation showed that the powerful manipulative and multi-media capability of computers allowed students to alter work easily and conveniently, thus increasing their productivity and the capability of performing multi-tasks.

2. Student-Centeredness and Teacher as Scaffolder

In many Hong Kong classrooms the student is seen as a passive recipient of knowledge and the teacher as the subject expert who dispensed the truth to the students. But now technology can change their roles and this change may be unavoidable and non-revisable. As the innovations showed students took a more active role and responsibility for their learning. Sometimes they might even become experts on certain topics. The teacher needed to be more sensitive to their students' individual needs and competency level, and provides optimum guidance and help. In Vygotsky's (1978) term, this concept is what he calls "zone of proximal development" which is defined as "the distance between the actual developmental level as determined by individual problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers." The innovative teachers were observed to create a "scaffolded" or supported situation in which the student can extend current skills and knowledge to a higher level of competence. One of the innovation teachers explained in the interview was how technology changed the roles of students and the teacher:

Sometimes students have much more updated information than what I found. They can spend most time on surfing the Internet and some of them become an expert in certain aspects. However, it seems that they don't quite understand how to organize the rich information and I need to keep them on the right track. In some cases they may know how to do the task but without the necessary skills, so I would provide some supports and hints for them. (translated from Cantonese)

3. Technology-Embedded Learning Environment

From the observations, both the teacher and students intensively used technology. They made use of technology as an instrument to perform different tasks. For instance, they used the computer as an effective presentation tool, communication tool, production tool for data retrieval and storage. In some cases, the technology itself could be a part of the learning environment. For example, the Internet could be a very rich source of information in which students learnt many things. This technology-embedded learning environment can be used to improve students' learning in terms of efficiency and effectiveness.

4. Cross-Discipline

Another learning attribute that was observed in the innovative classrooms was the integration of subject matter. Previously, each subject was content-specific and isolated, but these teachers showed that ICT could support the integration of different subject matter so that students applied what they learnt from various disciplines to solve the problem. The integrative nature was not only restricted in the curriculum but also appeared in the teaching workforce. In Case One and Case Two, multidisciplinary teams of teachers worked together (i.e., the computer teachers and other subject matter teachers). They performed different roles and provided different help for their students. For example, while the computer teacher usually provided technical support and training to students, the subject matter teacher helped his students to organize their subject matter work in a better way.

5. Authentic Task Context

In many Hong Kong schools learning has usually occurred through direct acquisition of the subject knowledge or doing the conventional drill and practice. Those exercises are context-free and meaningless to the students because they are detached from the students' daily experiences. However the observed innovative pedagogical practices emphasized the authentic task context. The innovative classrooms showed most students were excited to produce their own web pages, write their own stories or design their own cards. One innovative teacher mentioned in the interview:

They [the students] are so happy to produce their products and show off to their peers. They feel a stronger sense of ownership of their products and they don't like being behind others. (translated from Cantonese)

6. Interactiveness and Connectedness

In the innovative classrooms it was noted the technology facilitated the interactions between the students and the connectedness to the worldwide community. Through technology like the Internet, the Intranet, e-mail, and the Discussion Forum, students communicated and shared their ideas after school and they also accessed real-life situations and current information from around the world. The technology allowed students to contribute their knowledge to the learning community by uploading their work to the Internet at the school. This fertile learning environment was not achievable previously without ICT.

7. Assessment-Focused

The mode of assessment had changed in the innovative pedagogical practices observed at the school. For instance, in Case Two the storage and retrieval capability of the school server allowed students' work to become one of the items in their performance portfolio. This mode of assessment was beyond the conventional paper-and-pencil examination usually used in Hong Kong. It emphasized applying new solutions to the problems rather than memorizing the known knowledge. In fact, this mode of assessment is more appropriate for and closer to the reality of the information society where authentic assessment tasks are used.

Various Conditions and Constraints on IPPUT Development

In this study, it was identified that there were various conditions and constraints, which could influence the development of such innovations. Such conditions and constraints were derived from the data obtained through the classroom observations, interviews and the document analysis by using the Conceptually Clustered Matrices (Miles & Huberman, 1984). The four Conceptually Clustered Matrices for conditions on IPPUT were designed corresponding to those four critical dimensions (i.e., Teacher ICT Professional Attributes, School ICT Capacity, School System Capacity, and School Leadership). There were also another four Conceptually Clustered Matrices for constraints on IPPUT for the same four dimensions (Conceptually Clustered Matrix: Teacher ICT Attributes) shows one of the Matrices. The format is a simple informant-by-variable matrix. The first row shows various research focuses within the Teacher ICT Attributes dimension. The first column shows different informants in this research. They are grouped into three categories: Innovators (i.e., teachers who use innovative pedagogical practices using technology), Traditional Adopters (i.e., teachers who adopt traditional pedagogies), and Administrators (i.e., including the ICT coordinator and school principal). As a result, this includes all respondents and all responses to the five research focuses within the Teacher ICT Attributes dimension. The coded data then was entered into the cell entries. Furthermore, some quotations or short explanatory phrases were put inside each cell entry to explicate or qualify the coded data. After analyzing the data in the matrices, a content-analytic technique called "dendrogram" (Krippendorff, 1980) was adopted to cluster various conditions and constraints on innovative pedagogical practices with ICT, using a treelike display. The two "issue trees" (see Figure 3 and Figure 4) can provide school leaders with a deeper awareness of the potential influences of those factors.

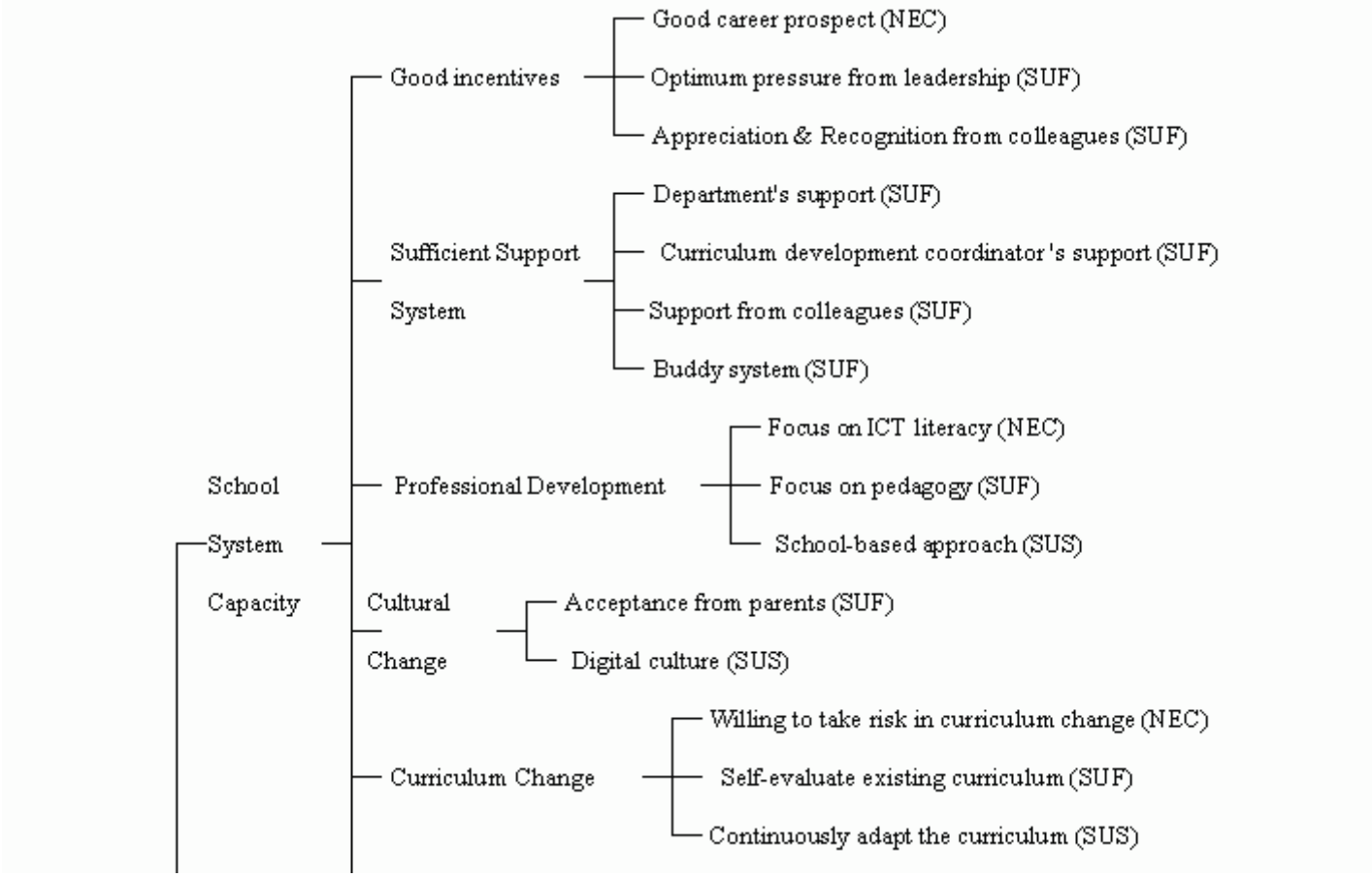
Difference between the Condition Statuses

