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TECHNOLOGY-SUPPORTED EDUCATIONAL INNOVATIONS IN FINLAND AND HONG KONG: A TALE OF TWO SYSTEMS

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Abstract: *The paper presents a comparison of case studies about innovative ICT-supported pedagogical practices in two educational systems, namely Finland and Hong Kong. The two systems were selected for this in-depth comparison for three main reasons. First, Finland and Hong Kong performed well in several international comparative studies of educational achievement. Second, the case studies collected via the SITES Module 2 indicated rather different profiles between Finnish and Hong Kong schools in terms of ICT infrastructure and pedagogical practices. Third, further analysis of the case studies data indicated differences in emergent pedagogical characteristics between the cases collected in Asia and in Western Europe. The paper aims at exploring in detail two research questions with regard to innovative pedagogical practices using technology. Firstly, are there systemic differences in the nature of the educational innovations across countries? Secondly, are there systemic differences in the change mechanisms and factors influencing change across countries?*

Keywords: *pedagogical innovation, comparative case study, educational change mechanism.*

INTRODUCTION

Large-scale comparative studies of educational achievement have attracted the attention and support of educators and researchers, as well as policy makers, as these provide data that may help us to compare and understand the impacts of different policies, strategies and resources on education. Since the 1990s, the International Association for the Evaluation of Educational

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Achievement (IEA) studies have moved beyond achievement and systems-level comparisons of curriculum (Schmidt et al., 2001) to include pedagogical practices (Stigler & Hiebert, 1997, 1999). With the increasing pressures for systemic changes in curriculum and pedagogy, there has been accumulating interest in the studies of educational innovation. During 1999-2003, the IEA conducted the Second Information Technology in Education Module 2 (SITES M2) study (see Kankaanrata, 2005, this issue), which is among the first large-scale international comparative study of educational innovation[1]. The SITES M2 study collected 174 case studies of innovative pedagogical practices using technology from 28 participating countries around the world (Kozma, 2003), which resulted in a rich source of data for the secondary analysis on educational innovation reported in this paper.

Finland and Hong Kong have performed well in several international comparative studies published recently. For example, in the Third International Mathematics and Science Study (TIMSS), both countries ranked above the international mean (Martin et al., 2000; Mullis et al., 2000). In mathematics Hong Kong was among the six highest achieving countries and Finland among the next group of countries. In science there were only four countries which had achievements significantly better than Hong Kong and Finland. The Programme for International Student Assessment (PISA) of the Organization for Economic Co-operation and Development (OECD) compared the academic capabilities of students in the specified academic areas. In PISA 2003, the 15-year-old Finnish and Hong Kong students were among the highest achievers in all four areas, namely literacy, mathematics, science, and problem solving (OECD, 2004).

On the other hand, results from the Second Information Technology in Education Module 1 Study (SITES M1), which was an international comparative survey on how well schools in different countries around the world were prepared for implementing information and communication technology (ICT) in teaching and learning, showed rather different profiles between Finnish and Hong Kong schools (Pelgrum & Anderson, 1999) in terms of ICT infrastructure and pedagogical practices. Regarding ICT infrastructure, particularly in terms of access to computers by students, Finnish schools were much better provided for than Hong Kong schools. Further, the presence of emergent pedagogical practices (i.e., practices with more innovative characteristics, such as student-directed, collaborative and inquiry type of practices) with or without the use of ICT was much higher in Finland than in Hong Kong. These differences are similarly found between cases collected in Asian and West European countries in the SITES M1 study. In the later SITES M2 study, Law, Chow and Yuen (2005) reported some differences between the cases collected in Asia and in Western Europe, including the observation that the classrooms in the Asian case studies were much less connected to the world outside of the classroom walls.

Innovative pedagogical practices are by definition outstanding exemplars and are thus non-representative of typical practices found in schools. Literature on educational change and innovation has identified a variety of factors that influence the nature of the changes as well as the change process (Fullan, 1993; Lankshear, Snyder, & Green, 2000). Some of these factors are related to the policies and implementation strategies at the school level, as well as at the national and regional levels. School climate has also been found to be an important factor influencing change. It is also expected that the predominant culture and practices in various countries would also have important impacts on educational change and change processes, though the literature in this area is much less well documented. Through an in-depth comparison of the case studies collected in Finland and Hong Kong in the SITES M2 study, this paper examines two important research questions with regard to innovative pedagogical practices using technology. Firstly, are there systemic differences in the nature of the educational innovations across countries? Secondly, are there systemic differences in the change mechanisms and factors influencing change across countries?

PEDAGOGICAL INNOVATIONS AS DEFINED AND OPERATIONALIZED IN THE SITES M2 STUDY

It is a reasonable assumption that the 28 participant countries in the SITES M2 Study were keen to foster the emergence of ICT-using innovative pedagogical practices in schools. Do different countries have similar expectations for the key characteristics of innovations? Are the criteria they use for selecting innovative pedagogical practices the same or different?

In the SITES M2 study, each participating country had to set up a national selection panel consisting of education professionals such as government officers, school principals, information technology coordinators, experienced teachers, and university researchers. It was the responsibility of the national selection panel to select cases according to the four international criteria (see Kozma, 2003) established for the study, such that the cases (a) showed evidence of significant changes, such as the roles of teachers and students, goals of the curriculum, etc.; (b) incorporated uses of technology that played a substantial role in the practices; (c) showed evidence of measurable positive student outcomes; and (d) showed evidence of sustainability and transferability. There was a fifth criterion that the cases had to be innovative. However, innovation or newness depends very much on the cultural, historical and developmental contexts of the countries concerned. Therefore, in the SITES M2 Study, the criteria for innovation were to be locally defined by the national selection panels as well, even though the study design did provide some suggestions regarding candidate criteria for consideration. The suggested criteria for innovation included promoting active, independent and self-directed learning; providing students with information and media skills and competencies; engaging students in collaborative, complex and real-world-like problems such as learning projects; “breaking down the walls” of the classroom to involve other people in the education process; promoting cross-curricular learning; addressing individual learner differences; providing students with individualized self-accessed learning opportunities; addressing equity issues; and improving social cohesiveness and understanding.

Most of the countries, including Hong Kong, accepted the specified international criteria as comprehensive enough to satisfy the local needs. On the other hand, some national panels further elaborated on one or more criteria to make them more specific to their needs. The Finnish panel indicated emphasis on cross-curricular projects and social competencies such as collaboration. It also characterized that innovative Finnish classrooms should promote active and independent learning and provide students with competencies to search for, organize, and analyze information, and communicate and express their ideas in a variety of media forms. The innovative classroom in Finland engaged students in collaborative, project-based learning in complex and real-world problems. The Finnish panel also highlighted the meaning of opening the classrooms in various ways, especially through involving different parties (such as, parents, scientists, or business professionals) into the daily work of the schools.

In Finland the selection of cases was based especially on three sources, namely SITES M1 data (see Kankaanranta & Linnakylä, 2003; Kankaanranta, Puhakka, & Linnakylä, 2000), previous Finnish studies and national assessments of the use of ICT at different educational levels (e.g., Sinko & Lehtinen, 1999), and panel members' own knowledge bases of good examples. The first source was the database of Finnish examples of satisfying ICT-related activities in the SITES M1 study. The data were gathered in the school year 1998/1998 and included 70 cases from primary school level and 62 cases from lower secondary school level. The ICT-related activities that Finnish school principals considered to be the most satisfying included various Internet-related activities. At the primary level, 63% of the examples and at the lower secondary level 76 % of examples were Internet-related. The most common theme of Internet-related activities at both school levels was international collaboration and communication, and the second most usual theme was information retrieval and processing. Some examples of the other themes were the dissemination of information on Web pages, national collaboration and communication, research projects, and more general practicing of Internet usage. The Internet-related examples covered the whole breadth of subject areas, and cross-curricular thinking also was prevalent at both levels.

