Policy Impacts on Pedagogical Practice and ICT Use:

An Exploration of the Results from SITES 2006

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Abstract

The SITES 2006 results reveal that principals' perceived presence of lifelong learning related pedagogical activities in their schools had changed markedly since the same data was collected in 1998 in SITES-M1. More intriguing was the fact that the directions of the changes were quite different depending on the education systems concerned – many of the Asian countries reported very high increases while some of the European countries reported large drops over the same eight year period. This paper reports statistical evidence that the observed "pendulum swing" reflects actual changes in teaching practices in these countries. Exploratory multilevel analyses results consistently show that national means of principals' vision can be used as a system level indicator predicting national means of pedagogical orientations in schools several years later. These findings also indicate the possibility of the "pendulum effect" being a consequence of system level policy differences in the countries participating in the two SITES studies.

Keywords: SITES 2006, lifelong learning, pedagogy, ICT in education, multilevel analyses, education policy impact

Introduction

The perceived role of ICT in the curriculum has moved through different phases since the early 1990s, as reflected by the descriptions of national policies and practices in over forty countries contained in these three edited volumes published over the past two decades: Plomp, Anderson, and Kontogiannopoulou-Polydorides (1996); Plomp, Anderson, Law and Quale (2003, 2009). The UNESCO (2008) policy framework provides a very succinct description of the changing trends – with the curriculum focus of ICT in schools moving from *technological literacy* as a subject to *knowledge deepening,* i.e. using ICT to improve the effectiveness of learning in different school subjects, to *knowledge creation,* i.e. leveraging ICT use as an agent of curriculum and pedagogical change to foster students' development of 21st century skills, which includes lifelong learning skills, creativity, communication and collaboration. In many education systems, major curriculum reform initiatives (e.g. EMB 2001; Tarragó 2009) and ICT specific masterplans (e.g. Singapore Ministry of Education 1997, 2002; Mallik 2009) have been launched since the turn of the millennium such that schools can adequately prepare their students for life in the knowledge economy. These documents generally recognize the need for changes not only in the curriculum goals, but also in the way learning and teaching is conducted, i.e. the pedagogical practices, to achieve those goals.

The above policy goals are accompanied in many countries by substantial investment in ICT infrastructure, internet connections, digital resources, technical and pedagogical support for teaching and learning, professional development and school leadership development of ICT in education (Plomp *et al.* 2003, 2009). Responses by the SITES 2006 National Research Coordinators to a national context questionnaire also indicate a substantial increase in the above areas of ICT-related spending in the

participating countries over the five years from 2001 to 2006 (Anderson & Plomp 2008). These policy initiatives have brought about clear improvements in ICT access in all the 22 education systems that participated in the SITES-M1 and SITES 2006 studies (Pelgrum, 2008). However, findings related to the possible changes in pedagogical practice in schools over the same period are more complex and nuanced. An indicator for *emerging pedagogical practices* was constructed in the SITES-M1 to reflect the extent to which students are taking responsibility to determine their own learning goals and learning pathways, working on open-ended projects in collaborative teams, creating knowledge products such as digital presentations and web pages instead of following a reproductive learning program. Comparing the SITES survey results collected from principals on perceived extents to which emerging pedagogical practices were present in their schools in 1998 and 2006, Pelgrum (2008) reports observed increases in some countries, particularly Asian countries such as Hong Kong SAR and Japan which reported very low presence in 1998, as well as big drops in Norway, Slovenia and Denmark, which reported relatively high presence of emerging practices in 1998. Figure 1 presents the relevant data in bar graph format, showing the "pendulum" effect of all countries moving towards a more similar value for their mean perceived presence of emerging pedagogical practice. If the policy rhetoric about the need for education to foster 21st century skills through more student-directed, inquiry oriented learning activities, then the reported increase in emerging practices in Asian countries can be interpreted as successful outcomes of such policies. However, the reported decrease in some European countries shows a trend reversal – that the emerging practices become even less prevalent. Commenting on the results from these European countries, Pelgrum (2008) remarked, *"… this finding prompts the question of whether, in those education*

systems, school management were no longer so certain that student-centered pedagogical approaches are relevant." (p. 112).

