

**ผลของการนำนโยบายเทคโนโลยีสารสนเทศและการสื่อสาร
ไปปฏิบัติทางการศึกษา:
หลักฐานจากโรงเรียนมัธยมศึกษาตอนปลายในประเทศไทย**
**The Performance of ICT Policy Implementation in Education:
Evidence from Upper-Level Secondary Schools in Thailand**

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บทคัดย่อ

งานวิจัยนี้มีวัตถุประสงค์ 3 ข้อ คือหนึ่งทดสอบตัวแบบเพื่ออธิบายผลของการนำนโยบายเทคโนโลยีสารสนเทศและการสื่อสาร (ICT) ไปปฏิบัติทางการศึกษา สองเปรียบเทียบระดับความแตกต่างของปัจจัยที่ส่งผลต่อการนำนโยบาย ICT ไปปฏิบัติระหว่างโรงเรียนมัธยมศึกษาตอนปลายสายสามัญของคณะกรรมการการศึกษาขั้นพื้นฐาน (สพฐ.) 2 กลุ่ม คือกลุ่ม I โรงเรียนมัธยมศึกษาที่เข้าร่วมโครงการโรงเรียนดีใกล้บ้านและกลุ่ม II โรงเรียนมัธยมศึกษาที่ไม่ได้เข้าร่วมโครงการ และสามเสนอคำแนะนำสำหรับการนำนโยบาย ICT ไปปฏิบัติทางการศึกษาในอนาคต

ผลการวิเคราะห์แบบจำลองสมการโครงสร้าง (SEM) ด้วยโปรแกรม AMOS และ t-test พบว่าตัวแบบผลของการนำนโยบาย ICT ไปปฏิบัติทางการศึกษา สามารถอธิบายได้ด้วยตัวแปรแฝงภายนอก 2 ตัวแปรและตัวแปรแฝงภายใน 2 ตัวแปร ตัวแปรแฝงภายนอกได้แก่เงื่อนไขนโยบาย ICT และคุณลักษณะของผู้อำนวยการโรงเรียน ส่วนตัวแปรแฝงภายในประกอบด้วยคุณลักษณะของครูและนักเรียน และผลของการนำนโยบาย ICT ไปปฏิบัติ ตัวแบบนี้อธิบายอิทธิพลของตัวแปรแฝงภายนอกต่อผลของการนำนโยบาย ICT ไปปฏิบัติทางการศึกษาได้ 38.40 เปอร์เซ็นต์ ผลการทดสอบสมมติฐานทางสถิติที่ระดับความเชื่อมั่น 95 เปอร์เซ็นต์ ไม่พบความแตกต่างของผลของการนำนโยบาย ICT

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ไปปฏิบัติและไม่พบความแตกต่างของระดับคุณลักษณะของครูและนักเรียนระหว่างโรงเรียนทั้งสองกลุ่ม แต่พบว่าระดับเงื่อนไขนโยบาย ICT เกี่ยวกับบทบาทการให้ความสนับสนุนของ สพฐ. ของโรงเรียนในกลุ่ม I มีค่าสูงกว่ากลุ่ม II ส่วนระดับคุณลักษณะของผู้บริหารโรงเรียนเกี่ยวกับภาวะความเป็นผู้นำเชิงการเปลี่ยนแปลงของโรงเรียนกลุ่ม II มีค่าสูงกว่ากลุ่ม I ข้อเสนอแนะมี 3 ประการคือ ด้านเงื่อนไขนโยบาย ICT เสนอให้เพิ่มความสนับสนุนทางทรัพยากรทางเทคนิคและงบประมาณ ด้านคุณลักษณะของผู้นำนโยบายไปปฏิบัติ เสนอให้เพิ่มการฝึกอบรมด้าน ICT ให้กับบุคลากรทางการศึกษา การเพิ่มการให้ความสนับสนุนด้านการให้ความช่วยเหลือต่อครูสำหรับการประยุกต์ใช้ ICT กับการเรียนการสอนของโรงเรียน และด้านการศึกษาเพิ่มเติมเกี่ยวกับผลของการนำนโยบาย ICT ไปปฏิบัติในอนาคตด้วยการศึกษาเปรียบเทียบระหว่างโรงเรียนที่อยู่ต่างส่วนราชการ เช่น ระหว่างโรงเรียนที่สังกัด สพฐ. กับโรงเรียนที่สังกัดการปกครองส่วนท้องถิ่น เป็นต้น

คำสำคัญ: ผลของการนำนโยบายเทคโนโลยีสารสนเทศและการสื่อสารไปปฏิบัติทางการศึกษา
เงื่อนไขนโยบายคุณลักษณะของผู้บริหารโรงเรียน
คุณลักษณะของครูและนักเรียน

Abstract

This study has three objectives: first, it aims to test a model of the performance of ICT policy implementation in education in Thailand; second it compares the level of differences and similarities of the determinants and the performance of ICT policy implementation between Group I—the upper-level secondary schools of the Lab School Project and Group II—the remaining upper-level secondary schools of the office of the basic education commission (OBEC); finally, it offers recommendations for further development of the performance ICT policy implementation in education.

The study employs a structural equation modeling (SEM) analysis based on the analysis of moment structures (AMOS) and t-tests. It reveals that the model can be determined by two exogenous latent variables; namely, the ICT policy conditions and characteristics of school directors; and two other endogenous latent variables include the characteristics of teachers and students, and the performance of ICT policy implementation. The coefficient of determination of the model explains that 38.4% of the variation of the performance of ICT policy implementation in education is determined by the condition, school director characteristics, and teacher and student characteristics. With a t-test at the confident level of 95%, findings indicated that the level of performance of ICT policy implementation in education, and the characteristics of teachers and students, between Group I and Group II schools were not statistically different. In contrast, the level of school director characteristics and the policy condition between the two groups were statistically different; the transformational leadership style of school directors in Group II was higher than that of Group I, and the role of the OBEC in Group I was higher than in Group II. The study offers three recommendations, including policy conditions, characteristics of policy implementers, and further study. The recommendations cover provisions of additional technical resources and budget, training for teachers and students, technical assistance with teachers' ICT operations, and a cross-comparison study between schools under centralized control of the OBEC and those schools under the decentralized control of local administration organizations, respectively.