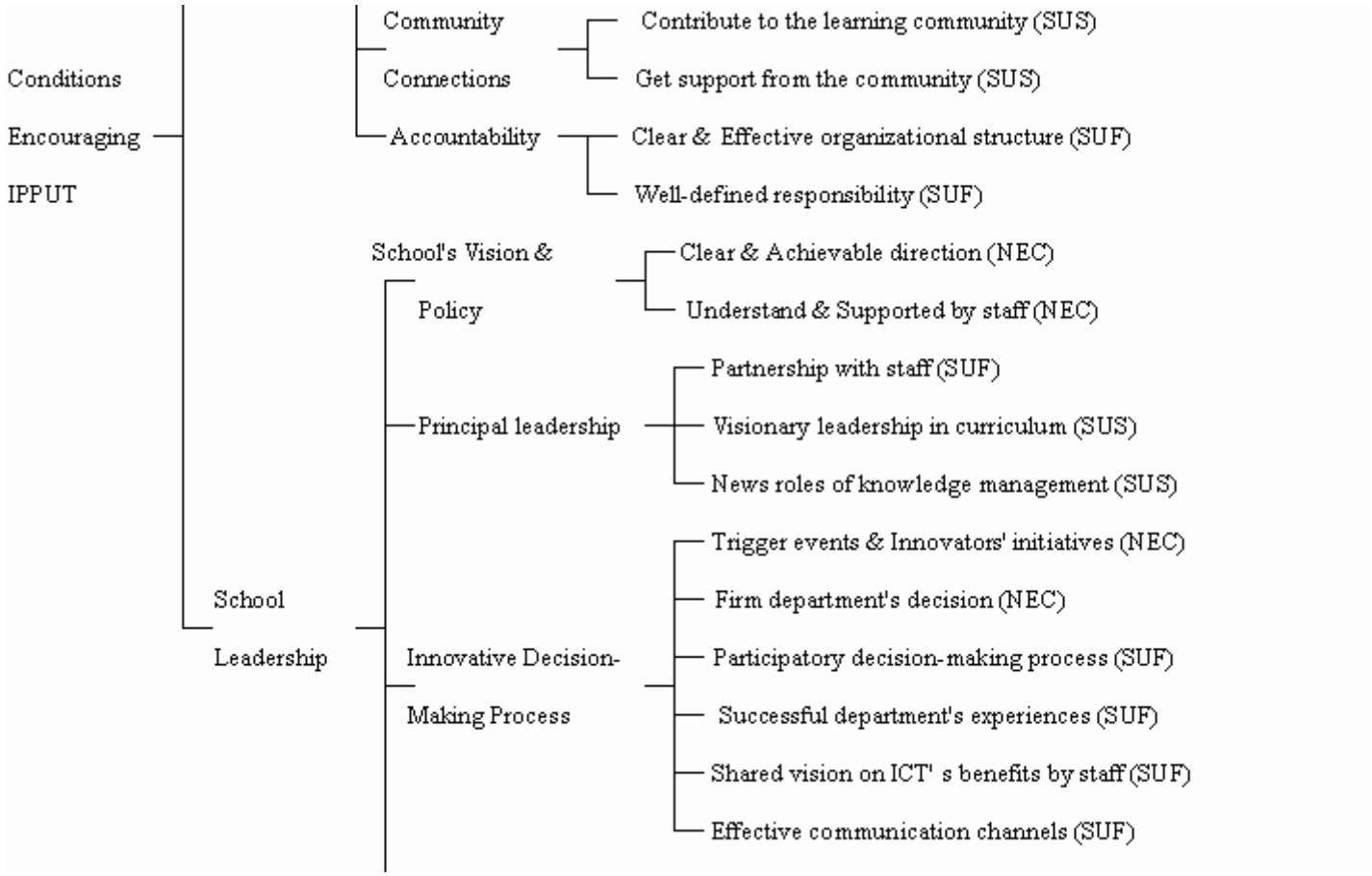
Figure 3 shows an "issue tree" of the conditions to support or sustain the development of IPPUT. It is hypothesized that the groups of conditions, which are most influential in encouraging teachers to use ICT in their pedagogical practices can be categorized into three condition statuses according to their nature and level of requirement. They are Necessary (NEC) conditions, Sufficient (SUF) conditions, and Sustainable (SUS) conditions.

The Necessary conditions are those conditions in whose absence in the IPPUT must not occur. However, this concept cannot be reversed and interpreted as providing such conditions solely for the IPPUT to occur. For instance, we cannot have IPPUT in the classrooms if there is no computer. However, imposing technology or computers in the classrooms solely cannot guarantee the happening of IPPUT.

The Sufficient (SUF) conditions on IPPUT are those factors in which the presence of such events would probably occur or such factors can facilitate IPPUT to occur in the school. However, again this does not mean providing such conditions will ensure the occurrence of IPPUT.

The Sustainable (SUS) conditions are those factors in which the presence of IPPUT can be sustainable or continuously developed and improved. This improvement is not in terms of quantity but in terms of quality. This can be interpreted as providing such factors, which enhance the pedagogically-sound environment, and may facilitate the students developing their cognitive and life-long learning skills in the long term.