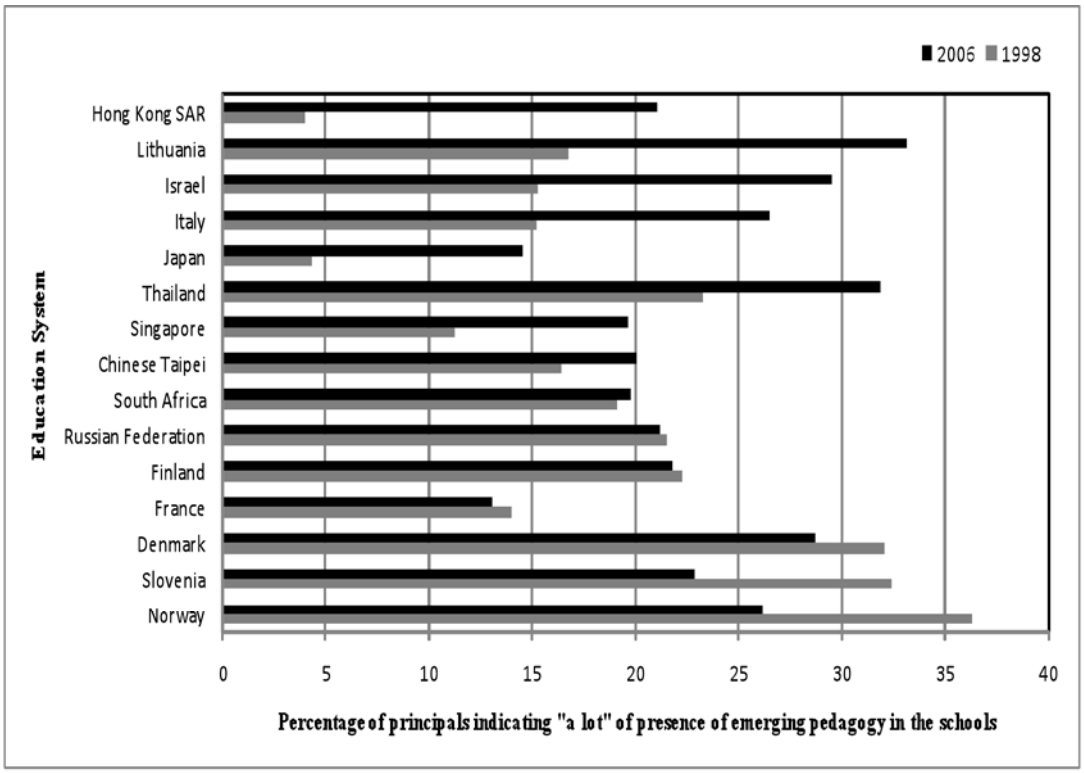

Figure 1 Percentages of school principals averaged over a set of items indicating "a lot" of presence of emerging pedagogy in SITES-M1 and SITES 2006 in countries that took part in both studies.

While there are many evaluation studies on the impact of ICT policy implementation that aim to inform both policy and practice (e.g. Harrison *et al.* 2002; Rudd *et al.* 2009, Jamieson-Proctor & Finger 2009; Ramboll Management 2006), cross-national comparative studies of policy impact on practice are rare and quantitative studies of such are not known. One major challenge to conducting such studies is the difficulties in getting comparable quantitative data on pedagogical practice across countries. The SITES-M1 and SITES 2006 studies offer the rare opportunity for quantitative exploration of policy impact on pedagogical change over the time period 1998 and 2006 because of the availability of pedagogical practice indicators across the countries participating in both studies. This paper reports on a study that takes

advantage of this opportunity to explore the following three research questions through a secondary analysis of the SITES-M1 and SITES 2006 data:

R1- Is there any evidence that the principals' perceived presence of emerging pedagogical practice in their schools actually reflect the pedagogical practice orientation of the teachers in their schools?

R2- Is there any evidence that the changes in some countries in the mean level of principals' perceived presence of emerging pedagogical practice in their schools between 1998 and 2006 as identified by Pelgrum (2008) relate in any way to policy differences in those countries?

R3- Is there any evidence that principals' vision has an impact on teachers' pedagogical practice, a claim that has often been made in the educational change literature reporting qualitative studies of educational innovation and change in general (e.g. Hargreaves & Fink 2005; Fullan 2007) and in changes involving the use of ICT in teaching and learning (e.g. Yee 2000; Owston 2003).