Key Words: Performance of ICT policy implementation in education,
Policy conditions, Characteristics of school directors,
Characteristics of teachers and students

1. Introduction

Thailand has undergone significant social and economic developments through numbers of national economic and social development plans. The society is now moving towards an information-based society, where creation and dissemination of knowledge play critical roles in both individual and social development. Friedman (2005: 408-410), however, has argued that in a globalized age, countries that do not train their people in the new knowledge economy will be left behind and will not be able to compete effectively in the global economy. As part of the strategic movement in the educational context, Thailand's education was reformed to enable learners to achieve high-order thinking skills, communication skills, and continuous learning. The new educational system is moving toward decentralization, focusing on restructuring the framework of resource allocation, organizational structure, curricula, teaching and the learning process, and professional development in which ICT plays an important role in managing these changes. The newly-established school curriculum standards in key learning areas incorporate ICT in supporting the shift to more student-centered approaches. ICT is now being integrated across the curriculum, encouraged and driven by several projects and initiatives, for instance, EdNet, SchoolNet, the Teacher Support System, ICT Training Center Schools, IT School, and the Lab School Project.

However, in order to integrate efficiently and effectively ICT into the educational system and structure during the educational reform period is a difficult task because there are some problems arising which can be broadly categorized into three areas, as follows. First, there is the problem of the readiness of the ICT infrastructure in schools, such as computer networks, connectivity of the computer networks to telecommunication service providers,

accessibility to computers in school, and the distribution of computers, which impacts the level of implementation of ICT in schools (Stamper, 2002: 12). Second, there are problems relating to the characteristics of educational personnel which impact the adoption and implementation of ICT education. These characteristics include computer and Internet literacy, English language skills, perceptions of the usefulness of ICT in education, the leadership style of the school leader, awareness of ICT policy, attitude towards ICT, and commitment to ICT policy. Finally, there are concerns about support from the government, for instance, financial support, technical support, effective coordination and communication between the decentralized administrative structures both within and outside the MOE, and administrative measures at the ministerial level mandating the expedition of the operation of responsibility units at departmental levels.

2. Objectives of the Study

This study has three objectives: first, it aims to test a model of the performance of ICT policy implementation in education in Thailand; second, it compares the differences and similarities of the factors affecting the performance of ICT policy implementation between Group I—the upper-level secondary schools of the Lab School Project and Group II—the remaining upper-level secondary schools of the jurisdiction of general education of the OBEC; finally, it offers recommendations for further development of ICT policy implementation in education.

3. Literature Reviews

This study adopts the definition of ICT from the World Bank (2009: 1), which refers to ICT in terms of the computer hardware, software, networks, and media for the collection, storage, transmission, and presentation of information. ICT services in education include the Internet, e-Mail, computer-assisted instruction, e-Books, and e-Learning.

Public policy can refer to the following: the actions taken by governments (Sharkansky, 1970: 1), the long-term commitment to implementing the planned activities of the government (Prewitt and Verba, 1983: 652-653), whatever governments choose to do or not to do (Dye, 1984: 1), a course of action which has many components (Anderson, 2003: 24), an intention that government chooses not to do (Sombat Thamrongtanyawong, 2003: 6, 8-20), and the guidelines or measures that the government or government agencies have established to solve problems (Voradej Chandarasorn, 2008: 16). The definition of public policy used in this study is "whatever governments choose to do or not to do." This concept is applied to Thailand's National ICT public policy, in which the Thai government decided to implement an ICT policy; namely IT2010. This policy aimed at building human capital, promoting innovation, and investing in information infrastructure and promoting the information industry to develop Thailand towards a knowledge-based economy/knowledge-based society. The ministry of education (MOE) subsequently adopted the IT2010 framework in several ICT master plans, e.g. ICT master plan B.E.2547-2549, which is under study here and aimed to develop and strengthen human capital at all levels to move the country towards being a knowledge-based society, in which life-long learning, computer literacy, human resource development, and virtual education are emphasized. The developments of ICT in secondary schools can be seen in

several projects, such as the SchoolNet Project and the Lab School Project. While SchoolNet that was an active project for 1995 to 2004 laid a solid foundation of Internet usage in schools throughout Thailand (Paisal Kiattananon and Taweesak Koanantakool, 1999: 49-53), the Lab School Project is now under implementation, where ICT plays a vital role in making education reform become a reality (Office of the Basic Education Commission, 2003: 9).

Policy implementation can be viewed not only from a particular perspective, but also according to various dimensions, as a number of remarkable scholars have noted, such as an attempt to determine the capability of an organization to plan and manage its resources, whether man or materials, and to motivate them to achieve organizational goals (Williams, 1971: 144), those actions by public and private individuals (or groups) that are directed toward the achievement of objectives set forth in prior policy decisions (Van Horn and Van Meter, 1975: 447-448), a purposive course of action followed by an actor or set of actors in dealing with a problem or a matter of concern (Anderson, 2003: 3), a process dealing with government activities related to the political process (Sabatier and Mazmanian, 1980: 538), and the study of organization responsible for bringing all organizational mechanisms and managerial resources together to implement policy objectives (Voradej Chandarasorn, 2008: 16). Puelzl and Treib (2007: 89) identified three generations of implementation research. The first generation of implementation studies existed during the 1970s and was characterized by a pessimistic undertone which was fuelled by a number of implementation failure case studies, such as the work of Derthick (1972: 83-102), Pressman and Wildavsky (1973: 1-6), and Bardach (1977: 3). The most important achievement of the first generation of implementation researchers was to raise awareness of the issue in the wider scholarly community and among the general public. While theory building was not at

the heart of the first generation of implementation studies, the second generation began to put forward a whole range of theoretical frameworks and hypotheses. This period was marked by debates between what was later called the top-down and bottom-up approaches to implementation studies. The top-down school, including scholars such as Pressman and Wildavsky (1973: xv), Van Meter and Van Horn (1975: 445-488), Nakamura and Smallwood (1980: 7-10), and Sabatier and Mazmanian (1979: 481-504, 1980: 538-567, 1983: 143-169), conceived of implementation as the hierarchical execution of centrally-defined policy intentions. The other group of scholars, for instance, Lipsky (1971: 391-409, 1980: xi-xvi), Ingram (1977: 499-526), Elmore (1979-1980: 601-606), and Hjern and Hull (1982: 107), on the other hand, emphasized that implementation consists of what Lipsky (1980: xi-xvi) called everyday problem-solving strategies of "street level bureaucrats." The third generation of policy implementation scholars such as Elmore (1985: 33-70), Majone and Wildavsky (1978: 103-117), and Goggin, Bowman, Lester, and O'Toole (1990: 17-18) tried to bridge the gap between top-down and bottom-up approaches by incorporating the insights of both camps into their theoretical models. In addition, the main goal of the third generation research was to be more scientific than the previous two in its approach to implementation. Key scholars are summarized in Figure 1 below.