School System Capacity
Good incentives
Good career prospect (NEC)
Optimum pressure from leadership (SUF)
Appreciation & Recognition from colleagues (SUF)
Sufficient Support System
Department's support (SUF)
Curriculum development coordinator's support (SUF)
Support from colleagues (SUF)
Buddy system (SUF)
Professional Development
Focus on ICT literacy (NEC)
Focus on pedagogy (SUF)
School-based approach (SUS)
Cultural Change
Acceptance from parents (SUF)
Digital culture (SUS)
Curriculum Change
Willing to take risk in curriculum change (NEC)
Self-evaluate existing curriculum (SUF)
Continuously adapt the curriculum (SUS)



KEY: Sustainable (SUS) conditions; Necessary (NEC) conditions; Sufficient (SUF) condtions

Figure 3: Tree Diagram of Conditions Encouraging IPPUT

Necessary Conditions on IPPUT

Referring to Figure 3, it was not surprising to find that the teacher was the most critical "key person" in the implementation of IPPUT in the school. Because teachers are at the center of curriculum change and collectively control the teaching and learning process, the adoption of ICT innovations is strongly dependent on their willingness, compliance and abilities. In the case studies, the innovation teachers' expertise and ICT competency was the necessary condition for IPPUT. Nevertheless, personal competency in ICT did not necessarily translate into classroom use of ICT. The teachers' attitudes towards innovation and technology were critical. All innovative teachers in the three case studies demonstrated a favorable feeling about IPPUT and confirmed the true benefits of technology. As one of the teachers mentioned in the interview:

The powerful communicative capability of computers can enhance the possibility of pedagogy since it allows me and my students sharing ideas and information through e-mail or Discussion forum. It extends the students' learning opportunities after school.(translated from Cantonese)

These teachers were also willing to take risks in curriculum change and believed that their career prospect, especially the work of curriculum development, was rewarding. This could be seen as an incentive for them to adopt IPPUT. In addition, it was also found that these teachers were concerned about students' attitudes and ICT literacy level before deciding to use computers in their lessons. They thought that the students' enthusiasm and sufficient ICT competence were essential prerequisites to their success of using technology and innovative teaching methods.

Although the teacher factors mentioned previously determine the adoption of the innovations, the case studies suggested that introducing ICT into the classroom could be more dependent on Departments making innovative decisions than on the level of ICT literacy or confidence that individual teachers possessed. Figure 3 shows that there

are many different conditions for encouraging IPPUT at the Departmental level. Nevertheless, the most necessary conditions for innovative decision-making processes are the innovators' initiatives, trigger events and a firm Department decision. Once an innovative decision has been made, it acts as a focus for training and implementing support structures.

At the school level, the necessary conditions for encouraging IPPUT include clear and achievable school vision and policy, providing appropriate and sufficient computer facilities and digital resource materials, reliable technological infrastructure, and on-site and just-in-time technical support for teachers etc. It was found that lack of technical support was very stressful for the teacher, which may effect the teacher's willingness in the adoption of IPPUT.

Sufficient Conditions Encouraging IPPUT

Regarding the sufficient conditions, according to Newhouse, et al. (2002) "Layer-Two" Model, the teachers who are on the "Integration" stage can facilitate the development of IPPUT, because the characteristics of ICT are exploited wherever possible to critically support outcomes-based learning with students in constructivist learning environments. Computer applications are used whenever they can achieve the teaching-learning objectives of the teachers and students more effectively than by other means. These kinds of teachers are also the major contributors to school ICT planning and the use of ICT within relevant learning communities. One innovative teacher in the case studies pertained to this stage.

With respect to the School ICT Capacity dimension, the requirements of the computer facilities and digital resource materials are not restricted to the appropriateness and availability of such items. The sufficient conditions concern the quality of such items in terms of user-friendliness, flexibility and compatibility. The support structures that teachers needed, as shown in the case studies, were not only the technical support given by the technician, but also included the ICT coordinator's advice on the ways of using technology, the Departments' support as well as the curriculum development coordinator's professional recommendations for teachers. Noted was how the ICT coordinator described his professional roles in curriculum change and his collaboration with the curriculum development coordinator:

My job duties are not limited to provide technical support and training for my teachers. Though they still think I am the knowledgeable one to help them solving day-to-day problems, however, since they gain more practical skills and knowledge on using ICT, they can solve such problems by themselves or ask the technician for help. Rather the teachers would like to ask me for suggesting ideas to improve their pedagogical practices by using ICT, or they may want me to evaluate their innovation. I am not an expert on some subjects, so sometimes I am not quite sure whether my suggested pedagogies or ways of using technology are optimum for a particular subject matter since every subject has its unique nature and idiosyncrasy, at this time I would consult with the curriculum development coordinator and other subject head. (translated from Cantonese)

Moreover, the professional development programs for staff emphasised the ways of using technology to enhance and enrich the pedagogical practices rather than technology-focused training.

In terms of the School System Capacity, the school began to institutionalize the practices of innovations. For example, the Departments organized a support system and a buddy system for the innovative teachers, and the responsibilities of all staff that related to the curriculum development were well-defined and written down in the formal school's documents. Other sufficient conditions that can facilitate IPPUT include participatory decision-making and providing effective communication channels for teachers to share their successful IPPUT experiences. One of the innovative teachers confirmed this at the interview:

Within this organizational structure, there are more interactions and communications between teachers, subject heads and the coordinators. I think it is better as the superiors can know more about the barriers that I faced at the frontline. Also I would like to suggest some ideas about IT policy to the management directly. I admire this effective and direct communication channel. (translated from Cantonese)

Another teacher mentioned a similar point:

I can communicate with subject heads and coordinators easily. We have regular meetings related to the implementation of ICT in school. They would listen to our ideas and adapt their plan accordingly if we reflect their original plan does not work. Moreover, it takes less time for decision-making. (translated from Cantonese)

The principal also demonstrated a similar point of view in the interview:

Encouraging open debate about attitudes to pedagogy change and sharing their successful innovation experiences among themselves may reduce their uncertainty about the value of ICT and have the effect of making change less painful. (translated from Cantonese)