THEORETICAL UNDERPINNING

Current literature on educational change has highlighted the importance of learning and capacity building for successful change (Banathy 1991; Fullan, Cuttress & Kilcher 2005; Fullan 2007; Hargreaves & Fink 2003, 2004; Engeström 2005) and that school level factors have the strongest, most immediate influence on a teacher's practice. There is ample evidence in the literature that the vision of the principal is a major leadership factor influencing school development for change in classroom practices (e.g. Fullan 2007; Hargreaves & Fink 2005). Hence, in the present study, the principal's vision for ICT use to support lifelong learning practices in teaching and learning is taken as the school level factor influencing teachers' pedagogical practices.

However, teachers' pedagogical adoption of ICT is also influenced by factors beyond the school. Zhao and Frank (2003) report, in a study on uses of IT over time in 19 schools in four US school districts that implementations involving group or whole school initiatives were more effective in promoting renewal with IT in education if these were aligned with the school's strategic plan and supported by its leadership. Davis (2008) puts forward an ecological model for envisioning the various factors that impact on a teacher's adoption of IT in his/her classroom practices – a model in which the classroom is nested within the school, local area, region, and the global biosphere of education. Based on this theoretical framework, explorations on factors influencing ICT implementation should identify the level at which specific factors are supposed to operate. On the other hand, it is not easy to have data available for exploration simultaneously for all the various levels of the education ecology for statistical investigation to be possible. It is fortunate that in the case of the SITES data, these are collected based on a well-defined rigorous sampling design (Monseur and Zuehlke, 2009) in all the participating countries such that multilevel analyses of the different levels of factors are possible, and the design of which are presented in the next section.

RESEARCH DESIGN AND METHODOLOGY

As mentioned earlier, the present study is a secondary analysis of the international data collected from SITES-M1 and SITES 2006. SITES-M1 was a survey of three populations of schools conducted in 1998 defined in relation to three populations of students studying in: grades 4 to 6, grades 7 to 9 and grades 10 to last year of secondary education. The survey comprised of two questionnaires, one for principals and the other for technology coordinators. SITES 2006 was a study consisting of two surveys, one of schools with grade 8 students and similar to that conducted in SITES-

M1, and the other of mathematics teachers and science teachers teaching grade 8 students. The sampling for SITES 2006 was designed such that two to four Grade 8 mathematics teachers and two to four Grade 8 science teachers were independently and randomly selected from each of the participating schools, which were randomly sampled from each of the participating systems (Monseur & Zuehlke 2009). The collected data are thus hierarchically structured so that teacher data are nested within schools and school data are nested within education systems. This sampling design allows for multilevel analyses linking system, school and teacher level data (Law 2008).

Indicators included in the analyses

The focus for the present study is to explore the possible link between system level policy and changes in the presence of emerging pedagogical practices (i.e. practices conducive to the development of 21st century skills in students) in schools. Hence, indicators for pedagogical practice and vision need to be identified.

The SITES-M1 study conducted in 1998 was only a survey of schools and hence there was no indicator on pedagogical practice or teachers' vision directly gathered from teachers' responses. On the other hand, the principal questionnaires in SITES-M1 and SITES 2006 contain an identical question that asked, "To what extent is each of the following aspects of teaching and learning currently present in your school?" Responses to some of the aspects were computed to yield the two *principals' perceived presence of emerging pedagogical practices* indicators, *P-EMGPP98* and *P-EMGPP06* based on the data collected in SITES-M1 and SITES 2006 respectively (see Pelgrum 1999 and 2008 for details).

The SITES 2006 study included a teacher questionnaire that collected, among other things, information about teachers' pedagogical practice orientations. In designing the

teacher questionnaire, the research team took advantage of the accumulated research findings on features of pedagogical practices for promoting the development of 21st century sills, particularly from the 174 case studies of technology-supported pedagogical innovations collected in SITES-M2 (Kozma 2003). Hence, more refined indicators were developed on the basis of the concept of emerging pedagogy, including lifelong learning and connectedness which were defined to portrait 21st century pedagogical orientation (Law & Chow 2008). Indicators related to lifelong learning (*TP-LLL06*) and connectedness orientations (*TP-CON06*) were computed from teachers' likert-scale responses to items under the question "In your teaching of the target class in this school year, how often do you conduct the following activities" (IEA 2008).