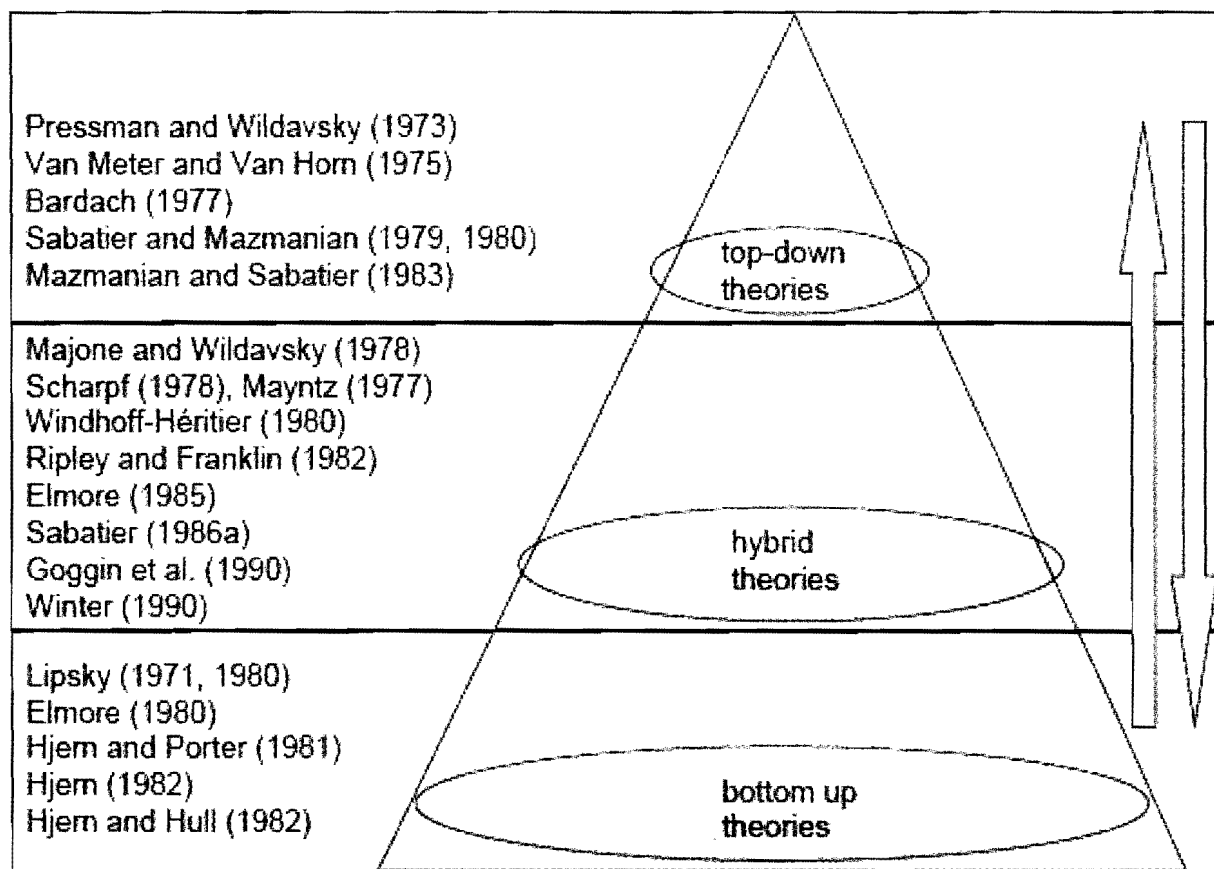


Figure 1 : Top-Down, Bottom-Up, and Hybrid Theories

Source: Puelzl and Treib, 2007: 91.

4. Factors Affecting the Performance of ICT Policy Implementation

This study integrates top-down theory and bottom-up theory of policy implementation and reviews the factors affecting the performance of policy implementation derived from academic implementation models and previous studies. It was concluded that a model of performance of policy implementation of ICT in education may be determined by three independent variables: policy conditions, characteristics of school directors, and characteristic of implementers-teachers and students. Policy conditions comprise three sub-variables: policy environments, policy objectives, and policy resources. Policy environments consist of political support, law enforcement, and the roles of regulating agencies.

Policy objectives cover policy continuity and clarity. Policy resources comprise human resource support and financial support. The characteristics of school administrators consist of transformational leadership style, policy commitment, and competency. The characteristics of teachers consist of English language skills, ICT skills, attitude towards ICT usage in education, ICT policy acceptance, and ICT policy commitment; on the other hand, the characteristics of students refer to English language skills, ICT skills, and attitude towards ICT usage in education. The performance of ICT policy implementation consists of output, outcome, and impact.

5. Research Methodology

The study is primarily based on the quantitative method. In addition, a qualitative approach using structural interviewing with selected schools is provided for insights into information that may not be obtained by the quantitative method.

The quantitative method begins with the unit of analysis, which is the upper-level secondary schools of the jurisdiction of general education of the OBEC. The population consists of all of the 2,645 secondary schools, of which 898 and 1,747 are from Group I and Group II, respectively. The sample size, with a 95% confidence level and a 5% sampling error, is 347 schools (Yamane, 1967: 886). The sampling process starts with the stratified sampling technique, in which total sampled schools are proportionally distributed into thirteen Offices of Strategy Management and Educational Integration (stratum), followed by a systematic random sampling technique to allocate the schools in the stratum to each province. Four forms of questionnaires are used for data collection regarding the characteristics of schools, teachers, students, and school

administrators, respectively. The questionnaires were tried out on 60 upper-level secondary schools of the jurisdiction of the general education of the OBEC in 25 provinces throughout Thailand to check wording and format, as well as to measure the reliability of the questionnaires. Descriptive statistics techniques such as percentage, mean, minimum, maximum, and standard deviation were used to explore the demographic data of schools, teachers, students, and school administrators. For the multivariate data analysis, a structural equation modeling (SEM) analysis was used. The main reasons that SEM is widely used in many scientific fields are the following: it provides a mechanism for explicitly taking into account measurement error in the observed variables (both dependent and independent variable) in a given model; it offers more flexible assumptions, e.g. allowing interpretation even in the face of multicollinearity; it performs confirmatory factor analysis to reduce measurement error by having multiple indicators per latent variable; it produces a graphical modeling interface for better model visualization; it covers testing the entire model rather than coefficient individually; and it performs model testing with multiple dependents and mediating variables, etc. (Garson, 2009). AMOS (Analysis of Moment Structures), a more recent statistical package, was selected for the SEM analysis because of its user-friendly graphical interface as an easier way of specifying structural models (Garson, *ibid.*). The t-test was used to evaluate the differences in means between two independent groups, i.e. Group I and Group II. All data-gathering instruments were translated into Thai and a five-point scale ranking from 1 (strongly disagree) to 5 (strongly agree) was used. For the univariate data analysis, the study presents every category or answer chosen; however, prior to the deployment of the multivariate analysis, it does not take into consideration the effect caused by the "3 (neutral)" answer (Pichit Pitaktepsombat and Watcharapon Supajakwattana, 2007: 21-31).