In Hong Kong, the national selection panel decided to select the innovative pedagogical practices through an open nomination process. A letter was sent to all schools about the SITES M2 study and the criteria for case selection, and included an invitation to nominate innovative pedagogical practices using technology. Two public seminars were also held to explain to interested teachers and principals the background of the study as well as the criteria and process of case selection. In addition, the selection panel members also contacted teachers and schools they knew personally as good potential candidates for nomination, encouraging them to submit nominations. The selection panel received over 100 nominations from primary and secondary schools and short-listed 20 cases as finalists for further solicitation of case details. Only nine innovative pedagogical practices were found to meet all of the agreed criteria and these were selected for participation in the SITES M2 study: three from upper primary classrooms, two from junior secondary classrooms, and four from senior secondary classrooms.

A FRAMEWORK FOR COMPARING INNOVATIONS

While there were variations in the emphasis of the innovation selection criteria by the national panels, the criteria were sufficiently similar and it was not clear whether there were systemic differences in the innovative pedagogical practices collected across countries. In order to address the research questions, there needed to be some methods to compare innovations. While the SITES M2 study collected in-depth case studies of educational innovations from around the world, the primary aim of the international study was to characterize and describe the different innovations as a collection. The international report for the SITES M2 study (Kozma, 2003) did not try to compare the cases and countries in terms of "level of innovativeness." So far, two research teams have published findings based on their efforts to look for meaningful ways of comparing the pedagogical practices collected in terms of "levels of innovation" in technology-supported pedagogical innovations (Law, Yuen, & Chow, 2003; Mioduser, Nachmias, Tubin, & Forkosh-Baruch, 2003). The methodology developed by Mioduser et al. (2003) focused on the *impact of ICT* on various aspects of learning and teaching in schools, while the one developed by Law et al. (2003) considered the case studies collected as examples of curriculum innovation that have incorporated the use of ICT and thus focused on *comparisons of various dimensions of curriculum change*, including ICT as one of the dimensions. As the interest of this paper is on comparing educational innovations, the later methodology and the preliminary findings based on that methodology (Law et al., 2005) has been adopted as the basis for further analysis.

The framework developed by Law et al. (2003) identified six dimensions to be the most important aspects of any curriculum implementation using ICT:

- Intended curriculum goals of the innovative practices
- Pedagogical role(s) of the teachers
- Role(s) of the students
- Nature and sophistication of the ICT used
- Multidimensional learning outcomes exhibited
- Connectedness of the classroom

A rubric for coding the level of innovativeness for each dimension was constructed based on the concept of *emergence*, which is grounded in the belief that innovations need to build on existing practices for them to be viable, yet need to have the courage to break new ground in order to be fruitful. This rubric was reported in Law (2003) and can also be accessed on-line (see SITES, Secondary Analysis, n.d.). Each case study was examined for indicators of change (as in breaking new ground) on a continuum along a traditional versus emergent dichotomy for key dimensions of analysis. Using this rubric, the Hong Kong SITES research team conducted secondary analysis on 83 of the 174 cases collected and published the analysis results in an on-line case studies database (see SITES M2 Database, n.d.; SITES Study Background, n.d.).

The findings from the above analysis revealed a wide diversity across the cases. Figure 1 presents the diagrammatic representations of two of the SITES M2 case studies, one collected in Hong Kong and the other in Finland. Further, the level of innovativeness across the six dimensions can be varied. Of the cases analyzed, ones that were highly innovative in all six dimensions were rare.

In addition to coding the cases in terms of their levels of innovation, the Hong Kong SITES research team further analyzed the case studies according to the way learning and teaching activities were organized and found that these cases can be categorized into six types of pedagogical practices: project work, scientific investigations, media production, virtual schools/on-line courses, task-based learning, and expository teaching. By examining the codes for the levels of innovation for each of the six types of pedagogical practices along the two dimensions of teachers' roles and students' roles, Law (2004) found that project work, scientific investigations and media production seemed to be the most intellectually demanding practices, as these required students to engage in collaborative inquiry. This indicated that these three forms of pedagogical practices probably provided learning contexts that were more conducive to facilitating student enquiry, and carried more of the features generally expected of emerging pedagogical practices. On the other hand, expository teaching and task-based learning were found to be more traditional, whereas virtual schools/on-line courses lie in between the two extreme ends of the spectrum. These results also provided good triangulation for the innovativeness coding methodology described above since project work, scientific investigations, and media production were found to be the most popular pedagogical practices in the principals' descriptions of the most satisfying ICT-using pedagogical practices in their schools, as collected in the SITES M1 study (Voogt, 1999).