Data related to principals' pedagogical vision were also collected in both SITES-M1 and SITES 2006. In SITE-M1, an indicator for *principals' vision for ICT-use to support emerging curriculum objectives* (*P-VISEM98*) was constructed based on responses to selected items for two questions in the principal questionnaire (Pelgrum 1999). A parallel indicator for *principals' vision for ICT use to support lifelong learning* (*P-VISLLL06*) indicator was constructed from one of the questions in the SITES 2006 principal questionnaire (Pelgrum 2008). The SITES 2006 teacher questionnaire collected information about teachers' pedagogical vision (Law and Chow, 2008) to provide an indicator for *teachers' vision for ICT use to support lifelong learning* (*T-VISLLL06*).

In addition to school and classroom level indicators, we also need indicators for system level policy. Based on the assumption that system level policies on classroom practice is most likely mediated through school level leadership, a possible indicator for system level policy on ICT use to support educational change for the development of 21st century skills is the system level mean of all the principals' vision for ICT use

to support lifelong learning practices in teaching and learning. Hence we have constructed two system level indicators *av_P-VISEM98* and *av_P-VISLLL06,* which are the system level means of the principals' vision *P-VISEM98* and *P-VISLLL06* collected in 1998 and 2006 respectively. Table 1 provides a summary of the indicators used in the analyses reported in this paper.

Table 1: A summary of the indicators used in the analyses reported in this paper and the related research questions

Indicators	Descriptions (no. and brief summary of items included in the indicator) and Cronbach's alpha reliability of indicator scale	Related research question
P-EMGPP98	Percentage of principals reporting a lot of presence of emerging pedagogical practices in their schools in 1998, scale comprising 6 items (mean scale values for each system taken from Pelgrum 2008, p. 109-110).	R2, R3
P-VISEM98	Principals' vision for ICT-use to support emerging curriculum objectives in 1998. Scale comprise 7 items (mean scale values for each system taken from Pelgrum and Anderson (eds), 1999, p. 298).	R2, R3 (only for computation of av_P-VISEM98)
P-EMGPP06	Percentage of principals reporting a lot of presence of emerging pedagogical practices in their schools in 2006. Scale comprises 6 items (α=0.662, for details see Law, Chow & Pelgrum, 2009, p.115).	R1, R2, R3
P-VISLLL06	Principals' vision for ICT use to support lifelong learning in 2006. Scale comprises 5 items (α=0.838, for details see Law, Chow & Pelgrum, 2009, p. 119)	R3
TP-LLL06	Lifelong learning teacher-practice orientation. Scale comprise 6 items (α=0.765, for details see Law, Chow & Pelgrum, 2009, p. 97-98).	R1
TP-CON06	Connectedness teacher-practice orientation. Scale comprises 3 items (α=0.689, for details see Law, Chow & Pelgrum, 2009, p. 97-98)	R1
T-VISLLL06	Teacher' vision to promote lifelong learning. Scale comprises 6 items (α=0.858) (, for details see Law, Chow & Pelgrum, 2009, p. 104-105)	R1
av_P-VISEM98	Mean level of Principals' vision for ICT-use to support emerging curriculum objectives in 1998 for an education system.	R2, R3
av_P-VISLLL06	Mean level of principals' vision for ICT use to support lifelong learning in 2006 for an education system.	R2, R3

ANALYSIS AND RESULTS

Each of the three research questions was explored using both exploratory and confirmatory methods. The methods of analysis and results are presented in this section.

Are principals' perceptions consistent with their teachers' reports?

The first research question is to find out if the principals' perceived presence of emerging pedagogical practices in their schools in 1998, *P-EMGPP98*, can be taken

as a reflection of teachers' pedagogical practice orientation in 1998 since no teacher level data was collected in SITES-M1. This research question is explored using school and teacher level data collected in 2006. First, an exploration was carried out through the construction of a scatterplot of the system level means of the principals' perception of the presence of emerging practices (*av_P-EMGPP06*) against the system level means of the level of adoption of lifelong learning teaching practices reported by mathematics and science teachers (*av_TP-LLL06*), presented in Figure 2. The results show visually a good linear relationship between these two parameters except for two countries, Chile and South Africa. These two countries have the lowest computer : student ratio among the 22 participating systems (Pelgrum 2008), which may explain why these two countries are outliers. In any case, because of this outlier behavior, data from these two countries are eliminated from our subsequent analysis.