Sustainable Conditions Supporting IPPUT Development

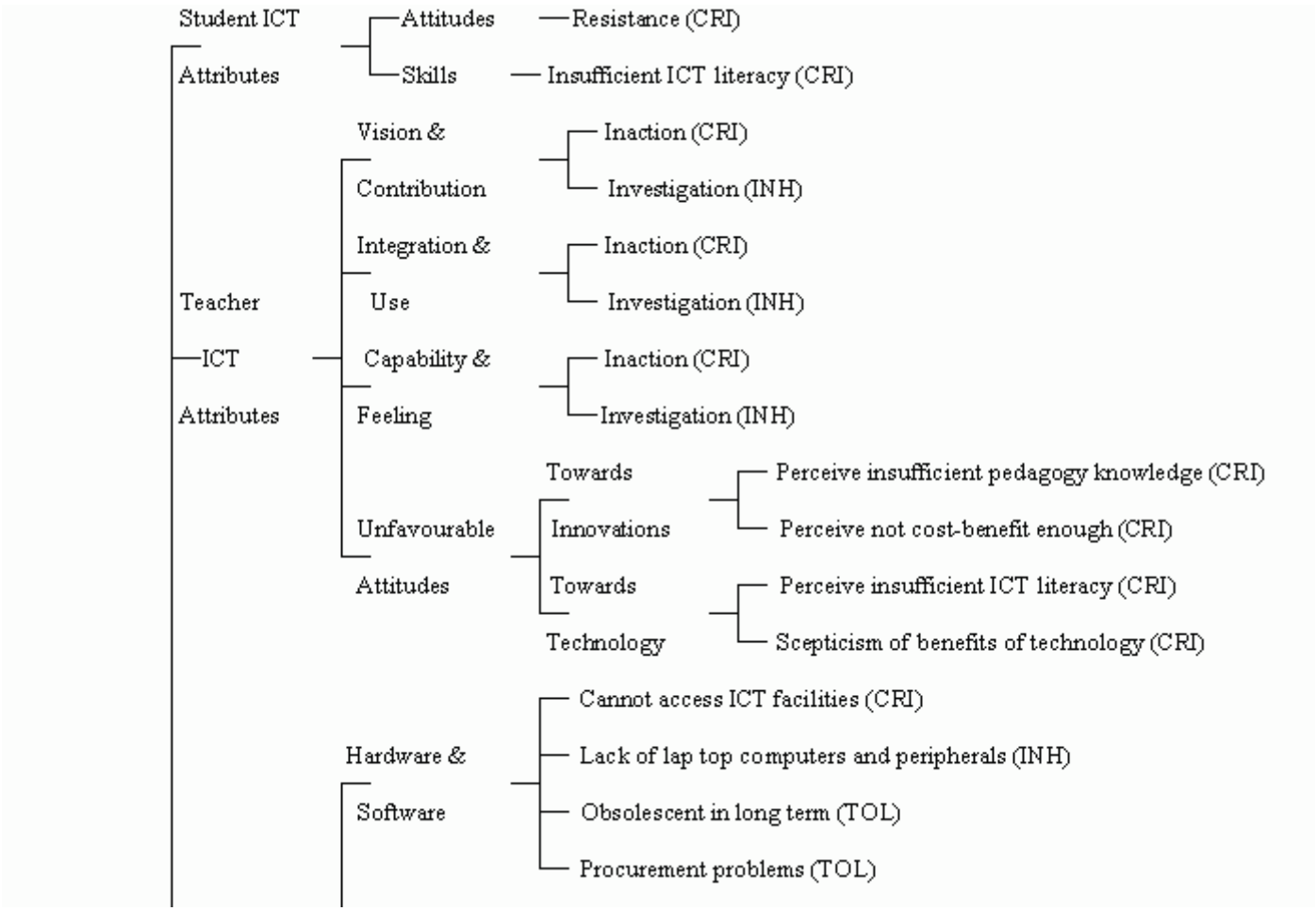
The highest status of condition is the Sustainable condition. As the name implies, these conditions are fulfilled for the continuous development of IPPUT. Within the Teacher ICT Attributes dimension, the teachers pertaining to the final stage (i.e., Transformation) of the ICT journey are able to develop IPPUT in a sustainable way. One innovative teacher in the case studies was at this stage. According to Newhouse, et al. (2002), this kind of teachers continually considers changes to his or her own practice and programs to incorporate more of the potential of the use of the computers and takes a leadership role in collaborating with others in the use of the computers in the classroom. Such teachers take an active leadership role in the evolution of the application of computers to the process of learning and teaching within the school and the use of ICT within relevant learning communities. The digital resource materials that the teachers use can enhance their quality of pedagogy.

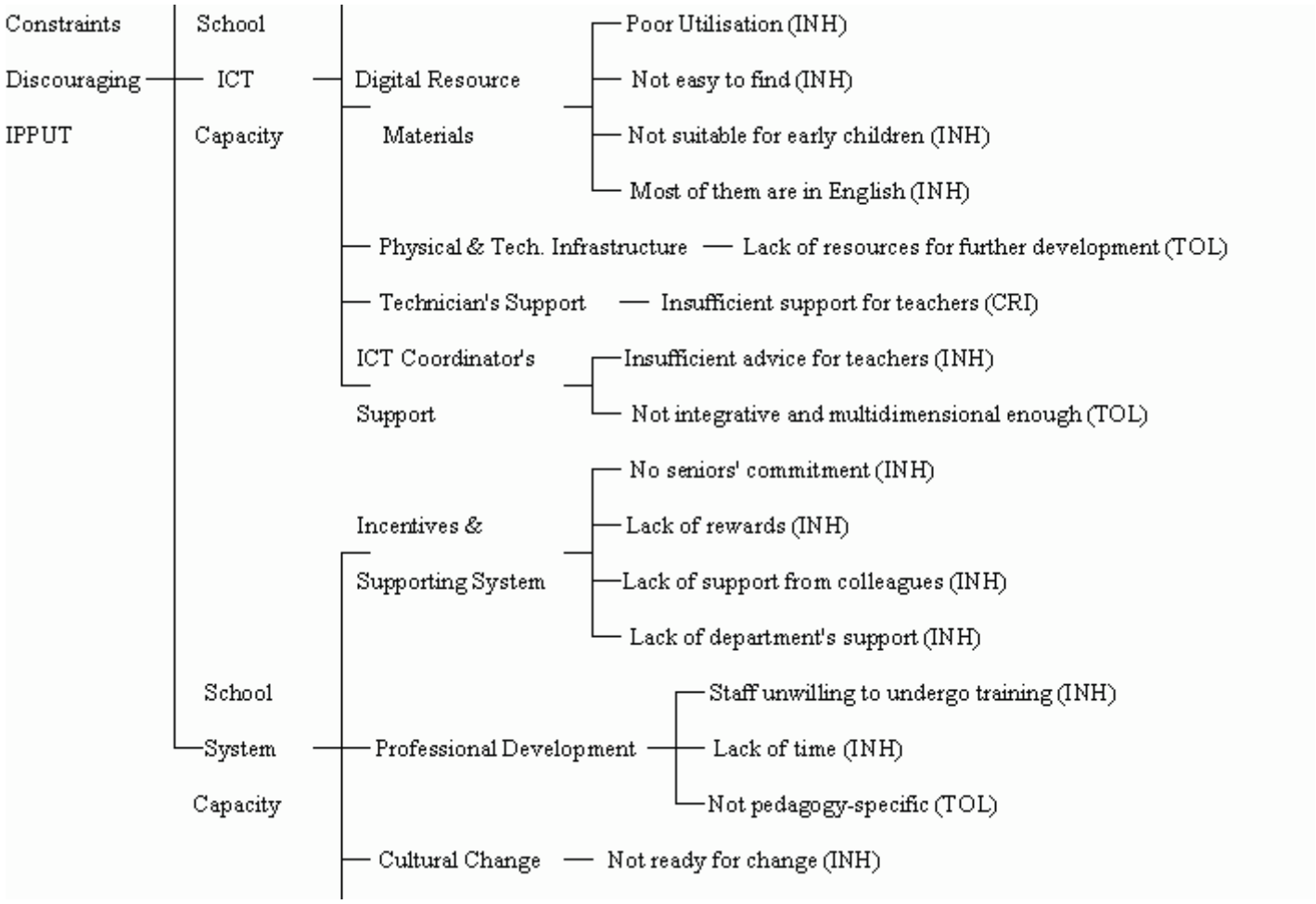
Within the School System Capacity dimension, the teachers expect the professional development programs to meet the school needs as well as their individual needs. This requires the school management to understand teachers stages of progression and provide tailor-made training for them. For this to be sustainable, the school culture for change is critical. It requires every person including staff, students, the school leader as well as other stakeholders to accept the risk and unpredictability of change. As Fullan (1993) mentioned that "every person is a change agent" in the business of educational change. Moreover, the traditional boundary of the schools will collapse due to more connectedness with the learning community. Finally, the principal's leadership is not only about administrative work, but rather people expect the school leader to take a strong leading role in curriculum development as well as being a chief officer of knowledge management within the school. The school itself becomes a valuable member in a learning community.