The qualitative method was added, by which a structural interview with school administrators, teachers, and students, as well as visual inspection of ICT practices in the schools, were conducted. The selection of schools interviewed was based on the purposive sampling of Group I and Group II schools in the Bangkok metropolitan area and covered three school sizes: large, medium, and small. There was a total of five out of six sampled schools in Bangkok, Nonthaburi, and Pratum Thani that participated in the interviewing.

6. Research Results

6.1 Quantitative Findings

There was a total of 286 schools, 143 schools and 143 other schools from Group I and Group II, returning completed questionnaires, constituting a 82.4% response rate. The figure is higher than an acceptable response rate for mailed questionnaires of at least 80% (Pichit Pitaktepsombat, 2007: 348).

6.1.1 School Characteristics

6.1.1.1 School size, number of teachers, telephone lines, and electricity

The majority of schools in Group I are medium sized (57.8%), followed by large size schools (28.9%). In contrast, the majority of schools in Group II are large size schools (50.7%), followed by medium size schools (28.3%). The average number of teachers in Group I and Group II was 55.39 persons and 82.75 persons, respectively. Both groups of schools were provided with telephone lines (97% and 95.9%), of which 75.2% and 64.1% were sufficient for ICT usage. The respondents of both groups reported a sufficient capacity of electricity (78.8%, 75% for Group II and Group I, respectively).

6.1.1.2 Availability of computer networks, Internet connection, speed of Internet connection, type of servers

Computer networks are available in schools for Group I and Group II. The majority of respondents (99.2%, 96.3%) are aware of the availability of computer networks in their school. In Group I, leased-line connections have the highest proportion (34.4%), followed by satellite (21.4%). The figures are also in the same direction for Group II, where leased-line connection has the highest proportion (36.6%), followed by satellite (22.8%). In regard to Internet connection speed, 88% of Group I and 67.9% of Group II deploy an Internet speed of 512 Kbps. The majority of schools use a Linux-based server (51.6% of Group I and 40.8% of Group II), followed by a Windows-based server (21.6%, 36.6%).

6.1.1.3 Computer networking, number of computers, performance of computers, school Web site, and learning management system

In regard to computer networking, 60.5% of Group I and 58.8% of Group II schools use both wire-line and wireless connection. The average number of computers in the schools of Group I and Group II was 103.46 units and 111.35 units, respectively. The majority of computers in the schools of Group I and Group II are Pentium IV (38.1%, 38.3%). At present Pentium IV computers are considered out-of-date; this means that more than half of computers in schools have limited capabilities for ICT application. The schools in Group I and Group II have their own Web site (93.1%, 87.8%), which is typically updated every week (38.7%, 34.6%). E-learning as found to be the most popular digital media from both groups (21.1%, 29%). In regard to the learning management system (LMS), the respondents of schools in Group I and Group II perceived that Moodle (Modular Object Oriented Dynamic Learning Environment) was the most popular LMS (73.7%, 50.5%).

6.1.1.4 Distribution of computers, computer service time, ICT services to the community, ICT development plans

The computers are distributed among three places: the computer laboratory, the library, and other places. The majority of schools in Group I and Group II extended computer service time beyond teaching time from Monday to Friday (62.4%, 65.1%). In view of providing computer services to the community, such as the Internet and ICT training, 81.3% of schools in Group I and 80.7% of Group II provide such services to the community. Both the Internet and ICT training services are frequently offered to the community (52.3%, 51.7%). Another interesting point is the ICT development plan; the majority of schools in Group I and Group II do have a plan (93.8%, 95.9%), where the most schools have a one-year plan (81.0%, 71.9%), followed by a three-year plan (8.3%, 17.0%).

6.1.1.5 ICT development team and ICT maintenance team

The ICT development team involved three groups: teachers, students, and ICT staff. The majority of respondents in Group I (94.70%, 93%, 78.30%) reported zero to ten development persons from teachers, students, and ICT staff, respectively. This is the same direction in Group II (95.80%, 94.40%, 65.30%), where there were zero to ten development persons among teachers, students, and ICT staff. Next, the number of ICT maintenance team members comprised teachers, students, and ICT staff. The majority of respondents in Group I and Group II (93.80%, 78.80%) reported that there was one to five ICT maintenance teachers. In contrast, 64.10% and 82.40% of respondents indicated zero maintenance students.

6.1.1.6 Frequency of ICT training and ICT budget

ICT training is provided for teachers (93.2%, 79.7%) and students (79.2%, 69.2%) for Group I and Group II schools. The average frequency of training for teachers was 1.79 times and 2.03 times per year, respectively. In

regard to the supporting budget for purchasing computer hardware and software, the average amount of budget for Group I and Group II was 192,147 Baht and 377,076 Baht per year, indicating that Group II has a higher supporting budget for purchasing new hardware and software. Furthermore, the average amount of the budget for the maintenance of computers for Group I and Group II was 71,740 Baht and 118,735 Baht per year—also indicating that schools in Group II have a higher supporting budget. The average amount of budget for Internet connection fees for Group I and Group II schools was 58,397 and 125,655 Baht per year, respectively. It can be concluded that schools in Group II have a higher supporting budget for paying Internet connection fees.

6.1.2 Teachers' Characteristics

The majority of respondent teachers from Group I and Group II were female (55.6%, 54%), with an average age of 38.43 and 38.32 years. A major portion of the respondents in Group I and Group II hold a bachelor degree (74.12%, 76.05%) and have more than 15 years of teaching experience (36%, 37.5%). The highest proportion of teacher respondents belong to the occupation and technology group (38.5%, 44.1%), followed by the sciences (18.5%, 20.3%). Group I and Group II teachers perceived that ICT is highly important for education (91.3%, 89.6%), followed by moderately important (8.7%, 10%). Group I and Group II respondents reported the highest adoption of knowledge obtained from using ICT in education (95.5%, 91.6%). Among eight learning substances, the proportion of teachers in the career/technology-related education of Group I and Group II exhibited the highest ICT adoption (38.8%, 41.3%), followed by science learning (20.5%, 19.4%). The respondents indicated that 65% and 60.8% of teachers in Group I and Group II, respectively, use ICT more than five hours per week, and 58.4% and 55% of them use ICT both at school and at home.