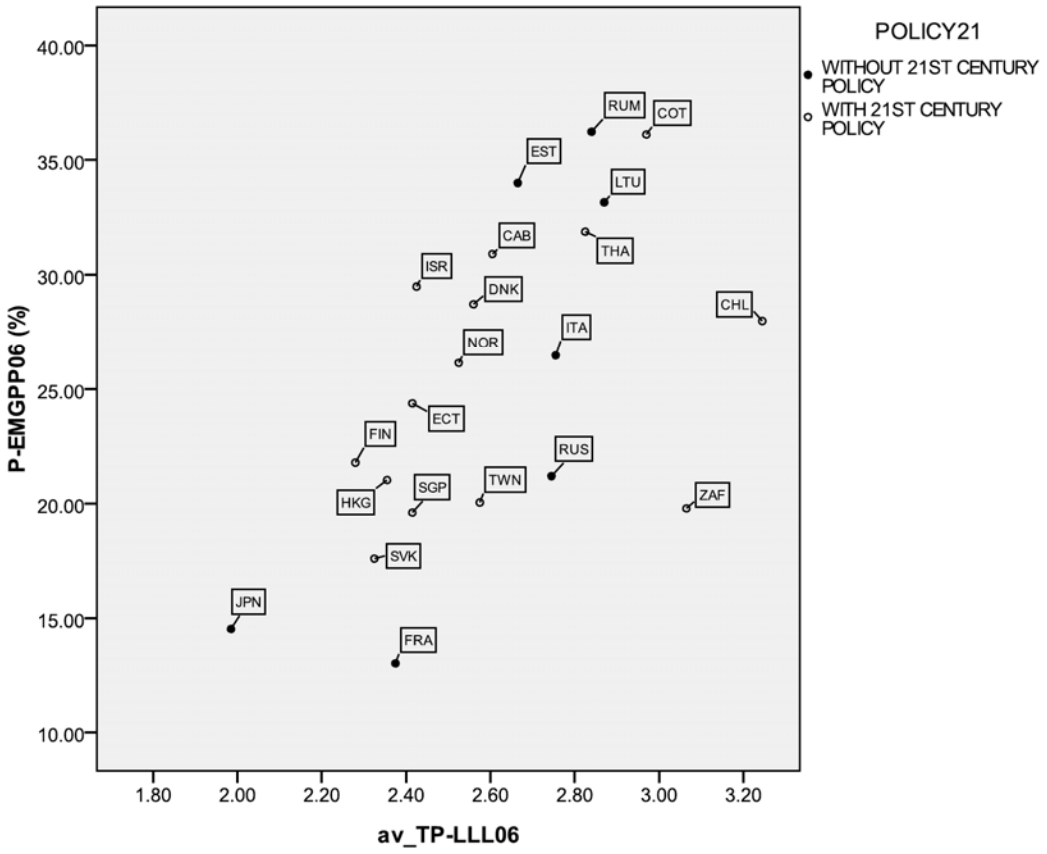

Figure 2 Scatterplot of the school principals' mean perceived presence of a lot of emerging practice in their schools with the respective mean level of adoption of lifelong learning teaching practice reported by mathematics teachers and science teachers.

SITES 2006 also collected information from the National Research Coordinators on whether their '*education system's policy documents promote approaches that mention "21st century skills"*. This information is also marked on Figure 2 to see if there appears to be a different relationship between *P-EMGPP06* and *TP-LLL06* whether such an explicit policy exists. It is clear from the display in Figure 2 that the relationship is not affected.

Correlation analysis was used as a second method to gain a statistically more rigorous understanding of the relationship between principals' vision and perception with teachers' espoused practices and vision. The results presented in Table 2 indicate statistically significant strong correlations between all six pairs of parameters. The highest correlations are found between principals' perception of a lot of emerging practices present in the school and teachers' reported extent of adoption of lifelong learning oriented teaching practice, with a Pearson correlation (γ) of 0.745 (p<0.01). The second highest correlation is found between principals' perception of a lot of emerging practices present in the school and teachers' vision to promote lifelong learning (γ = 0.675, p<0.01). Further, the principals' vision in using ICT to promote lifelong learning was also highly correlated with teachers' reported extent of adoption of lifelong learning and connectedness oriented teaching practices as well as teachers' vision to promote lifelong learning, with Pearson correlations of 0.578 (p<0.01) and 0.577 (p<0.01) and 0.647 (p<0.01) respectively.