Differences between the Constraints Statuses

Figure 4 illustrates the "issue tree" of the constraints, which discourage or prevent the innovation development. The constraints can also be classified into three statuses. These three constraint statuses represent different degrees of seriousness of the constraints that discourage or inhibit the occurrence of IPPUT.

The first and the most serious constraint on IPPUT is what is called Critical (CRI) constraint. Those factors can prevent the happening of IPPUT immediately. For example, the "inaction" teachers pertain to this kind of constraint status since IPPUT does not happen if the teachers do not take any innovative actions. The second one is the Inhibitory (INH) constraint. They are those factors in whose presence the IPPUT would be inhibited or discouraged, or the effectiveness of such events would be reduced. The final one is called Tolerable (TOL) constraint. Those factors do not prevent IPPUT immediately, however, they may have a negative effect on the development of IPPUT in the long term.


Student ICT Attributes
Attitudes
Resistance (CRI)
Skills
Insufficient ICT literacy (CRI)
Teacher ICT Attributes
Vision & Contribution
Inaction (CRI)
Investigation (INH)
Integration & Use
Inaction (CRI)
Investigation (INH)
Capability & Feeling
Inaction (CRI)
Investigation (INH)
Unfavourable Attitudes
Towards Innovations
Perceive insufficient pedagogy knowledge (CRI)
Perceive not cost-benefit enough (CRI)
Towards Technology
Perceive insufficient ICT literacy (CRI)
Scepticism of benefits of technology (CRI)
Hardware & Software
Cannot access ICT facilities (CRI)
Lack of lap top computers and peripherals (INH)
Obsolescent in long term (TOL)
Procurement problems (TOL)



KEY: Sustainable (SUS) conditions; Necessary (NEC) conditions, Sufficient (SUF) conditions

Figure 4. Tree Diagram of conditions encouraging IPPUT

Critical Constraints on IPPUT

In Figure 4 it was found that "inaction" teachers were the main critical constraints that discouraged the IPPUT in the study school. This kind of teacher displayed a resistance to the use of new technology in their classrooms. They had negative or unfavorable attitudes towards innovations and technology. Indeed, the rationales behind this might be very complicated, but there were three main reasons that could be identified from the research. First, some teachers felt not confident when they used technology because they lacked the ICT competency or the knowledge of using ICT in their classrooms. Second, some teachers did not confirm the true benefits of using ICT. They did not think ICT could improve students' learning. Third, other teachers acknowledged the potential usefulness of technology, but they perceived the cost of using ICT (e.g., time and effort spent on ICT) outweighed the benefits, so they did not adopt innovations. The following comments by one of the traditional teachers in the interviews illustrated these three main points:

I don't think I grasp sufficient knowledge to use ICT in my classroom.

Computers can motivate students to learn but it never improves students' thinking!

Everything has its pros and cons. I think [the] computer has more disadvantages than its benefits.

I admit that the computer can help the students to learn, but I cannot afford double or triple time spending on the preparatory activities.

At the Department level, it was discovered that the diffusion and adoption of IPPUT was seriously restrained or diluted if there was no innovative decision. Moreover, insufficient technical support was also another contributory factors that prevented the development of IPPUT in some Departments of the school.

Inhibitory Constraints Discouraging IPPUT

With respect to inhibitory constraints, the teachers who were on the "Investigation" stage in the "Layer-Two" Model (Newhouse, et al., 2002), to some extent, could be seen as similar to this kind of constraint. Those teachers usually accept the use of computers in the classroom but still have some reservations. They are often unwary of what or how to change their pedagogies. So they use new technology marginally or use it to support traditional approaches. For example, they used the PowerPoint slides to present the lectures rather than using chalk and blackboard or they used computers for drill and practice. Using Law's et al. (2000) term, they just "technologized" the conventional classroom practices by using new media. Thus, from the points of view of the innovator, those teachers did not facilitate IPPUT in the school if they did not proceed to the higher stages. In the case studies, there was one traditional teacher pertaining to this stage.

In the dimension of School ICT Capacity, the inhibitory constraints included inappropriate and inflexible computer facilitates, poor utilization of digital resource materials, insufficient ICT coordinator's advice, and so forth. For example, a Music teacher (she is also an Art teacher) had some comments on the flexibility of the equipment, which was relevant to the innovative pedagogical practices:

What I need is more laptop computers for my students since I can only demonstrate some interesting curriculum materials through the teacher's computer in the music room. The students cannot compose their own songs by themselves. (translated from Cantonese)

Regarding the utilization of the resources, one of the innovation teachers complained in the interview:

I cannot find any appropriate curriculum materials in the school, so I tried to search it from the Internet and I had spent almost an hour to find a suitable one. It's too time consuming. (translated from Cantonese)

In reality, there were many sleeping digital material resources in the library. According to the ICT coordinator, the problem of ineffective utilization of the resources might be due to two reasons. First, the management of the materials was not systematic and well organized, thus the teachers could not find what they wanted. Secondly, the materials could not meet the teachers' or students' needs, so the teachers did not choose to use them. Therefore, the School IT Plan suggested to establish an in-house repository of curriculum materials and used the Intranet as a platform for sharing materials among teachers in the next academic year. Of course this required additional human resources to administrate and organize such a platform in an effective and efficient way.

In terms of the School System Capacity, other inhibitory factors were insufficient incentives and support systems, staff's unwillingness to undergo training, lack of direction for curriculum change, lack of monitoring of teachers' innovative practices, and no cultural change for the new school practices, and so forth. In addition, some inhibitory factors came from the School Leadership. Authoritarian leadership, top down approach, ineffective innovative decision-making process, poor ICT Implementation Plan, and lack of knowledge about the teachers' stages of progression were noted as constraints. Therefore, it is most important for the school leader to understand teachers' stages of progression in the innovation ladder before planning and implementing staff development. In fact, a one-fits-all approach to staff development is no longer appropriate; instead more individual-based apprenticeship training may be more suitable for teachers as it allows for teachers to develop according to their own needs.

Tolerable Constraints Preventing IPPUT Long-Term Development

Regarding tolerable constraints, some factors had a negative impact on the development of IPPUT in the school in the long term. The School Development Plan in the case study showed that a lack of resources for the development of the technological infrastructure and procurement of new computer facilitates could be a serious problem in the near future. While the pace of development of technology is so rapid, the equipment and software will quickly become obsolescent. At that time the school computers might not meet the new requirements of IPPUT. On the other hand, the ICT coordinator's support and the professional development programs for teachers should not only focus on the technical issues. In fact, innovative pedagogical practices require teachers not only knowing what ICT can be used for, but also how ICT can be used in the best way. Therefore the ICT coordinator's support and PD needed to be more pedagogy-specific, cross-discipline and multidimensional. Otherwise, it might not support or inspire the teachers to explore new ideas in their innovations. Finally, in terms of the school's vision and policy, ICT must be used to actualize the school's future plan. Thus, ICT should be closely linked to the School Development Plan, otherwise, the

role of ICT in the school development would become blurred and lose its focal point.

Implied Model for IPPUT Development

Implementing innovative pedagogical practices or changing school curriculum is not an easy task, however, keeping a momentum of those changes and improving the school in a continuous way is more difficult. Sustainability seems to be one of the most critical attributes for the success of the school. In fact, what can the school or school leaders do to sustain the development of innovations? Perhaps the first thing they need to do is to identify their school position in the process of school development.