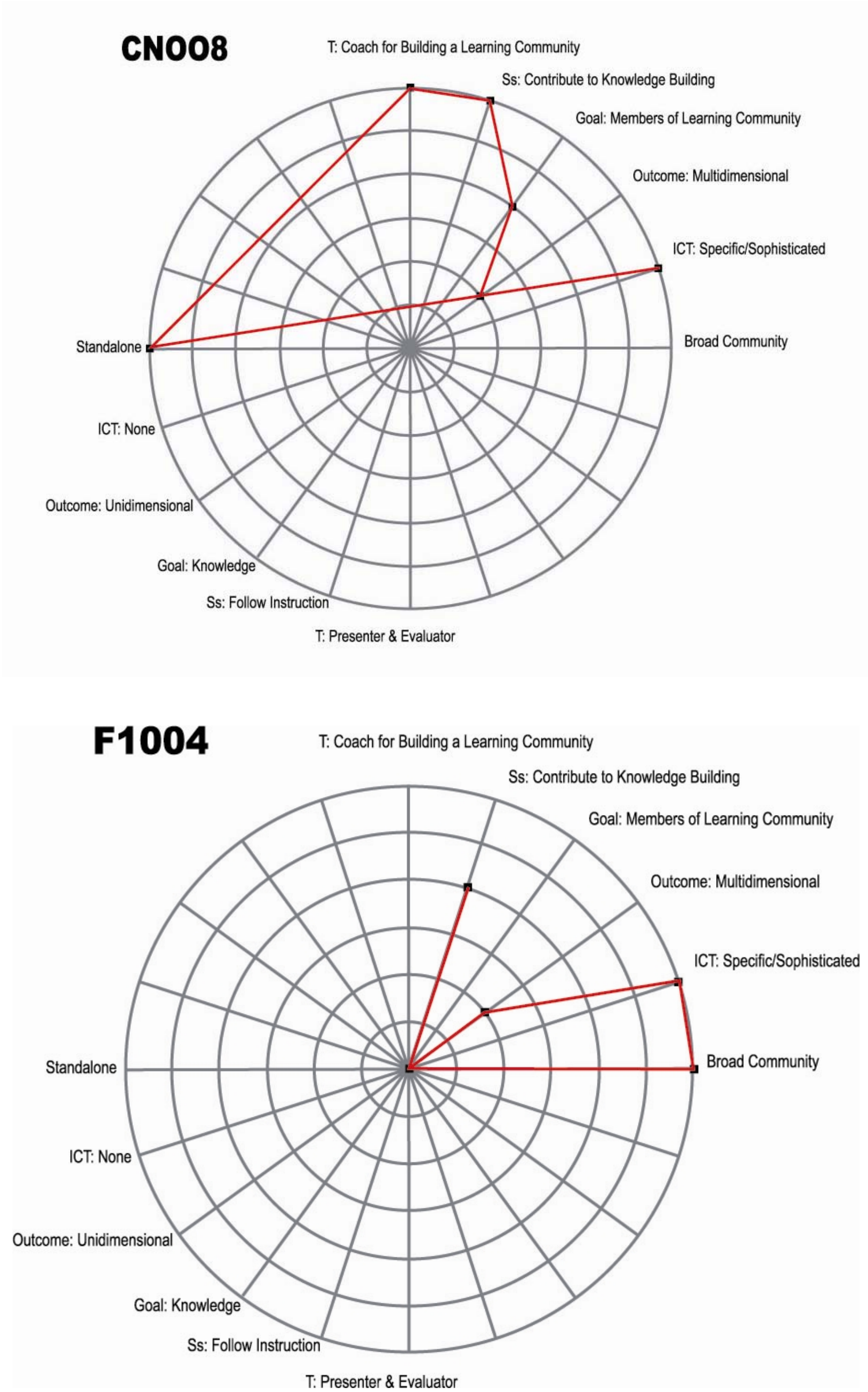

Figure 1. A diagrammatic representation of the profile of level of innovation for two of the SITES M2 case studies, one collected in Hong Kong and the other in Finland.

REGIONAL DIFFERENCES IN INNOVATION CHARACTERISTICS

Law et al. (2005) reported on the analyses of the innovation profiles of the 83 cases that were coded using the six-dimensional rubric described above. Owing to the small number of cases collected in each country, they were not able to make national comparisons. Instead, they explored the possibility of some regional differences in innovation characteristics by examining the six-dimensional innovation scores of the case studies grouped under four geographical regions: Western Europe, the Americas, East Europe, and Asia. Due to the small numbers of analyzed cases in the Americas (8) and East Europe (6), they confined their observations and preliminary conclusions regarding regional differences to the cases collected in Western Europe (45) and Asia (25).

The mean innovation scores (see Table 1) revealed sizeable regional differences across the various dimensions. In particular, Western Europe had the highest mean innovation score for all dimensions, except for the dimension ICT sophistication. On the other hand, with the exception of the ICT sophistication dimension, the mean innovation scores for Asia were below 4 for all the other 5 dimensions. Furthermore, the regional difference is smallest for the dimension *ICT sophistication* and greatest for the dimension *connectedness of the classroom*. The relatively small difference in ICT sophistication is not too surprising in that the case studies collected are not meant to be representative of the general situation of schools in a country and the schools that were selected for the case studies were generally well provided for in terms of ICT infrastructure. The large regional differences in connectedness of the classrooms indicate differences in how the countries take advantage of the potential opportunities that ICT offer. In Western Europe, many of the innovations seized upon the communication capability of the technology to extend the educational opportunities for their students by allowing them to reach outside expertise or to learn with students outside of their own schools. In Asia, even though Internet accessibility was available in many of the case study schools, it was mainly used for the purpose of information search, and students' learning interaction was still very much confined to the original classrooms.

Law et al. (2005) also examined whether the sophistication of ICT used correlated in any way with the level of innovation in the other five dimensions. Tables 2 and 3 indicate some regional differences. In particular for Western Europe, ICT_score is only significantly correlated

Table 1. The mean innovation score and related descriptive statistics along each of the six dimensions of innovation for the 83 cases analyzed by Law et al. (2003) as distributed across geographical regions.

Dimension of innovation	W. Europe (45) *	America (8)	E. Europe (6)	Asia (25)	Finland (5)	Hong Kong (9)
Curriculum goals	4.60	4.25	3.67	3.48	4.4	4.4
Teacher's roles	4.74	4.13	4.00	3.64	4.4	4.7
Students' roles	4.57	4.13	4.50	3.76	4.0	5.1
ICT sophistication	5.79	6.00	5.50	5.52	6.4	5.8
Manifestation of learning outcomes	4.45	3.88	3.33	3.76	4.2	4.9
Connectedness of the classroom	4.67	4.50	4.00	3.16	5.8	3.9

* The figures in brackets are the number of case studies from countries within the respective region that were included in this analysis.

Table 2. Correlation matrix of the six dimensional innovation scores for cases within Western Europe (N=42).

	G_SCORE	T_SCORE	S_SCORE	IT_SCORE	M_SCORE	C_SCORE
G_SCORE	1.00					
T_SCORE	0.64**	1.00				
S_SCORE	0.56**	0.67**	1.00			
IT_SCORE	-0.08	-0.01	-0.02	1.00		
M_SCORE	0.50**	0.57**	0.81**	0.17	1.00	
C_SCORE	0.04	0.15	0.17	0.42**	0.20	1.00

**p<0.01

N.B. G_SCORE, T_SCORE, S_SCORE, IT_SCORE, M_SCORE and C_SCORE are the innovation scores assigned to each case in relation to its declared curriculum goals, teacher's roles, students' roles, manifestation of learning outcome and connectedness, respectively.

Table 3. Correlation matrix of the six dimensional innovation scores of cases within Asia (N=25).

	G_SCORE	T_SCORE	S_SCORE	IT_SCORE	M_SCORE	C_SCORE
G_SCORE	1.00					
S_SCORE	0.76**	0.85**	1.00			
IT_SCORE	0.35	0.45*	0.28	1.00		
M_SCORE	0.58**	0.64**	0.69**	-0.10	1.00	
C_SCORE	0.17	0.30	0.28	-0.03	0.35	1.00

*p< 0.05, **p<0.01

with the connectedness score while for Asia, the ICT_score is only significantly correlated with the T_score (teachers' role). Also, the difference in the connectedness score is biggest across regions while the ICT_score has the least variance across regions.

The above discussion indicates that there is evidence of systemic regional differences in the way ICT is being used to support educational innovations. However, the statistics on the innovation scores per se do not tell us too much about how these differences should be interpreted in qualitative terms, nor whether these statistical differences really do carry meaning. In the next section, we will examine the general features of the cases collected in Finland and Hong Kong, and then will focus on couple of case studies from each of these two education systems to explore in greater detail the similarities and differences between these innovations.

ICT AS A SCAFFOLD TO BUILD CONNECTEDNESS FOR INNOVATION VERSUS ICT AS A TOOL TO SUPPORT INNOVATIONS

Based on Law et al.'s (2003) analysis, it was found that the mean innovation scores on the various dimensions for the cases collected in Hong Kong and Finland were very similar, except for the connectedness dimension (see Table 4). A careful review was made on each of the case studies collected from these systems to examine the roles played by ICT in these innovations. The results,

Table 4. The innovation scores for cases collected in Finland* and Hong Kong reported in Law et al. (2003).