Table 2 Correlations between system-level means of principals' perception and vision with teachers' reported teaching practices and vision[1]

	System level means of teachers' responses		
System level means of Principals' responses	TP-LLL06	TP-CON06	T-VISLLL06
P-EMGPP06	.745**	.563**	.675**
P-VISLLL06	.578**	.577**	.647**

Note:
** Correlation is significant at the 0.01 level (2-tailed)
[1] The correlations are computed only for 20 of the systems that participated in SITES 2006. South Africa and Chile are excluded.

System means of principals' vision as an indicator of policy emphasis – an exploratory analysis

The second research question is whether there is any evidence that the changes in some countries in the mean level of principals' perceived presence of emerging pedagogical practice in their schools between 1998 and 2006 as identified by Pelgrum (2008) relate in any way to policy differences in those countries? Altogether 16 education systems participated in both SITES-M1 and SITES 2006, which includes Chile and South Africa. Because of the outlier behavior of the latter two countries only 14 systems are included in the multilevel analysis involving the use of data from both studies. Table 3 summarizes the education systems that participated in SITES-M1, SITES 2006 and those included in the multilevel models explored reported in the later sections of this paper.

Table 3: Education systems included in the four multilevel models reported in this paper.

Education systems in SITES-M1 & SITES 2006	Abbreviation	SITES-M1	SITES 2006	Model			
				1a	1b	2	3
Belgium		✓					
Bulgaria		✓					
Canada		✓					
Alberta Province	CAB		✓			✓	
Ontario Province	COT		✓			✓	
Chile*	CHL		✓				
China Hong Kong	HKG	✓	✓	✓	✓	✓	✓
Chinese Taipei	TWN	✓	✓	✓	✓	✓	✓
Cyprus		✓					
Czech Republic		✓					
Denmark	DNK	✓	✓	✓	✓	✓	✓
Estonia	EST		✓			✓	
Finland	FIN	✓	✓	✓	✓	✓	✓
France	FRA	✓	✓	✓	✓	✓	✓
Hungary		✓					
Iceland		✓					
Israel	ISR	✓	✓	✓	✓	✓	✓
Italy	ITA	✓	✓	✓	✓	✓	✓
Japan	JPN	✓	✓	✓	✓	✓	✓
Lithuania	LTU	✓	✓	✓	✓	✓	✓
Luxembourg		✓					
New Zealand		✓					
Norway	NOR	✓	✓	✓	✓	✓	✓
Russian Federation	RUS	✓	✓	✓	✓	✓	✓
Moscow	RUM		✓			✓	
Singapore	SGP	✓	✓	✓	✓	✓	✓
Slovak Republic	SVK		✓			✓	
Slovenia	SVN	✓	✓	✓	✓	✓	✓
South Africa*	ZAF	✓	✓				
Spain Catalonia	ECT		✓			✓	
Thailand	THA	✓	✓	✓	✓	✓	✓

Note: *Data collected from Chile and South Africa are excluded in this study because low ICT-infrastructures were found in these two systems in the SITES 2006 survey.

As argued earlier, the system level means of the principals' vision for ICT use to support lifelong learning can be taken as an indicator for the strength of the corresponding system policy. There are two such indicators available, *P-VISEM98* and *P-VISLLL06*, collected from SITES-M1 and SITES 2006 respectively. A first exploration was conducted on each of these two indicators using scatterplots of system level means of principals' vision and teachers' reported practices in the lifelong learning orientation. We began with a scatterplot to display the difference in percentage of principals reporting a lot of presence of lifelong learning practices in their schools in 2006 and 1998 (i.e. *P-EMGPP06* - *P-EMGPP98*) against *av_P-*

VISLLL06, which is displayed in Figure 3. As can be seen from the results displayed, the data points are very scattered and a Pearson correlation analysis revealed no statistically significant relationship ($\gamma = 0.066$, $p>0.05$).