6.1.3 Students' Characteristics

There were slightly more female respondents than male respondents (55%, 54.5%). The majority of students in Group I and Group II were from grade 12 (57.4%, 48.2%) and used ICT between two to five hours per week (57.7%, 46.1%). The students used ICT at school (26.5%, 23.5%), followed by using ICT in two places—at school and at an Internet shop (25.8%, 21.3%). E-Books were considered the most popular digital content (34.7%, 32.6%), followed by a combination of e-Books and e-Learning. The Internet was the most used to acquire knowledge (59.1%, 58%), followed by a combination of using the Internet and electronic media (15.1%, 18.8%). The Intranet in schools had a low proportion of usage (3.8%, 3.1%). The respondents of Group I and Group II reported the highest adoption of knowledge obtained from ICT (90%, 85.9%). The proportion of students using ICT knowledge in Thai language learning group are the highest (45.8%, 55.5%), followed by science group (17.9%, 13.1%).

6.1.4 School Administrators' Characteristics

There were slightly more male school administrators (54.5%, 53.7%) than female ones (45.5%, 46.3%) in Group I and Group II, respectively. The majority of respondents were between 40 to 50 years old (38.20%, 39.10%), with an average age of 45.61 years and 45.68 years. The majority of them hold a bachelor degree (50.7%, 48.3%). The figures indicate that school directors have a higher educational degree than that of teachers. The respondents were the heads of the learning substance (51.40%, 54.10%), followed by deputy director (43.4%, 41.50%). The average teaching and administrating experience of school administrators in Group I and Group II was 20.49 years and 20.89 years, respectively. School administrators perceived that ICT was the most useful for education (94.1%, 91.5%), followed by moderately useful (5.2%, 6.5%). In addition, the respondents used ICT more than five hours per week (56.9%, 61.1%).

6.1.5 Data Analysis

A SEM analysis with AMOS version 6 was undertaken to explore the relationships among the determinants and the performance of ICT policy implementation in education. An evaluation of multicollinearity was successfully conducted, ensuring that it was possible to distinguish the effect of the independent variables on the dependent variable. The total sample size (n) of 286 schools was also higher than the minimum recommended sample size for SEM analysis of 200 (Hair, Black, Babin, Anderson, and Tatham, 2005: 741). The SEM analysis covers confirmatory factor analysis, model fitting, the evaluation of composite reliability, and the examination of the causal relationship in the model using path-coefficient analysis.

First, confirmatory factor analysis was employed for testing the causal relationships of the series of structural equations in the proposed model simultaneously. The criterion for accepting the model was that the factor loading of latent variables had to be higher than 0.3 (Kanlaya Wanichbuncha, 2003; 27-30). The results of confirmatory analysis are shown in Table 1, where none of factor loadings are below the cut-off figure of 0.3. It can be concluded that the items designed appropriately measured their respective latent variable.

Table 1: Confirmatory Factor Analysis of Factors and the Loading of Variables

	Policy condition (PCON)	Director characteristics (DCHA)	Teachers' and students' characteristics (TSCHA)	Performance of ICT policy implementation (PERFM)
Political support (PSUPP)	0.651			
Law enforcement (PLAWN)	0.701			
Roles of regulating agencies (PRREG)	0.685			
Clarity of policy (PPCON)	0.832			
Continuity of policy (PPCLA)	0.726			
Human resource support (PHUMA)	0.533			
Financial support (PFINN)	0.430			
Directors' commitment (DPCMT)		0.938		
Directors' ICT competency (DCMPY)		0.830		
Directors' Transformational leadership style (DLEAD)		0.790		
Teachers' English language skills (TENGL)			-0.443	
Teachers' ICT skills (TICTL)			-0.463	
Teachers' attitude towards ICT (TATTD)			0.441	
Teachers' acceptance of ICT policy (TACCT)			0.737	
Teachers' commitment to ICT policy (TCOMT)			0.899	
Students' English language skills (SENGL)			0.390	
Students' ICT skills (SICTL)			-0.333	
Students' attitude towards ICT (SATTD)			0.422	
OUTPUT				.811
OUTCOME				.704
IMPACT				.769

Second, the SEM analysis continues with the model fitting for accepting or rejecting a model. The assessment measures the extent to which the covariances predicted by the model correspond to the observed covariances in the data (Garson, *ibid.*). The output of SEM includes indices of the estimated relationships between variables in the model. Several scholars, e.g. Carmines and McIver (1981: 80), Bollen (1989: 303-316), Kline (1998: 130), McDonald and

Ho (2002: 64-82), and Schumacker and Lomax (2004: 82), have suggested the indices and criteria for testing of the model fit as summarized in Table 2 below.

Table 2 : Results of the Testing of Model Fit

Indices	Criteria	Statistical values obtained from analysis
1. Chi-square	P = 0.05	0.576
2. CMIN/DF	Range of 2 to 1	0.975
3. GFI	Close to 1	0.950
4. AGFI	Close to 1	0.931
5. NFI	Close to 1	0.930
6. IFI	=0.90	1.000
7. CFI	=0.90	1.000
8. RMR	< 0.05	0.047
9. RMSEA	< 0.05	0.000

Third, the SEM analysis advanced to the test of composite reliability or Raykov's reliability ρ_c , which refers to whether it may be assumed that a single common factor underlies a set of variables (Garson, *ibid.*). Raykov (1998: 375-385) argued and demonstrated that Cronbach's alpha may over- or under-estimate scale reliability, and concluded that ρ_c is preferred and may lead to higher estimates of true reliability. The acceptable cutoff for construct reliability would be the same as for Cronbach's alpha, i.e. 0.7, whereas the variance extracted shall not be below 0.5. Table 3 illustrates the composite reliability (ρ_c) and the averaged variance extracted (ρ_v) figures of all latent variables, indicating the model has no measurement problem; thus the examining of path coefficients proceeded.

Table 3 : Composite Reliability (ρ_c) and Average Variance Extracted (ρ_v)

Variables		ρ_c	ρ_v	R^2
DCHA	DPCMT	0.804	0.779	0.879
	DCMPY			0.689
	DLEAD			0.625
PCON	PSUPP	0.682	0.585	0.424
	PLAWN			0.491
	PRREG			0.469
	PPCLA			0.692
	PPCON			0.528
	PHUMA			0.285
	PFINN			0.185
TSCHA	TENGL	0.689	0.553	0.196
	TICTL			0.214
	TATTD			0.194
	TACCT			0.543
	TCOMT			0.809
	SENGL			0.152
	SICTL			0.111
	SATTD			0.179
PERFM	OUTPUT	0.671	0.609	0.657
	OUTCOME			0.495
	IMPACT			0.591

Finally, the SEM examined the causal relationship of the model using a path-coefficient analysis. Figure 2 demonstrates the inter-relationships among latent variables. It can be seen that all exogenous variables have an effect on the endogenous variables. For instance, the characteristics of teachers and students (TSCHA) has the highest direct effect on the performance of ICT policy implementation (PERFM) ($p < 0.05$, path coefficient 0.438), followed by

policy conditions (PCON), which have a direct effect on the characteristics of teachers and students ($p < 0.05$, path coefficient 0.417). Then, the director characteristics (DCHA) exert a direct effect on the characteristics of teachers and students ($p < 0.05$, path coefficient 0.336). Further, director characteristics (DCHA) have a direct effect on the performance of ICT policy implementation (PERFM) ($p < 0.05$, path coefficient 0.170), and policy conditions (PCON) have a direct effect on the performance of ICT policy implementation (PERFM) ($p < 0.05$, path coefficient 0.282). Table 4 presents a matrix of direct, indirect, and total effect, respectively.