Research (e.g., Mooij & Smeets, 2001) suggests a school must go through several stages in the process of ICT implementation. From this research, it seemed that the case study school also went through a process when implementing the IPPUT. Thus, differentiating the conditions or constraints into three statuses according to their nature and level of requirement becomes very useful for the school leader to understand the related issues. The school leader can formulate the optimum strategies or intervention actions to fulfill the requirements of the different types of conditions or tackle different types of constraints accordingly.

In the case study school it was found that different phases of development of IPPUT could be mapped to the different statuses of conditions and constraints. Table 2 illustrates this concept.

Phases of IPPUT Development in the school	Conditions in the School			Constraints in the School		
	Necessary	Sufficient	Sustainable	Critical	Inhibitory	Tolerable
Pre-Adoption Phase	Less	Less	Less	More	More	More
Initial Adoption Phase	Must	Less	Less	No	More	More
Institutionalization Phase	Must	More	Less	No	Less	More
Sustainable Development Phase	Must	More	More	No	Less	Less

Table 2 Implied Model for Four Phases of IPPUT Development in the School

This model can help the school leader to define the school position in the process of IPPUT development by identifying the conditions and constraints the school has. Therefore, if the school has more constraints (especially Critical constraints) and less favourable conditions (especially Necessary conditions), the school may be in the first phase. In this Pre-Adoption Phase the school has no IPPUT. For instance, it is hard to image a school that would have IPPUT if computer facilities are not available or all teachers do not know how to use ICT. Thus, the model implies that the first priority the school leader should do is to fulfill all the Necessary conditions and eliminate all the Critical constraints if he or she wants the school to progress to the next phase.

In the second phase (Initial Adoption Phase), the school begins to develop IPPUT though the innovations might not be so innovative or the innovations are more intermittent due to insufficient coordination and support. All the Necessary conditions are satisfied and there should be no Critical constraints. Nevertheless, the school has less Sufficient and Sustainable conditions for supporting and more Inhibitory and Tolerable constraints for discouraging the institutionalization of IPPUT. Thus, the school leader needs to satisfy the Sufficient conditions and try to resolve those Inhibitory constraints before going to the next stage.

The third phase of progression is called the "Institutionalization Phase." As the name implies, the school at this stage has a well-established system and mechanism to institutionalize the implementation of IPPUT. Teachers and students have already adapted to the new school environment. The school culture is also supportive to those pedagogical and curriculum changes. There are more Sufficient conditions encouraging the routine operation of innovations and less Inhibitory constraints to restrict the happening of those practices. However, the challenge to the school leader is how to further improve those practices and sustain the development. So the school leader has to consider how to meet the Sustainable conditions and get rid off those Tolerable constraints. The study school pertains to the third phase of IPPUT development.

In the final phase of development (Sustainable Development Phase), all three types of conditions are satisfied and all three types of constraints are eliminated by the school. This ideal situation allows the school to improve itself in a life-long way and keep up the pace with the fast changing information world. The goal of preparing students for life-long learning can also be fully achieved.

Whole-School System Model for Sustainable Development of IPPUT

Once the school leaders have identified the possible impacts of various conditions and constraints as well as their schools' phases of IPPUT development, it is essential to establish a responsive and effective whole-school model for sustainable IPPUT development. The model (see Figure 5) derived from the research findings emphasizes the importance of methodical IPPUT development, which involves fully collaboration between three levels: strategic, department, and teacher level.

At the strategic level, the critical point is to define strategic objectives for IPPUT development. It helps to figure out the direction of the school, which leads all the staff. However, achievable and unambiguous objectives need strategic analysis (e.g., SWOT Analysis). Opportunities and threats that are in the external environment and what strengths and weaknesses the school has are identified. In light of the SWOT Analysis management needs to reevaluate its visions, missions and objectives. Are they realistic? Do they need modification? If changes are needed in the school's overall direction, this is where they are likely to originate. On the other hand, if no changes are necessary, management is ready to begin the actual formulation of strategies (i.e., ICT Implementation Strategic Plan). During the process of strategic planning, the school leadership and outsiders (e.g., consultants, PTA, and other stakeholders) might have some influences on it.

At the department level, sharing and dissemination of true pedagogic benefits and objectives are essential for successful IPPUT implementation since this is a momentum for teachers to adopt IPPUT. Provided with other favorable background conditions, the trigger events and innovators' initiatives can inspire teachers to think up some new ideas for innovations. Next the middle management (including ICT coordinator) can have thorough discussion and negotiation with teachers. During the process of discussion, there might be some arguments and compromises, but it is common and necessary. Every participant has a say in the decision-making process. Once a firm and binding innovative decision is made, the department can concentrate its efforts on the innovation. Time and resources are invested in planning and preparing the materials and tasks needed in the innovation.

At the teacher level, the first priority for teachers to do is formulating an ICT Action Plan. This helps them figures out what should they do and what should they need in the innovative pedagogical practices. Then they need to prepare some tasks or curriculum materials before the delivery of the innovation. During the course of innovation, teachers' typology of ICT uptake and students' ICT literacy and attitudes would influence the outcomes. Finally, the outcomes of the innovation are evaluated and the feedback has to be reflected to students, teachers, ICT coordinator and the senior management. This feedback process is absolutely critical because it helps the school to learn from those applicative experiences and refine or modify the school system to sustain the development of IPPUT.