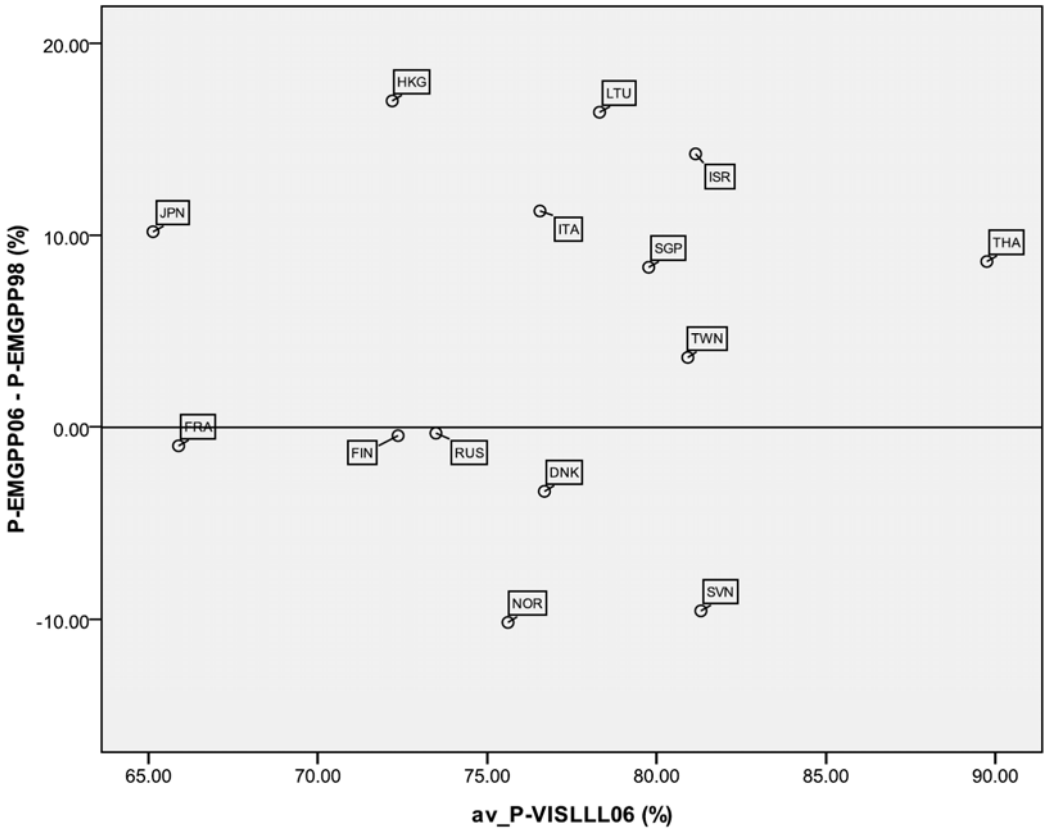

Figure 3 Scatterplot of the difference in percentage of principals reporting a lot of presence of emerging practices in their schools in 1998 and 2006 against the national means of principals' vision for ICT use to support lifelong learning in 2006.

These results led us to reconsider the relationship between policy and changes in pedagogical practice. In particular, policy changes take time to filter down to schools and classrooms. It is hypothesized that principals would be more directly exposed to implementation strategies from the government as schools participate in policy incentive schemes through the principal, and the principals are also accountable for the performance of their schools through the various monitoring mechanisms set up at the system level. Hence changes in principals' vision would probably be among the first school level conditions that change in response to system policy. It is expected

that principals would set up school level policies and strategies to implement their vision. Hence changes in classroom practice would lag behind policy changes at the system level. In order to explore whether this line of reasoning is worthy of further examination, we used the national means of principals' vision for ICT use to support lifelong learning practices collected in SITES-M1, (i.e. *av_P-VISEM98*) as the policy indicator to check whether this can explain the pendulum changes in perceived presence of emerging practices between 1998 and 2006.

Figure 4 displays the scatterplot of (*P-EMGPP06* - *P-EMGPP98*) against *av_P-VISEM98.* The results show a clear and much stronger positive relationship compared to results shown in Figure 3, with the exception of three outliers Japan, Hong Kong SAR, and Slovenia. Both Japan and Hong Kong SAR reported a much higher increase between 1998 and 2006 in the percentage of principals reporting a lot of presence of lifelong learning practices in their schools as would be expected based on those of countries having comparable values for their principals' espoused vision for ICT use to support emerging practices in 1998. The results for Slovenia deviated from the pattern of associated exhibited by the other countries in the other direction. It is not clear whether there are any particular contextual factors in these three systems that may explain for the outlier behavior observed. If the three outliers are removed, then a much stronger linear relationship can be found through a Pearson correlation analysis (γ =0.948, p<0.001).