Case no.	G_SCORE	T_SCORE	S_SCORE	IT_SCORE	M_SCORE	C_SCORE	AV_SCORE
Finnish innovation cases							
FI001	5	6	6	6	6	5	5.7
FI002	4	4	2	7	2	6	4.2
FI004	4	4	6	7	5	7	5.5
FI005	5	4	3	6	4	6	4.7
FI007	4	4	3	6	4	5	4.3
	4.4	**4.4**	**4.0**	**6.4**	**4.2**	**5.8**	**4.9**
Hong Kong innovation cases							
CN001	6	5	6	5	7	5	5.7
CN003	3	4	5	6	4	7	4.8
CN005	5	4	4	5	5	3	4.3
CN006	3	3	4	5	6	1	3.7
CN008	6	7	7	7	5	1	5.5
CN009	5	5	6	6	5	7	5.7
CN010	2	2	2	6	1	2	2.5
CN011	4	6	6	5	6	7	5.7
CN012	6	6	6	7	5	2	5.3
	4.4	**4.7**	**5.1**	**5.8**	**4.9**	**3.9**	**4.8**

*The innovation scores for the cases FI003 and FI006 are not presented here as they were not included in the analysis in Law et al. (2003).

together with a short summary of the innovations collected in Finland and in Hong Kong, are presented in Appendixes 1 and 2 respectively, and these revealed important cross-national differences. For the Finnish case studies, the most prominent role played by ICT was that of a scaffold to build connectedness, which was a critical feature for all the innovations. Furthermore, the goals of the innovations would not have been realized without building up the connectedness. On the other hand, in the Hong Kong case studies, ICT was mainly used as a cognitive or productivity tool for students to accomplish the designed learning activities. In some cases, ICT played a critical role, especially in cases where the technology was used as a cognitive tool, while in other cases, ICT was useful but not crucial to the innovation.

Of the seven cases collected in Finland, with the exception of the cases FI001 and FI003 (cases listed in Appendix 1), the innovations involved participation of students and teachers from other schools. These five innovations were either part of a regional/national project or have evolved into a regional/national project during the process. A common feature across these five innovations was the recognition that a lot of resources and expertise were necessary in order to provide the extended learning experiences desired for the students (e.g., the teaching of a foreign language, learning about a minority religion, achieving competency in a wide range of ICT skills) and building up a network of resources and expertise as well as collaboration between teachers and students in different parts of the country were perceived to be the most viable way to achieve the educational goals. Further, in all seven cases, there was expertise support provided to the innovations from individuals or institutions external to the school, such as university researchers and teachers, private enterprises, etc. The importance of building up connectedness in the Finnish cases was also reflected in the presence of an integrated virtual learning environment in all of the cases so as to be able to deliver distance, on-line learning to students.

For the nine innovations collected in Hong Kong, ICT was used to build connectedness to bring in expertise from outside of the school to support student learning in only one of the cases (CN009, see appendix 2). Furthermore, all of the cases did not involve any other school within Hong Kong. In two of the Hong Kong cases, the innovation involved students entering into some joint learning activities with a partner school in mainland China. However, in both cases, the joint activities were study trips organized for students from Hong Kong to visit the respective partner schools on the mainland and did not involve any on-line interactions between the students. Even in the case of CN009, where school alumni and members of the community were involved in contributing to discussions to address the problems raised by students in their learning process, the technology used was only a simple discussion forum software program unconnected to the other learning activities of the students. The case information for the Hong Kong cases listed in Appendix 2 reveals that there were three popular forms of ICT use in those cases. One was to use technology designed as cognitive tools for specific purposes. For example, data logging equipment was used in CN008 and CN012 to support experimental scientific investigations, a Chinese punctuation software program was used in CN010, and paint programs together with specialized input devices for creating digital art were used in CN003 & CN006. Another popular form was to use Web browsers, search engines, e-mail programs, instant messaging software, etc. to search for information and to communicate with fellow students or teachers to accomplish the set learning tasks (e.g., CN003, CN005, CN006 & CN011). The third and most popular form of technology use in the Hong Kong innovations was as a productivity tool to create reports, presentations and Web pages for publishing the outcomes of their learning; this form was found in most of the cases collected worldwide. Clearly, the technology used as information, communication, and productivity tools were also used in the Finnish innovations by both teachers and students and this should not be seen as characteristics unique to the Hong Kong cases. Further, these functions were often incorporated into the virtual learning environments used in the Finnish innovations.

From the above discussion, it is evident that there are important differences between the ICT-supported pedagogical innovations in Finland and Hong Kong. In the next section, we will explore whether there are also systemic differences in terms of the change processes as well as the transferability and sustainability between these two sets of case studies.

CHANGE PROCESSES: BUILDING UP A COLLABORATIVE SUPPORT NETWORK VERSUS BUILDING UP REQUISITE INFRASTRUCTURE AND TEACHER COMPETENCE

According to Fullan (2001), educational change can be viewed as a three-stage process. The first phase is *initiation*, which is the process leading up to and including the decision to initiate or adopt the innovative pedagogical practices. The second phase, *implementation*, is the process of putting the innovation into practice. In the third phase, *continuation*, the innovative practice establishes itself as part of the regular practice within the classroom or the school.

Initiation: Which Actors are Involved?

Initiation includes both generating the innovation ideas as well as taking the initial ideas forward to formulate an innovation plan. For both the Finnish and the Hong Kong innovations, teachers played a significant role in the initiation phase in nearly all of the case studies collected (Appendixes 1 and 2). However, for the Hong Kong innovations, with the exception of two cases (CN003, which involved the principal, and CN010, which involved a university researcher), both aspects of the initiation phase involved only the classroom teachers concerned. On the other hand, the Finnish cases involved a broader group of participants in both phases of initiation. The generation of the innovation ideas in Finland was various: it might have been the principal (FI003) or the classroom teachers (FI005 & FI007) whose ideas sparked the innovation, or it might have been the ideas of both the teachers and the principals in the local area (FI002 & FI004), or sometimes it was initiated by personnel external to the school, as in the cases of FI001 and FI006 when it was university researchers. Another prominent feature of the Finnish cases was the way these multiparty collaborations developed to satisfy the intertwined needs of the various parties concerned. For example, in the ITM (Information Technology and Media) line project (FI003), the aim was to raise the school's profile and academic standards with a technology-oriented curriculum while, at the same time, the city was striving to ensure the development of ICT expertise in the region by investing in the education of future ICT experts and encouraging them to stay in the region. In this project, the students had the possibility for an early start in higher education in the ICT fields as a part of their studies at the upper secondary level and the opportunities to practice in the local ICT companies.

Implementation: The School-based Teacher Team versus the Diverse Community Participation

The differences between the Finnish and Hong Kong innovations became even more apparent if we examine the phases of innovation plan formulation and implementation. In the case of the Hong Kong innovations, it was generally only those who generated the ideas who worked on the development of the plans. An important part of realizing the action plan was to ensure that the requisite ICT tools and infrastructure, as well as the necessary technical and pedagogical skills, were in place, which then became the first obstacle that the innovation teachers had to overcome. If the innovation required substantial ICT tools and infrastructure that the school did not already have (CN003, CN008, CN012), then the teachers had to work very hard to solicit funds for them, which involved writing and submitting grant application proposals to the various funding schemes that the Hong Kong government had set up to encourage and support school-based innovations. Furthermore, the innovation teachers had to look for ways to equip themselves with the necessary technical skills if they did not already possess them before the innovation, which may have been done through attending relevant courses if available, and/or through self-study. In all of the Hong Kong innovations, with the exception of CN010, the teachers had to explore and develop new pedagogical skills only with peer support from other teachers directly involved in the innovation.