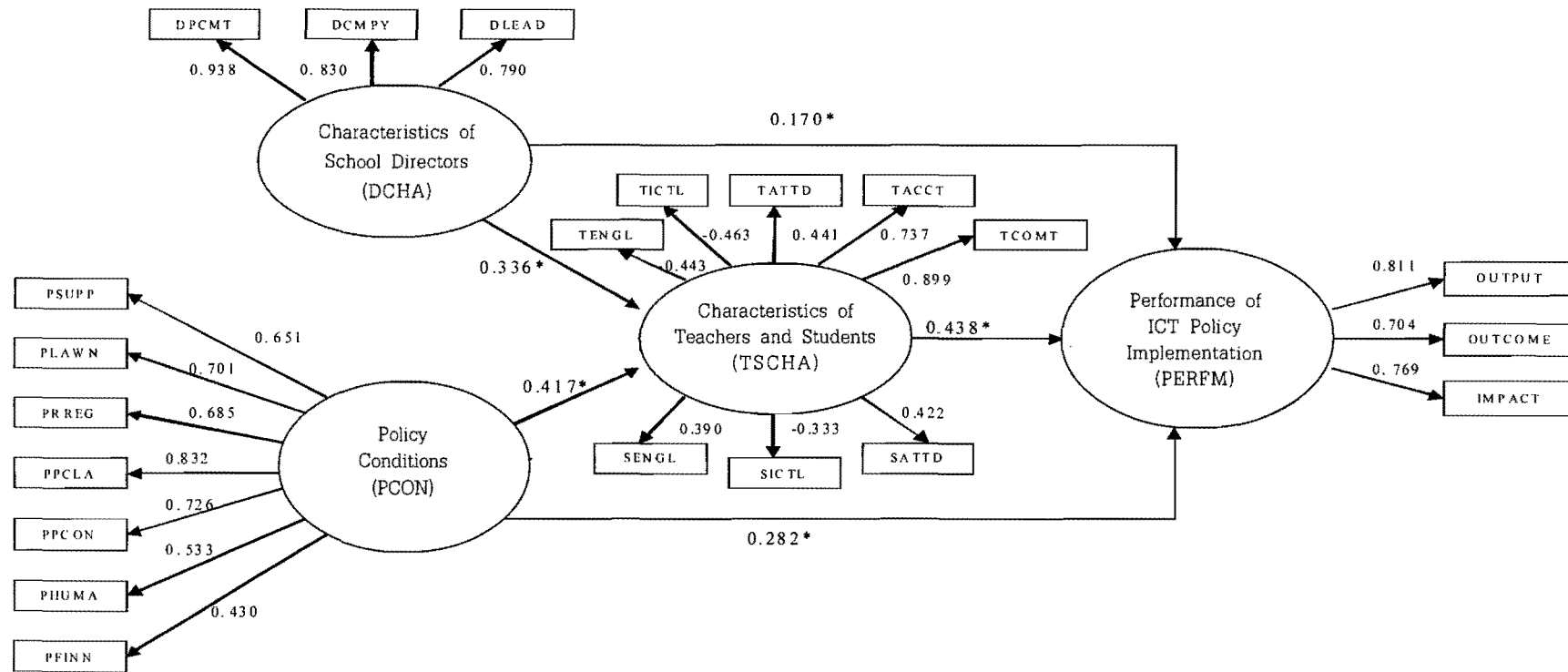


Figure 2 : Factor Loading and Path Analysis of the Model of Factors Affecting the Performance of ICT Policy Implementation in Education

Table 4 : Matrix of Direct Effect (DE), Indirect Effect (IE), and Total Effect (TE)

Dependent Variable	Effects	Independent Variables		
		Policy condition (PCON)	Director characteristic (DCHA)	Teacher and student characteristic (TSCHA)
Teacher and student characteristics (TSCHA)	DE	0.417	0.336	0.000
	IE	0.000	0.000	0.000
	TE	0.417	0.336	0.000
Performance of ICT policy implementation (PERFM)	DE	0.282	0.170	0.438
	IE	0.183	0.147	0.000
	TE	0.465	0.317	0.438

The structural equation of the dependent variables can be expressed as below:

$$TSCHA = 0.336* DCHA + 0.417* PCON ; R^2= 0.308 *P<0.05$$

Where:

TSCHA = Characteristics of Teachers and students

DCHA = Characteristics of School Director

PCON = Policy Condition

$$PERFM = 0.172* DCHA+0.282* PCON +0.438* TSCHA; R^2= 0.384$$

*P<0.05

Where:

PERFM = Performance of ICT Policy Implementation in education

DCHA = Characteristics of School Director

PCON = Policy Condition

TSCHA = Characteristics of Teachers and students

The coefficient of determination (R^2) of performance of ICT policy implementation indicates a figure of 0.384, or that 38.4% of the performance of ICT policy implementation in education is determined by policy condition, directors' characteristics, and teachers' and students' characteristics.

6.2 Qualitative Results

The findings that were obtained from the structural interviewing and visual inspection of ICT practices in the five participating schools are discussed below.

First of all, the school administrator and teacher respondents perceived high satisfaction regarding political support, rules and regulations, clarity of policy, and the roles of the supporting agency. Yet, they recommended that the policy be continuously implemented, and that financial and human resource support be more intensively delivered. Secondly, in terms of teacher characteristics, a school administrator elaborated that teachers must be aware that they play a key role in implementing ICT integration in school and articulation of ICT policy regarding that implementation. Teachers need to be involved in the integration of ICT in schools by modifying classroom practices with ICT. In addition, an ICT teacher respondent viewed that a measure to promote ICT implementation may come from the school director, who acts as an ICT role model in school. Routine ICT competitions among students at the school level or beyond are recommended to stimulate the initiative and creativity of students. Furthermore, as regards the problems of ICT implementation, a school administrator reported that the school director's vision towards ICT is the most important for the implementation of the policy in school. Teacher respondents mentioned that some older teachers are reluctant to adopt ICT in education because they are afraid of using computers and there have a negative attitude towards ICT. In terms of suggestions, a deputy director respondent

recommended that a separate entity ICT department in school be required to articulate effectively ICT in teaching and learning, and development of ICT-based educational services in school. Another school deputy director raised the issue of the impact of ICT implementation in education on the thinking skills of students by which knowledge can be easily accessible and available through the Internet. He pointed out that students tend to "cut and paste" ideas, information obtained from the Internet, in their assignment without assimilation. Lastly teacher respondents worried about ethical issues of the ICT usage of students in terms of plagiarism, use of illegal software, and pornography. They pointed out that the Internet is like a double-edged sword. On the one hand the Internet offers huge potential to improve educational standards, but on the other hand it can transmit dangerous materials to students. Some measures at schools have been carried out, for example, advising the use of citation whenever using somebody else's work or ideas; censorship or use of blocking or filtering software to prevent students from visiting inappropriate Web sites; and advising students to observe rules and regulations in using the Internet. But these are not enough. Parents need to help teachers guide students so that they are able to use the Internet to enrich their knowledge rather than spending time playing games or engaging in on-line chats with their friends, claimed the teacher respondents.