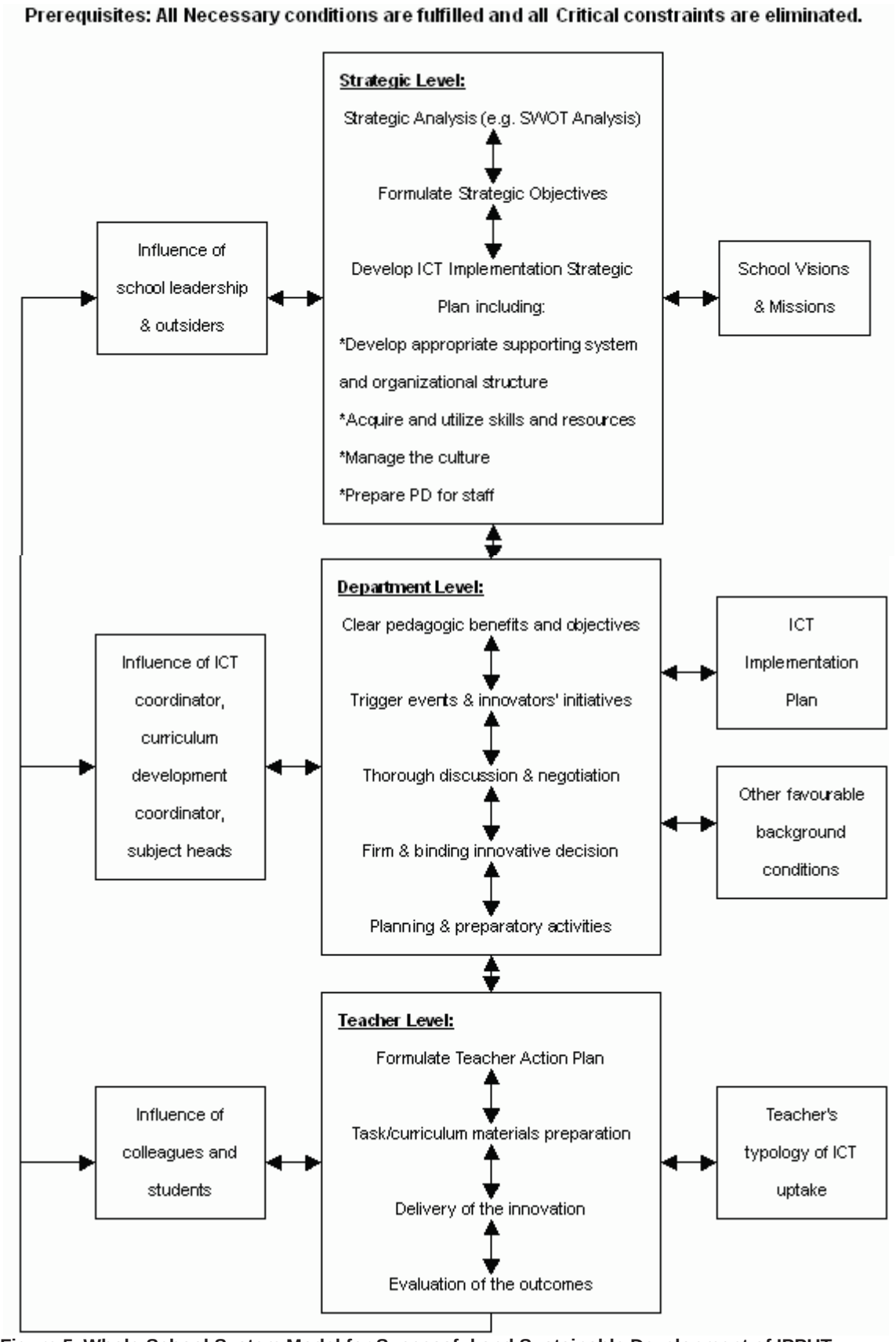


Figure 5. Whole-School System Model for Successful and Sustainable Development of IPPUT.

Conclusion

While education systems have responded vigorously to the ICT revolution by providing schools with computers and other resources, most of them have failed to develop coherent strategies for true ICT integration based on a broad and deep understanding of the school system factors. This research addresses such problems by firstly introducing what an innovative classroom might look like, then identifying the possible impacts of various conditions and constraints on development of such innovations. The two "issue trees" can provide school leaders a deeper awareness of the potential influences of those factors. Moreover, they may formulate optimum strategies for implementing ICT by comparing their schools realistic situations with those conditions and constraints mentioned in the "issue trees". The whole-school system model also suggests that given favorable conditions and methodical managerial methodology, it is possible to successfully integrate innovations into the curriculum and sustain their development.

The adoption and implementation of such strategies is the main challenge to the educational leadership in the 21st century. It requires visionary school leadership, whole heart collaboration and active participation of all school stakeholders, and application of both physical and intellectual resources. This challenge is not easy to cope with and most schools are now at the cross road of innovation development. They have to make a decision. For those conventional schools there remains a status quo, ICT can be a crisis that confronts their survival due to the rapid spread and development of ICT (e.g., on-line education). For those visionary and proactive schools where they try to adapt themselves to the new environment, ICT can be a good opportunity for enhancing the quality of education. Nevertheless, the school leaders should first ask themselves: "What are the aims of education?" "How can ICT serve them?" "And if so, in what ways?" Only when they had come up with some answers would they have true integration of ICT into education, know how to adapt the school system to those changes, and sustain a pedagogical-sound environment for students learning.

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CASE 1

Extract from Case Report #1 of Innovative Pedagogical Practices in the Study School (History of Coastal Defense in Hong Kong)

Part (I): Innovation Description

Section A: Descriptive Background Information
The innovation was undertaken in December 2002, which involved the whole Primary 6 class level students. The total number of students participating in this innovation was 72. This innovation was one of the projects in the Curriculum Development Plan, which was designed in advance by a group of academic staff including the ICT coordinator, the curriculum development coordinator, two P.6 teachers of General Studies and another two P.6 teachers of Computer Study (one of them the researcher). The whole innovation involved several classroom lessons and a field trip.

Section B: Summary of the Innovation
The innovation involved the integration of two subjects (i.e., General Studies and Computer Study). It aimed at the new approach to teaching General Studies using ICT as a source of information as well as a production tool to demonstrate the students' work. The innovation involved couples of lessons of General Studies and Computer Study as well as a field trip to the Hong Kong Museum of Coastal Defense. In fact, the whole innovation process could be divided into three stages.

In Stage One (Preparatory Activities), students were asked to search background information about the curriculum topic (i.e., History of Coastal Defense in Hong Kong) at the Museum official web site (http://www.lcsd.gov.hk/hkmcd/) and other related web sites through the Internet in the General Studies lessons. It aimed to stimulate the students' interest and help them to be familiar with the curriculum topic. Meanwhile, students learnt the basic practical skills of using multi-media production software (e.g., Flash, Dreamweaver) and some video-editing programs in the Computer Study lessons. The purpose was to provide students the necessary technical training on using such software to produce their own web pages in the later stage.

In Stage Two (Field Trip), one full-day visit at the Hong Kong Museum of Coastal Defense was arranged. The students were divided into several groups (eight students per one group). They needed to study the artifacts, graphical illustrations and other multi-media programs in the Museum. During the visit, each group could capture what they had learnt by the digital video recorders. Meanwhile, some of them acted as reporters and interviewed some information officers in the Museum. Again, digital video recorder became the information-capturing tool in this learning activity.

After visiting the Museum, the students entered into the final stage (Production Activities). The students were required to produce their own web pages about the curriculum topic. They could make use of the information sources from the Internet and what they had captured in the Museum visit. All students participating in this innovation had additional time to work on the curriculum topic during lessons of Computer Study. They needed to apply the practical skills they learnt in those Computer Study lessons to produce their web pages. This authentic task allowed making lessons of Computer Study more "alive" and meaningful. At the same time students developed their abilities to learn independently. Finally the students' end-products were published on the school's Intranet.

Part (II): Thematic Analysis of the Innovation
Section C: Students' and Teacher's Roles and Practices

In this innovation the main actors from teaching staff were the two teachers of General Studies and another two teachers of Computer Study. During the General Studies lessons, the teacher acted as a facilitator who did not give students formal "lecture" or instruction, rather, he only set the tasks and the boundary for students to explore and construct their own knowledge. The students became active learners who searched information and learnt independently. They made the decisions about the content of the work. While the students were working, the teacher walked around and helped the students who asked for it. When some technical problems arose, the computer teacher and the technician helped to solve them. Moreover, the teacher acted as a co-partner with students in the interview with the information officers of the Museum. He helped each group students to formulate their own interview questions in advance and encouraged the student reporters to ask the questions.

Mostly students had group work during the course of the innovation. Each group had to distribute responsibilities for the group members. They needed to learn how to cooperate with their peers and contact with the outsiders (i.e., the information officer). In fact, the teacher thought this could help the students to sharpen their collaborative and inquisitive skills.

Section D: Technology Used in the Innovation

During the course of innovation, mostly students worked in the computer room with 20 computers (two students shared one computer). All computers are networked and connected to the Internet. Students can access information from the Internet freely. Moreover, other peripheral equipment like printers, scanners and digital video recorders were used by students, but only when they were necessary and had asked permission from teachers. Regarding software, the multi-media production programs (i.e., Flash and Dreamweaver) and video editing programs (i.e., VideoStudio and Adobe Premiere) were used. Though some of the programs might be too complicated for primary school students, only the basic concepts and practical skills were introduced to them.