As an example, the teacher in CN008, who had the innovative idea of employing data logging equipment in science experiments to develop students' ability to design and conduct scientific investigations, began by convincing two other science teachers to become interested as collaborators in trying out the new ideas. Then they had to obtain the principal's support to submit a grant proposal to get funding from the Quality Education Fund to purchase 10 sets of the requisite data logging equipment and associated software. When the school received the good news that they were successful in obtaining funding, the teachers then had to face serious pressure to handle the whole tendering and purchase process, start learning to use the data logger for conducting general scientific experiments, before finally facing the ultimate challenge: to guide students in developing their own inquiry problems into specific experimental designs and to complete them. All these teachers handled this process without external support, except for the funding for the innovation.

In Finland, as mentioned earlier, most of the cases have extended the circle of participants involved in the initiation phase of the innovations so that there was a much broader network of expertise and support that the initiators could draw on in developing the innovation plan. In some cases, the implementation plan may have been mutually beneficial to the outside partners so that they become eager to engage in and to extend their collaboration. For example, in the case of distance language teaching in archipelagic schools (FI002), the need for the innovation came from the small schools in the region. They wanted to provide a broader range of optional foreign languages for their students to choose from. The teacher training school at the local university responded to this and used this as an opportunity to develop outsourcing services. Further, this also responded to the university's own needs for providing opportunities for student teachers to engage in different and, especially in this case, technology-enhanced teaching methods.

In terms of infrastructure, all Finnish schools had rather good access to varied forms of technology. Four of the cases received support from universities in the form of access to research-based learning environments designed by university researchers. In terms of pedagogical expertise development, teachers in four of the cases received valuable support for their work through collaboration with outside experts. Nevertheless, the schools themselves had to make efforts to ensure the continuous development of the infrastructure and the pedagogically relevant use of ICT. Thus, the Finnish teachers and principals, like their Hong Kong counterparts, needed to make constant efforts to apply for funding to implement and sustain the innovations.

Continuation: The Standalone Fragility versus a Network of Innovation

The distinct differences in the change process between the Hong Kong and Finnish innovations did not stop at the initiation and implementation phases, but had as well important impact on the continuation phase in terms of the sustainability and transferability of the innovations within the respective systems. As described above, a lot of the energies spent during the initiation and implementation phases of the Hong Kong innovations came primarily from the innovative teachers themselves to build up the technology infrastructure and teacher competence required. At the point when the data for the case studies were collected, it was not clear whether those innovations would stay if the specific teachers involved in the innovations were to leave the school. The possible exception was CN003, where the principal was very much involved in supporting the innovation through the establishment of a large team of 12 peripheral "art" teachers within the school to support the more labor-intensive activities in the innovation, such as looking after the pupils when they went out on art field trips. A consequence of the totally school-based nature of the innovations and the change processes of the Hong Kong innovations was the difficulties in transferring (or extending) these innovations to other schools. The lack of a support infrastructure beyond the school meant that schools interested in adopting these innovations would have to go through a similar process of innovation as the original innovators. The innovations themselves had not generated any support structures for scaffolding new innovations, even though there was accumulation of expertise in the individual innovation teachers involved in those cases.

On the other hand, all of the Finnish cases built support structures and implementation infrastructures right from the initiation phase, which were further strengthened during the implementation phase. Such support structures would greatly reduce the burden of innovation if the practice were to be extended in time or extended to more classrooms within the same school or different schools, thus aiding the sustainability and transferability of the Finnish innovations in the continuation phase. It was thus not surprising to note that clear evidence for sustainability and transferability was observed in the Finnish case studies even at the time when the SITES M2 data were collected. The sustainability of the innovative practices was evident also in the follow-up made in June 2005. As surveyed from the schools' Web sites, five out of the seven cases had continued their existence at least in similar, but also in some cases in more extended, intensity. One of the cases, Netlibris, had resulted also in high transferability, which was foreseeable already at the time of data collection for SITES M2. The following excerpt from the home pages of Netlibris (see Netlibris, n.d.) describes the current situation and ongoing widening of the literature circles.

> *Netlibris attracts students from across Finland, and although most are located in the south, there are participating schools from areas as far as 170 kilometers (appx. 100 miles) north of the Arctic Circle. Literacy growth and appreciation is at the heart of Netlibris, but information and communication technology (ICT) skills also are developed through participation in the project. Some literature circles connect schools across Finland - they use video conferencing for face-to-face contacts. In seven years the concept has spread not only geographically but also from the primary school level to the secondary and upper secondary schools and from the gifted students to all levels of readers. Now there are more than a hundred teachers and over 2000 students, including also groups for struggling readers. In 2002 - 2003 more than 70.000 messages were posted at Netlibris-discussion forums.*
>
> *The concept of Netlibris is easily transportable in various user groups, subjects and cultures. The technology required is available in many countries. The most important ingredients are the network of dedicated teachers and the opportunity for collaboration and in-service training. The first international literature circle, Matilda i Norden, was launched during the Netdays`99 week. Netlibris was chosen one of the Umbrella projects of Netdays2000.*

Currently Netlibris is one of the "virtual school" projects supported by the National Board of Education (NBE). This means that the project receives half of its funding from NBE and the other half from the participating municipalities. Each year, the municipalities apply for discretionary allowance from NBE, which requires the municipalities to commit themselves to a similar amount of their own funding. The coordinator of the Netlibris project explained that the funding in 2005 was reduced by half (S. Mattila, personal communication, June 20, 2005) because NBE estimates that, given the long history of the project, it is already becoming part of the regular practices, meaning it is in the phase of continuation (Fullan, 2001). The coordinator, in the same communication, also analyzed the reasons for successful implementation of the project, and explained as follows:

> *The reason for such a fantastic and lively development of Netlibris is mostly based on the immense enthusiasm and commitment of those participating in it. The biggest resource and capital is the huge knowhow we currently have in our network. A special richness is the "infinity" of our project - the teacher network transcends the limits of municipalities and school levels.*

CONNECTEDNESS, EDUCATIONAL INNOVATIONS AND NATIONAL INFORMATION STRATEGIES

Connectedness was the sixth dimension identified by Law et al. (2003) for comparing the level of innovation across different cases. It described one prominent feature emerging from many of the case studies collected: the boundaries for classrooms have become much less well defined in these innovations as compared to the average classroom. Students and teachers involved in the connected innovation classrooms benefited from being able to interact with and to learn from students and teachers from other classrooms, other schools, or even other countries, as well as from parents, alumni, community groups, outside experts, etc. The roles that these external participants play were also very diverse, from peripheral to core involvement in the teaching and learning process.

As described in the previous sections, the biggest difference between the Western European and Asian innovations in terms of levels of innovation was that the former were much more connected than the latter. This paper also drew on the Finnish and Hong Kong case studies to reveal how this difference in connectedness was linked to the qualitative differences in the nature of the innovations as well as differences in the change processes associated. Are there any reasons for the differences observed? Obviously change factors can be found at the individual teacher level as well as the school and system levels. Teacher- and school-level factors should help to explain why the innovations were observed in some schools and not others. On the other hand, the cross-national differences observed between innovations are likely to be associated with systems-level differences. Differences such as the organizational culture in schools and whether interschool and cross-sector collaboration is commonly found in schools and the community obviously may contribute importantly to the systemic differences observed between the case studies collected from Finland and Hong Kong. However, the study did not attempt to collect data in a systematic way to address the issue of cultural differences. On the other hand, each case study had to include systematic information on national and regional policies and strategies on ICT in education. In the remainder of this section, we examine what differences, if any, exist at the policies and strategies levels and, if so, whether such differences may be linked to the differences in innovation and change processes observed.