7. Hypothesis Testing

The three research questions were tested with fourteen hypotheses using two separated statistical techniques, including analysis of independent sample t-test and path analysis based on SEM with AMOS version 6.0.

The first research question, which was "Are there any differences in the levels and dimensions of the performance of ICT policy implementation in

education between Group I and Group II schools?" was explored. The data analysis indicated that the level of the performance of Group I was higher than Group II schools. With the t-test of four hypotheses, however, the differences of the level of the performance between Group I and Group II schools were not statistically significant at the confidence level of 95%.

In the second research question, which was "Are there any differences in the determinants of the performance of ICT policy implementation between Group I and of Group II schools?" three other hypothesis tests were conducted. First, one finding revealed that the average level of characteristics of school directors, which was a combination of ICT policy commitment, ICT competency, and transformational leadership in Group II, was higher than that of Group I. However, only the transformational leadership style of Group II schools was statistically different, at a confidence level of 95% ($p\text{-value} = 0.028$). In contrast, the average level of policy conditions in Group I was higher than that of Group II schools in one sub-variable; namely, the role of the regulating agency ($p\text{-value} 0.042$). Lastly, there was no statistical difference between the characteristics of teachers and students of Group I and Group II schools.

Regarding the third research question, "How do the determinants influence the performance of ICT policy implementation in education?" seven hypothesis tests were conducted. With a path diagram of SEM analysis, the following hypothesis tests were explored. First, the characteristics of teachers and students exhibited a significant direct and positive relationship with the performance of ICT policy implementation, with a path coefficient of 0.438 ($P < 0.05$). Next, policy conditions and the characteristics of school directors exerted a significant direct and positive relationship with the performance of ICT policy implementation, with path coefficients of 0.282, and 0.170, respectively ($P < 0.05$). Furthermore, policy conditions and the characteristics of school directors

had a significant direct and positive relationship with the characteristics of teachers and students, with path coefficients of 0.417 and 0.336, respectively ($P < 0.05$). Also, policy conditions had a significant indirect and positive relationship with the performance of ICT policy implementation, as mediated by teacher and student characteristics, with a path coefficient of 0.417, and an indirect effect of 0.183 ($P < 0.05$). Finally, the characteristics of school directors exhibited a significant indirect and positive relationship with the performance of ICT policy implementation, as mediated by teacher and student characteristics, with a path coefficient of 0.336 and an indirect effect of 0.147 ($P < 0.05$).

8. Discussion and Implications of Findings

This study highlights that the performance of ICT policy implementation in education is affected by two independent factors and a mediating factor. The study reveals that policy conditions, the characteristics of school directors, and the characteristics of teachers and students exhibit a direct and positive relationship with the performance of ICT policy implementation in education. The policy conditions and characteristics of school directors, as mediated by the characteristics of teachers and students, have an indirect and positive relationship with the performance of ICT policy implementation. All of these findings are consistent with previous research conducted in foreign countries and in Thailand.

In the international context, the findings that policy conditions affect the performance of ICT policy implementation in education confirm the top-down theory of policy implementation of Sabatier and Mazmanian (1979: 482-492), who argued that the model for effective implementation should include, among four other variables, clarity and consistency of policy objectives and

commitment of implementing officials to the program's goals. In addition, the findings supported an empirical study of Cheema and Rondinelli (1983: 16), who reported that the policy environment, including clarity and consistency of program objectives, appropriate allocation of functions, adequacy of budget, and availability of budgetary resources, affected successful decentralization programs in Asia. In regard to the implementers of the policy, the findings of this study confirmed the importance of the characteristics of school directors, teachers, and students, all of whom affect the performance of ICT policy implementation in education. Additionally, the findings supported the research of the bottom-up theory of Lipsky (1971: 391-409), who analyzed the effect of public service workers or street-level bureaucrats on the performance of policy implementation. Furthermore, the finding that teachers' characteristics affect the performance of ICT policy implementation is consistent with the previous study of Rogers (1995), who found that teachers' characteristics, e.g. experience with the computer for educational purposes, can influence the adoption of an innovation.

In the Thai context, the findings that the characteristics of school directors, teachers, and students affect the performance of ICT policy implementation exhibit the same association with several policy implementation models of Voradej Chandarasorn (2008: 129-146). For example, the findings support the bureaucratic process model (Voradej Chandarasorn, 2008: 137-139), that successful policy implementation relies on the decision-making process and working conditions of front line staff who directly come into contact with people, or the so-called street level bureaucrats (Lipsky, 1980: xi-xvi), because they can use their own judgment in their operations to a certain extent without control from their bosses. In addition, the findings that clarity of policy and continuity of policy affect the performance of ICT policy implementation confirm

the applicability of the rational model of Voradej Chandarasorn (2008: 130-132), who argues that successful policy implementation requires the clarification of goals and missions to assist implementers in defining the scope of their responsibilities according to policy objectives. Also, the findings that ICT competency and the ICT policy commitment of school directors affect the performance of ICT policy implementation in education are in-line with the management model of Voradej Chandarasorn (2008: 133-135), who states that successful policy implementation depends on: organizational capability, organizational structure, personnel, e.g. human competence and technical and administrative skill, budget, infrastructure, machinery, and equipment. Furthermore, the findings of this study correlate with the previous research of Lalida Chuayrak (2006: IV), who viewed a group of independent variables, including policy environment, policy objectives, and policy resources, variables that have a direct and positive relationship with the effectiveness of policy implementation of electronic government procurement (E-GP). In the same research, she reported that operating resources have a direct effect on the effectiveness of policy implementation.

It can be concluded that in order to increase the performance of ICT policy implementation in education, the major concern should be placed on the factors of policy conditions, the characteristics of teachers and students, and the characteristics of the school director. The better the support of these factors, the higher the performance of ICT policy implementation will be.