CASE 2

Extract from Case Report #2 of Innovative Pedagogical Practices in the Study School (My First Story)

Part (I): Innovation Description

Section A: Descriptive Background Information

This innovation was also a planned project in the school Curriculum Development Plan document. It integrated the content of two subjects: English and Computer Study. The people involved included all P.6 students and teaching staff of English and Computer Study as well as the ICT coordinator and the curriculum development coordinator. The whole project comprised 22 teaching sessions in total and started from February 2003. The course of the innovation lasted for over two weeks. Though only one double lesson was observed by the researcher, however, he was one of the teaching staff responsible for designing the project, so he grasped a deep understanding about the whole process of the innovation.

Section B: Summary of the Innovation

The innovation namely as "My First Story" was an English project which required students to make use of ICT to write up their own electronic version of a story. By the end of the project, the students were expected to:

1. think up the ideas and organize the main themes of their stories,
2. build up their vocabularies through developing their stories,
3. use accurate grammar and appropriate sentence patterns in writing up the stories,
4. use accurate pronunciation and intonation to present the stories, and
5. make use of software (i.e., Flash) to design and create a multi-media product in which the stories are embedded.

The following table summarized the 22 teaching sessions of the innovation.

Summary of the 22 teaching sessions of the English Project

Part (II): Thematic Analysis of the Innovation

Section C: Students' and Teacher's Roles and Practices

Mostly students worked in groups in this innovation. They needed to discuss, interact and listen to each other ideas and then created their own stories. In the sense of this social constructivist approach, the students learnt how to respect and compromise with each other opinions. Sometimes they might argue, however, the teachers acted as a mediator to soothe the students' emotion and settle the situation. The authentic task of creating a story also motivated students to learn language items in a more meaningful way. Their happy facial expressions and hot discussion during the lessons could prove this. In fact, it was not uncommon that students disliked or felt uncomfortable with English language items due to they lacked opportunities to express their views in English in their daily life. Thus, this innovation provided a good chance for them and the ICT tools they used could support their learning. The kinds and ways of technology used in this innovation are discussed in the next sub-section.

Regarding teacher's practices, there was a quite different role between the one who played at the very beginning and at the middle of the innovation. Initially, the teacher acted as an instructor and subject expert. The English teacher defined the boundary and requirement of the project and she gave students formal lectures about the language items. The Computer teacher also provided technical training on using the software. Both teachers' pedagogical approaches were teacher-oriented, straightforward and discipline-based. However, started from the middle of the innovation, the burden of the responsibility of learning was shifting from the teachers to the students. The students took an active role to search information, brainstorm the ideas, write up the story and finally produce their own animations. The teachers only monitored the student's progress and provided necessary guidance and support but did not participated in their work directly. Another characteristic of this innovation was it involved multidisciplinary team of teachers working together. This broke the boundary between the two subjects and allowed students to apply their knowledge across different disciplines.

Section D: Technology Used in the Innovation

A number of ICT tools including hardware and software were used in this innovation. The different capabilities of the ICT tools served different purposes in the learning activities. For visual stimuli and exposition of information, the Internet, on-line animations and the PowerPoint were used. The very rich sources of information from the Internet provided ample examples to arouse the students' curiosity. In the Mental-Processing Sessions, students made use of mind tools (i.e., electronic version of flow chart and concept map) to conceptualize the framework of their stories and organized every elements of the story in a more systematic way. The powerful manipulative capabilities of computers could help the students to alter the structure of their concept maps and flow charts so easily. This could allow them to take more risks to create their stories and also enhance their cognitive power during the process of creation of stories. In the Writing-Up Sessions, Word Encyclopedia provided complementary assistance for students building up their vocabularies and the checking function of the software helped them to use appropriate and correct grammar and spelling. This enhanced the students' confidence on writing up their stories. When the students finished the final draft of their stories, they used the multi-media production software called Flash to produce their animations. The powerful multi-media capability of the software offered expressive power beyond the conventional paper and pencil media. It also allowed students to input their voices into the program, thus encouraging students to read aloud their stories, and modify their pronunciation and intonation. Finally the students' end products were published on the school's Intranet. The storage and retrieval capabilities of the school server allowed their work to become one of the items in their performance portfolio.

CASE 3

Extract from Case Report #3 of Innovative Pedagogical Practices in the Study School (My Father Day's Card)

Part (I): Innovation Description

Section A: Descriptive Background Information

The innovation was carried out in May 2003. This was neither a project in the school Curriculum Development Plan nor in the school IT Plan. This innovation, namely as "My Father Day's Card", was totally designed and implemented by an Art teacher and a Chinese teacher. The Art teacher spent two double lessons for the whole innovation and it involved one class of Primary 3 students.

Section B: Summary of the Innovation
The main activity of the innovation was designing and creating a "Father Day" card. In fact, a similar task had been done in the previous academic year and students did it by using conventional art and craft materials. This time the teacher tried to adopt a new approach to teaching Art using ICT as a source of information as well as a production tool for creating the card. The innovation involved using a simple drawing program (i.e., Painting Pad). This program allowed students to "draw" what they wanted freely by just clicking the mouse buttons. It was because of the simple and user-friendly functions of the software program, it was not necessary for the teacher to introduce the software to the students before starting the innovation. In fact, most students were very familiar with the software.

At the beginning of the innovation, the teacher used the Internet as a rich source of information to demonstrate ample examples of others' work. This could stimulate the student's curiosity and interest for making their own cards. Next, the students had to make use of the software to create their cards. At this time the teacher walked around the computer room and gave students advices when they needed. Different from the previous year, the teacher added some Chinese elements into the innovation. The students were required to type a short passage in Chinese about their feelings and appreciations for their fathers and put it in their Father Day's cards. Finally, when all students finished their work, they chose the ways of sending the cards to their fathers by either e-mail or hard copy.

Part (II): Thematic Analysis of the Innovation

Section C: Students' and Teacher's Roles and Practices
During the innovation, mostly the students worked independently. However, the interaction between the students and the teacher was frequent as the teacher gave students advices for designing their pictures. The students also liked to share their ideas with their peers. In the Writing session, the students took an active role in thinking up their ideas and tried to express their feelings and appreciations for their fathers by typing a short passage. At this time the teacher acted as a coach to monitor the students' progress and keep them on the right track. In general, students looked motivated and tried to finish the task except there were some technical problems with the writing pads, which frustrated some students because they could not type what they thought.

Section D: Technology Used in the Innovation
The drawing program, namely Painting Pad, was the main software used in this innovation. The simple and user-friendly functions of the program allowed students to design their pictures freely by just clicking some buttons. The manipulative capabilities of computer also allowed students to modify, change or delete their work easily. Thus re-creating their pictures when they were not satisfy with the previous ones did not frustrate them. Other ICT tools used in this innovation included the Internet and the writing pads as most P.3 students did not know how to type Chinese characters by keyboard.

Appendix D:
Conceptually Clustered Matrix: Teacher ICT Attributes

Research Focuses / Informants	Vision & Contribution (VC) (5 types)*	Integration & Use (IU) (5 types)*	Capabilities & Feelings (CF) (5 types)*	General Attitudes towards Innovation (GAI) (Favourable/ Neutral/ Unfavourable)	General Attitudes towards Technology (GAT) (Favourable/ Neutral/ Unfavourable)
Innovators (I1)					
(I2)					
(I3)					
Tradition (T1) Adopters					
(T2)					
(T3)					
Administrator (ICT coordinator) (A1)					
Administrator (School principal) (A2)					

**Remark : The five types are Inaction, Investigation, Application, Integration, and Transformation.*