Hong Kong: A Strategy that Encourages School-based Development and Interschool Competition

At the systems level, both the Hong Kong and Finnish governments have established their respective ICT in education implementation policies to promote the use of ICT in teaching and learning activities in schools. However, there are fundamental differences in the overall educational developmental context and their policy and strategic emphases.

Hong Kong announced its first 5-year ICT in education master plan, *Information Technology for Learning in a New Era Five Year Strategy*, in 1998 (EMB, 1998). Before the announcement of the master plan, very few primary schools had any computers for instructional purposes. On the other hand, nearly all secondary schools at that time had at least one computer lab, but it was generally confined in use to teaching computer-related subjects. Therefore, the use of ICT across the curriculum was in itself a relatively new phenomenon.

The educational goals for integrating the use of ICT across the curriculum were not clearly spelled out nor well understood in the Hong Kong education community or the general public. At the rhetorical level, the use of ICT was intended to link students with the vast networked world of knowledge through the Internet, to help them to develop better information processing capabilities, and the attitude and capability of undertaking lifelong learning. At the practical level, the master plan included a specific target for all schools: Within 5 years, at least 25% of the teaching and learning within the school curriculum should be supported through ICT and that, within 10 years, all teachers and grade 11 graduates should achieve competence with ICT tools.

Significant financial resources were allocated for the implementation of this master plan and a prime focus of the policy measures was on preparing the technological readiness of schools and teachers. The various ICT-specific provisions amounted to US$391 million in capital cost and US$125 million in total recurrent funding from 1997/98 to 2001/02. Most of the non-recurrent funding was spent on access (provision of computers to schools; 62%), followed by connectivity (i.e., computers that can access the Internet; 22%), and teacher training (16%). Recurrent funds are mainly used to support activities under five main subcategories: organizing ICT in education refresher training courses; educational software development; provision of 250 ICT coordinators for public sector schools; contract of technical support services to schools; and contract maintenance services for school PCs. In addition, a program called Technical Support Service (TSS) was also launched to provide extra human resource and technical support for the hardware and troubleshooting. Another important initiative taken in Hong Kong was the region-wide provision of technical training for teachers. Three levels of technical competencies for teachers were identified: basic, intermediate and advanced levels. All Hong Kong teachers (about 50,600) had completed training at the basic level by the academic year 2002/03.

It is important to note that the Education and Manpower Bureau (EMB) adopted a differential funding strategy that provided incentives for schools which took the lead in spearheading changes that the policy stipulated. There were altogether 428 secondary schools and 829 primary schools at the time the master plan was announced. Resources were set aside to ensure the basic access and connectivity of schools, leaving a substantial proportion of the funding to be utilized in the form of incentive schemes, such as a pilot scheme on ICT integration for 20 schools to explore innovative ways of using ICT to support learning and teaching, as well as the ICT Coordinator Scheme, and the Technical Support Service Scheme described above. In addition, schools were able to apply for funding from the Quality Education Fund to implement various ideas related to the improvement of education; Projects related to ICT in teaching and learning were one of the priority areas for funding. These funding schemes encouraged schools to take proactive steps to innovate, while at the same time also promoted a highly competitive culture among schools.

None of the nine Hong Kong innovative case studies involved cross-school collaboration with any other school within the Hong Kong territory. The change processes in these cases also did not develop a structure of collaboration and support beyond the school. Seven out of the nine SITES M2 cases in Hong Kong received financial support from the government, but only in one case was the innovation part of a bigger university-based project and received pedagogical support from beyond the school. The schools and the teachers involved thus had to make tremendous efforts in bootstrapping their innovations from initial conceptualization to the final outcome, and bore the consequences of all the risks involved by themselves. The features and changes achieved in the innovations studied varied greatly, depending on the understanding and knowledge of individual schools and/or teachers of the pedagogical innovations and ICT functionalities. This lack of cross-school collaboration may also be relegated to the lack of a collaboration culture among schools. However, the strategies used by the government for school education development in general and for ICT-specific developments in particular certainly did not encourage or support collaboration across schools, nor give specific support to the establishment of wider support structures beyond the innovation school.

Finland: A Policy Emphasis on Collaboration and Teamwork

Finland, on the other hand, had a much longer history of ICT use across the curriculum. During the 1990s the Finnish strategy was to develop ICT in education as part of its policy of building a Finnish information society. In 1995, the government produced a position paper outlining its information society strategy of providing every citizen with opportunities to acquire the skills they will need to access the information mediated by new technology. It is thus clear that one of the priorities for using ICT is to improve the equity of access to information and to education that is essential to that access. The Finnish Ministry of Education (1999a, 1999b) has developed its national ICT policy for education through a series of information strategies, the latest being the 3-year strategy "Information Society Program for Education, Training and Research 2004-2006" (Finnish Ministry of Education, 2004).

The Finnish NBE commenced an ICT implementation program in 1996, titled "Information Finland" (see Kankaanranta & Linnakylä, 2003). The program has helped schools acquire the necessary infrastructure, become linked to information networks, provide in-service teacher training, and develop learning and teaching materials. In particular, one of its subprojects, OPE.FI, was conducted to ensure that every Finnish school would have a strategy for the implementation and use of ICT in teaching and learning, suited to the contextual characteristics and needs of the school by 2002. Teacher training was further emphasized in the in-service training program called "Finland as an Information Society," which provided a framework and guidelines for developing the pedagogical use of ICT in Finnish schools. Some of the main focus areas were collaborative teaching and learning, networking, and teamwork. This policy emphasis resulted in various technology-supported school projects in different parts of Finland. The program also produced on-line instructional materials in Finnish, which was in accord with the Ministry's goal to produce Finnish content in the new media (Finnish Ministry of Education, 1999b).

In Finland, the schools had widely adopted the national strategic emphasis of networked and collaborative use of ICT in instruction, the research-based development of this instruction, and the building of virtual schools. Five out of the seven innovative cases actually represented larger networked projects within local, regional or national contexts, although they were studied in the SITES M2 with a focus on the classroom, as specified in the SITES M2 study design. A networked project implied that similar ICT-supported pedagogical practices were implemented in several schools (e.g., distance language teaching in the archipelagic small schools and orthodox religion teaching in one Finnish region), and may even involve several school levels (e.g., the Netlibris literature circles), or be part of a larger project which acted as a local center for enhancing ICT usage (e.g., web course). It is also evident that one of the goals for building these networked projects was to improve equity of educational opportunities for students, which allowed for students to be able to learn foreign languages, the orthodox religion, complex ICT skills, etc. Further, on-line technology was heavily adopted in nearly all the Finnish cases, resulting in a relatively high level of connectedness in the SITES M2 Finnish cases. Already in SITES M1 (school year 1998/1999) the ICT-related activities that Finnish school principals considered to be the most satisfying included various Internet-related activities (Kankaanranta, Puhakka, & Linnakylä, 2000). The connectedness of the cases also involved essential linkages to different parties outside schools.