9. Limitations, Contributions, and Recommendations

9.1 Limitations

This study has some limitations. First, it was done only with upper-level secondary schools of general education of the OBEC; second, it limited ICT services to only computers and the Internet; third the study was seen as a snapshot of ICT policy implementation for the period of data collection during 2009-2010; and finally, the opinions obtained from the structural interviewing were only collected from five schools in the Bangkok metropolitan area.

9.2 Contributions

Some contributions of this study to the theory of policy implementation and models are as follows.

First, the study supports previous policy implementation in terms of bottom-up theory, for example, the works of Lipsky (1971: 391-409, 1980: xi-xvi), Ingram (1977: 499-526), Elmore (1979-1980: 601-606), and Hjern and Hull (1982: 107) regarding the involvement of street-level bureaucrats whose knowledge, comprehension, and understanding of proposed changes are very important for policy implementation. Implementers' disposition is a major reason why policies do not succeed or why perfect implementation is unattainable. In the Thai context, the study confirms the validity of several policy implementation models of Voradej Chandarasorn (2008: 129-146), e.g. the bureaucratic process model, and the management model. As well, the findings support the casual model proposed by Surang Weerakitpanich (2004: iv, 109) and Lalida Chuayrak (2006: iv). With these findings, the study not only confirms previous bottom-up theory but also enhances the theory that the characteristics of implementers

have contributed to the performance of ICT policy implementation in education in Thailand.

In addition, the study confirms the top-down theory of policy implementation of Sabatier and Mazmanian (1979: 482-492), who found that clarity and consistency of policy objectives, commitment of implementing officials to program goals, and support of interest groups and executives and legislative sovereigns affect the performance of policy implementation. The findings of this study also extend the validity of the rational model of Voradej Chandarasorn (2008: 130-132), that performance policy implementation requires the clarification of goals and missions to assist implementers in defining the scope of their responsibilities according to policy objectives.

9.3 Recommendations

The fourth objective of the study was to provide recommendations for further development of the performance of ICT policy implementation in education. Based on the quantitative data analysis and qualitative findings, the study recommends the following.

9.3.1 Recommendations for Policy Conditions

The policy conditions comprise three sub-variables: policy environment, policy objectives, and policy support. In particular regarding policy support in terms of financial support, the study revealed that the mean score of the financial support for Group I and Group II schools was the lowest among the other factors. It is recommended that there be following-up projects that focus on the provision of the higher capacity of ICT infrastructure for schools. Such ICT projects are, for instance, provision and budget allocation for technical resources, which often includes the amount and type of computer and multimedia hardware, Internet and computer networking resources, along with a budget for

educational software which would be needed to accomplish Thailand's ICT strategic goals. For example, the development of ICT infrastructure in school can be realized by enlarging the Internet connection circuit. As indicated in Section 6.1.1.2, 88% and 68% of the schools in Group I and Group II, respectively, have Internet connection at a speed of 512 Kbps. This capacity is shared among all of the students in the schools and is much lower than that of a recommended speed of at least 1Mbps for medium-size, upper-level secondary schools (Office of the Basic Education Commission, 2007: 182), whereas the majority of schools are medium size (57.8%) and large size (50.7%) for Group I and Group II, respectively (see Section 6.1.1.1). In addition, it was indicated in the in-depth interview that schools face problems of a slow response time from their Internet connection—leading to a longer wait time for data enquiry or knowledge searching on the Internet. Moreover, schools need to pay a monthly fee for Internet connection, which costs a lot. A strategic direction is recommended, that instead of relying on telecommunications operators for the Internet connection circuit, the MOE should build its own Information Superhighway using a high speed fiber optical cable network for each school. With this network, a high speed communication circuit up to several Gbps (at least 200 times faster than the present speed of 512 Kbps) is guaranteed. The schools would then not only obtain a higher-speed communication circuit but would also pay no rental fee. This approach may also solve the problem of inequity in the current distribution of these resources.

Further, the researcher wishes to recommend having an increasing rate of digital content that takes the uniqueness of the curricula or special school-made digital content into consideration in order to emphasize the development of digital content as part of ICT policy. This will increase the level of ICT implementation in education. As an example, in the interviews

with an ICT teacher respondent in Pratum Thani province, it was revealed that a web-based ICT program in a socially-oriented educational portal was organized as a community square that included a school-made digital content section created by numbers of school teachers and students, an online-journal, an e-Library, school news, and linkage to external knowledge centers.

9.3.2 Recommendations Concerning the Characteristics of Policy Implementers

The study found that the mean score of ICT skills and English language skills of teachers and students in Group I and Group II schools was quite low compared to the other characteristics. The teachers obtained an average ICT training of approximately two times per year. The qualitative data obtained from interviewing indicated that the trainings covered the operation of computers, some office software programs, and to some extent, basic training that consisted of e-Mail, Internet, and administrative uses. In order to improve the level of the performance of ICT policy implementation, it is recommended that, as the use of ICT progresses, teachers and students be trained in more advanced skills in how to efficiently integrate ICT into the curriculum and into everyday classroom practice. For example, a training program should provide the knowledge and skills needed to reform the pedagogical practices in schools, especially with regard to collaborative teaching and learning, networking, and teamwork. Also, it is recommended that advanced training and resources be offered for teachers and students in the areas of media and digital resource development, technology planning and evaluation, and specialized ICT applications in all eight learning substances.

Another recommendation that relates to the training of teachers and students would be the operational component regarding ongoing technical assistance, which teachers need not only during the early phases of ICT

implementation but as hardware and networking technologies become more sophisticated and educational applications become more complex. To be in line with teacher training, it is recommended that the ICT assistance team in school be increased not only to support teachers' operations and the connection of hardware and software, but also to help integrate the use of ICT across the full range of curricular subjects.

9.3.3 Recommendations for Further Study

First, it is recommended that further study be conducted between schools under different administrations. For instance, a cross-comparison study is proposed between schools under the centralized control of the jurisdiction of the general education of the OBEC and those municipal schools under the decentralized control of local administration organizations.

Second, it is recommended that the definition of ICT services be broadened to cover television and radio broadcasting in education.

In addition, further study may include a longer period of data collection, e.g. until the Lab School Project is closed. This might ensure the generalizability of the model.

Finally, further study is recommended to include more of the independent factors that would contribute to a higher degree of ICT policy implementation performance since the proposed model explains only 38.4% of the variation of the performance. This implies that additional factors need to be uncovered. Such factors may include, for example, a classroom environment that would help teachers to extend opportunities to integrate ICT in education, motivation and increasing the level of teachers' confidence in using ICT in education, or school strategies to integrate ICT in teaching and learning.

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