CONCLUSION

In this paper, we have conducted in-depth comparisons of the ICT-supported innovation pedagogical practices collected in SITES M2 from Finland and Hong Kong. Starting from the observation that the Asian case studies were lowest in connectedness while the Western European ones were most connected, the qualitative analysis revealed significant differences in the role played by ICT in the cases collected from these two education systems. In the Finnish cases, ICT played the core role of providing a scaffold to build up the connectedness, which was essential to the Finnish innovations. For the Hong Kong innovations, ICT was used mainly as a learning and productivity tool. Even though Internet access was available in all of the Hong Kong innovation schools, its use was confined mainly to information search on the Internet. The only communication tools used in the Hong Kong case studies were e-mails and a discussion forum. On the other hand, all of the Finnish innovations adopted on-line learning environments that formed an important information and communication infrastructure to scaffold the learning activities and the collaborative interactions between the various parties involved in the innovations.

The analysis also found significant differences in the initiation, implementation and continuation phases of the innovation process across the two systems, which is also linked to the difference in connectedness. All of the Finnish cases found collaborators and established a network of technological, learning resources and/or expertise (subject matter and pedagogical) support for the innovations. Most of the innovations also extended beyond a single school to become a networked project at the local, regional or national levels. Such a change process not only helped to reduce the burden of innovation on the initiators, but also helped to establish an infrastructure (technological and socio-institutional) that will contribute importantly to the sustainability and transferability of the innovations. On the other hand, in the nine Hong Kong cases, with the exception of one innovation that was part of a university-based project, the innovation teachers had to build up the requisite infrastructure and teacher competence by themselves. Support and collaborations were confined within the innovation schools. Even though the teachers involved in these innovations did accumulate a lot of expertise in the change process, it did not result in the establishment of any support infrastructure beyond the school. As a result, the sustainability depended largely on the continued support from the teachers and the school heads concerned, while the transferability of the Hong Kong innovations was very limited.

The differences in the roles played by ICT in the innovations and the different characteristics of the change processes between the Hong Kong and Finnish innovations can be linked to systemic differences in the historical educational contextual differences as well as the differences in ICT related education policies in these two systems. Hong Kong had a much shorter history of ICT use across the curriculum. It established a strategic master plan of ICT in education that encouraged schools to compete for funds and human resources to develop their own ICT-supported pedagogical practices. On the other hand, Finland had a much longer history of ICT use across the curriculum and a national priority for ICT development was to improve the equity of access to educational opportunities. Furthermore, the policy priority was to promote collaborative teaching and learning, networking, and teamwork.

The above in-depth comparison between the Finnish and Hong Kong innovations is useful in providing us with a much deeper understanding of the connection between the classroom, school and system level changes in ICT-supported educational innovations. It is not clear to us whether these same differences were applicable to understanding the differences in the SITES M2 case studies between other Asian and Western European countries. It is however our view that such an approach to cross-national comparisons will contribute valuable insight to our understanding of educational innovations, which would not be easily accessible otherwise.

ENDNOTE

[1] The SITES M2 study was conducted at about the same time as the OECD study on cases studies of ICT and organizational change reported in Venezky and Davis (2002).

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APPENDIX 1

A brief summary of the case studies collected in Finland and the roles played by ICT in each innovation studied.

Case number & title	Brief case summary	Role of ICT in innovation
FI001: A computer-supported collaborative learning project	The goal of the innovation was to increase computer-supported collaborative learning in school. Students collaboratively conducted research projects in science. They were responsible for their learning, and they dealt with the entire research process by themselves. Students and teachers utilized the Web-based environment WorkMates, which was developed by the University of Turku. The environment supported students' learning by providing tools for questions, discussions, and knowledge production. Students could comment on each other's notes, and shared information on their progress in the research project and knowledge acquisition. Teachers guided and supported students' learning, and provided feedback to students throughout the project. The teachers received pedagogical support on computer supported collaborative learning from a researcher at the University of Helsinki.	Key issues of this innovation were Internet access and the WorkMates environment, which supported the students' collaborative inquiries.
FI002: Web-based distance language teaching in archipelago schools	This innovation was a collaborative effort between a teacher training school and a primary school in Finland. Students learned German through distance learning. The goal was to guarantee equal opportunities for pupils in small rural schools to choose optional foreign languages. It also advanced teachers' ICT skills and the schools' technological resources. This innovation utilized a Web-based learning environment designed for young language learners. A teacher designed a series of exercises to be done in Microsoft NetMeeting application and virtual notebook. Students worked on various tasks in a Web-based learning environment either alone or collaboratively with each other and with the distance teacher. This strengthened the students' responsibility for their own learning.	Video-conferencing equipment, Internet connections, and a Web-based learning environment, which included a virtual notebook and Microsoft NetMeeting capabilities, were used to allow students in the rural school to learn from teachers located at a distance via a variety of learning and interaction formats.
FI003: Information technology and media in teaching. ITM Line	The aim of the information technology and media (ITM) studies was to provide students with knowledge about computer technology and practical ICT skills. Students were given chances to select different courses offered by ITM Line. In the courses, students engaged themselves in various kinds of activities, such as doing exercises and conducting projects. Moreover, within the collaborating scheme with some private companies and a university, it was possible for the students to work for the companies or take a university course. Teachers guided and supported students and also taught them ICT skills in this innovation.	ICT was essential for this innovation because the entire content of the innovation was based on ICT and media. The project used word processing, e-mail, and multimedia tools.

FI004: Web course	This innovation involved a Web course consisting of 20 study weeks of information technology in an upper secondary school. Students acquired various ICT skills, learned skills for group work, and worked on projects involving virtual companies, as well as carried out practical training in some companies. The school did not have enough qualified staff to teach the course, so teachers who were employed from outside the school planned and developed learning activities with the support of the project coordinator. This Web course was supported pedagogically, financially, and technically by a project called the Sipoo Institute, which is a virtual center for network pedagogy development. This institute also organized supplementary seminar activities. A considerable amount of work in the Web course was independent work. Students constructed Web-based portfolios as part of their learning activity.	ICT played a very significant role in this innovation not only because the curriculum goal was for the students to acquire various ICT skills. ICT also provided the platform for learning to take place and allowed students to learn from experts outside of the school.
FI005: Netlibris literature circles	Netlibris was a literature project that aimed at encouraging students to read more books, share their reading experience with peers, and to encourage girls to use ICT. Teachers planned activities with librarians, students, project coordinators, and several experts (authors, etc.). Teachers also participated in Web-based literature discussions and modeled literature discussions and interaction skills. In this innovation, students chose books to read from common bookplates on the Netlibris Web site, kept a reading diary, and discussed the books with others in the Web-based environment and in face-to-face meetings with peers. They also planned and arranged literature events for other students, such as virtual “author visits.”	The Netlibris environment is critical to this innovation as all key activities are conducted there. Students read books, discussed them with students from different cities and countries, “met the authors” virtually, took turns editing a network magazine, etc. Tutors and mentors also had their own discussion space.
FI006: Diversifying school instruction of the Orthodox religion by means of ICT	Ort + Edu is a national project that develops instruction on the Orthodox religion, which is a minority religion in Finland. In this project, participants collected materials related to the Orthodox Church’s visual and auditory cultural heritage (e.g., the divine services, icons, church buildings, and sets of church-related articles) from the Web, implemented a Web-based learning process, posted their knowledge back to the Web, and collected feedback. This innovation utilized a virtual, open-learning environment for the students; teachers could also communicate with each other. Altogether 12 teachers participated in this project, which was supported by a researcher from the University of Joensuu. The project also succeeded in increasing interest regarding new learning environments and promoted a more positive attitude towards ICT among teachers. The purpose of the learning environment was to teach the Orthodox religion.	Internet connections, videoconferencing equipment and e-mail were critical to this innovation in order to extend the learning activities beyond the classroom walls. These tools also allowed students to learn with and from other students, as well as to meet with Orthodox priests, etc. Multimedia (Real Player) software was used for putting course materials on the Web.

FI007: Technology-enriched history projects	This innovation aimed to promote the use of Web-based learning practices, to get students to understand and apply their knowledge of history through role-playing historical characters, and to cultivate students' responsibility for their learning. It was a joint project between the lower secondary classes in two schools. The study theme was industrialization, and students from one school played roles in the British society while students from the other school played roles in the Finnish society. The teachers planned the lesson activities, gathered the relevant information sources, and guided students' learning. Students did exercises and discussed their roles. They worked both independently and collaboratively with students in the other school. They sent messages to each other utilizing a Web-based environment. The researchers from the Institute of Educational Research, University of Jyväskylä, supported the project and this was found to be extremely useful by the innovation teachers.	FLE, a Web-based environment developed at the University of Helsinki, was the key technology used in this innovation. It has five separate modules to support different facets of the students' activities: the students' own "worktable" for creating their own products, an asynchronous conferencing and discussion environment, an asynchronous environment for communal planning and writing, a "library" for publishing multimedia teaching materials for students, and management tools.

APPENDIX 2

A brief summary of the case studies collected in Hong Kong and the roles played by ICT in each innovation studied**.**

Case number & title	**Brief case summary**	**Role of ICT in the innovation**
CN001: My pocket money	A class of Primary 6 (grade 6) students participated in a 4-month interdisciplinary project covering general studies, mathematics and Chinese. This innovation encouraged the development of students' abilities in various areas, such as information and analysis skills, communication skills, and the ability to work in teams. Students took part in different activities such as research and fund-raising. Under the teacher's facilitation, students learned actively from peer collaboration in a variety of activities.	In this case study, ICT functioned as the students' tool for documentation, data analysis, presentation, and publicity, as well as a medium of demonstration for the teacher.
CN003: The cyber art project	This project aimed at cultivating students' creativity, promoting a new way of learning and teaching art with multimedia, and extending the learning space beyond classroom. Students from primary grades 4 to 6 used laptop computers and related software for artwork in both the art lessons and the extracurricular activities. The activities included outdoor and indoor sketching practice, collaboration with a primary school in Mainland China, a students' exhibition, and trip to Beijing. This innovation encouraged collaboration between teachers and enhanced the efficiency of lesson preparation.	In this case study, the laptop fitted with the special pressure pad and associated software allowed students to learn to create art through different simulated media formats and in various indoor & outdoor settings, which would not have been possible without the technology.
CN005: Exploring the live physics	In this innovation, students in a Secondary Three physics class (grade 9) worked together to investigate one real-life physics phenomenon assigned by the teacher, using Internet search, group discussion, and presentation of their proposal and findings. The teacher played a facilitating role while students became actively engaged in self-directed exploration and collaborative work with their fellow classmates. It aimed at cultivating students' interest in learning physics, enabling students to learn via information search, encouraging whole-person development, and promoting self-learning.	In this innovation, students searched for information on the Internet, published their findings through a Web page and used e-mail and instant messaging software for communication during the project process.

CN006: Creanimate	This innovation was implemented by two teachers in the Secondary 3 (grade 9) classes in the art and design subject in a girls' school. The major goals of this practice were to foster students' creativity and to develop in them an understanding that creativity often needs good rational bases supported by rich information. Students had to work in pairs to create a fictitious animal and to submit a report on the habitat of that animal, explaining how the features of the animal were suited to its "natural" habitat. The teachers played the role of facilitators in guiding students through the exploration and creative process, while students learned from one another by participating in collaborative work and peer evaluation.	Students searched for information about various habitats as well as pictures for different species through the Internet. Students also used special art creation software, Picture-It, as a productivity tool for creating their fictitious animal.
CN008: Problem-based learning: Computer-assisted scientific investigations	This innovation involved students in three science subjects, namely biology, chemistry and physics, in Secondary 4 to 6 classes (grades 10-12). Students participated voluntarily in as an extension of their school curriculum to design 10 investigations in each of the three subject areas. The investigation problems were initiated by the students and had to involve the use of data logging systems in the data collection and computers for data analysis. Each investigation was composed of three phases: pre-laboratory discussion, laboratory session and post-laboratory discussion. It aimed at promoting science learning via authentic experimental investigations using digital technology.	ICT played a key role in supporting data collection and analysis, allowing students to tackle investigations that would not otherwise be possible (e.g., collecting data in fast-changing processes) and supporting discussion beyond face-to-face contact via the use of e-mail & instant messaging.
CN009: Learning through Web discussion forums	This innovation started as an initiative from the science teachers in a school to provide an opportunity to students throughout the entire school—from secondary 1 to 7 levels (grades 7-13)—to participate voluntarily in forums on physics, chemistry, biology, and mathematics. The forums were also open to teachers, school supervisors, and alumni. In this practice, students posted questions and received feedback from teachers, peers, and experts outside of the school (e.g., alumni or parents who may be engineers, medical doctors, scientists, etc.). Teachers acted as guides and colearners of the students, while students played the active role of peer tutors, knowledge explorers, and active learners.	The online discussion forum provided a platform to mediate the peer collaborative learning and to connect the students with teachers, peers and experts outside of the school.

CN010: Chinese punctuation	This pedagogical practice was implemented in the Chinese curriculum of a primary school grade 6 and the goal was to use software designed at the University of Hong Kong for learning Chinese punctuation. This innovation was part of a government-funded initiative to allow more schools to take advantage of the R&D outcomes of the universities to enhance learning and teaching. Three teachers from the school were involved in this innovation and they had access to support from a consultant from the University of Hong Kong.	Teachers used the specially designed Chinese punctuation software as demonstration (tutorial) software in classrooms as well as drill and practice software for students.
CN011: The study trip to Shun Tak in mainland China	This innovation was an extracurricular activity organized by teachers of the economics subject for 25 Secondary 3 and 4 (grades 9 and 10) students. Six teachers were involved in this practice. The goals of the trip were to enhance students' understanding of the economic development of Hong Kong and mainland China, to promote exchange of ideas between students in both places, and to gain insights into the world of running a business. Students worked collaboratively on investigating problems related to the economic development in Hong Kong and Shun Tak, a medium-sized, fast-developing town in the vicinity of Hong Kong.	ICT acted as tools of information search, presentation and documentation in this project.
CN012: Project-based model building in physics	Two physics teachers, one laboratory technician, and 35 Secondary 6 (grade 12) students were involved in this innovation. It aimed to provide students with an opportunity to engage in scientific investigations and to develop an understanding of scientific theories as models. In this pedagogical practice, students worked collaboratively to design and conduct experiments related to particular curriculum content and to verifying mathematical models embedded in the scientific theories. Teachers acted as advisors and project managers, whereas students took an active part in generating questions, designing the experiments and drawing conclusion from their investigations.	Data logging equipment and data analysis tools were used to support scientific investigations, modeling software was used to support theory building and theory exploration, and e-mail and instant messaging were used to support communication and collaborative learning among students and teachers. Teachers and students used ICT also for presentations.