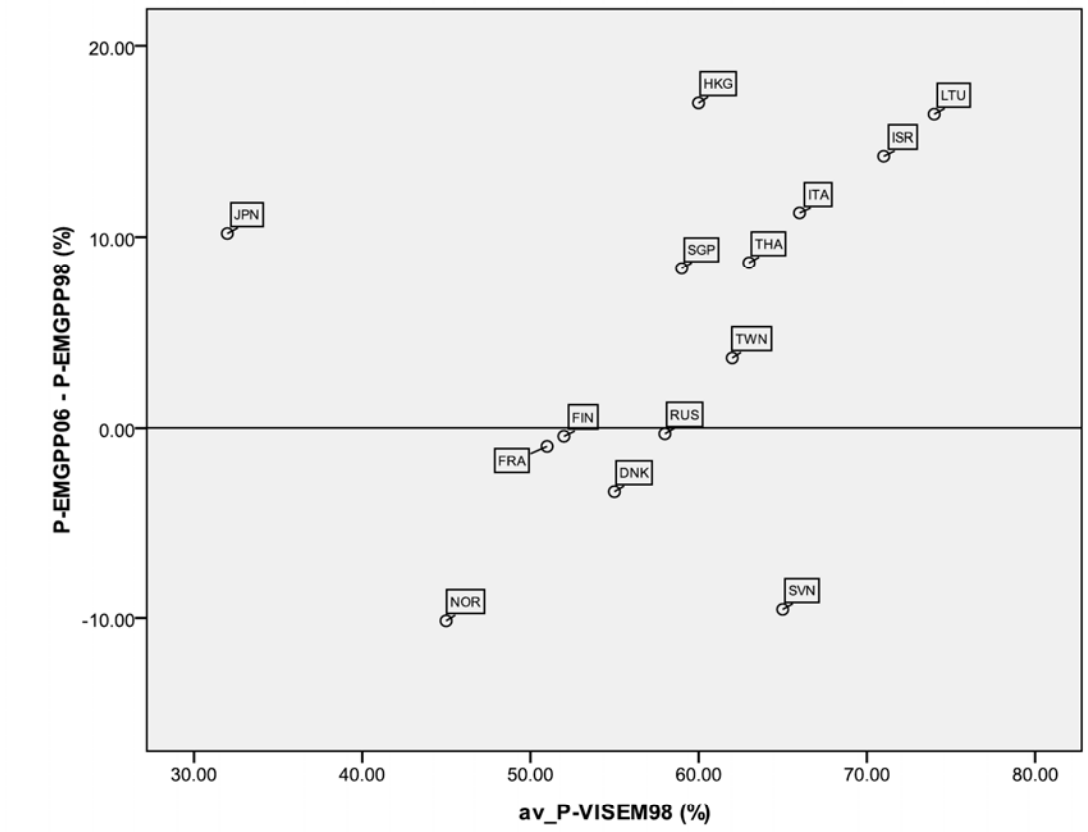

Figure 4 Scatterplot of the difference in percentage of principals reporting a lot of presence of lifelong learning practices in their schools in 2006 and 1998 against the national means of principals' vision for ICT use to support emerging practices in 1998.

To summarize, preliminary exploration through scatterplots and correlational analyses indicate that national means of school principals' vision for ICT use to support emerging/lifelong learning practices are delayed positive predictors for the observed changes in the national means of the principals' perceived presence of emerging practices in schools. On the other hand, the three outlier systems indicate that there are possibly other factors influencing pedagogical practice in schools than principals' vision and that such factors may differ greatly across countries.

System means of principals' vision as an indicator of policy emphasis – an exploration using multilevel analysis

Given the encouraging outcome of the preliminary exploration reported in the previous section, we then undertook multilevel analysis using the statistical package HLM (Raudenbush *et al.* 2004) to examine whether there is evidence that *av_P-VISEM98* is a statistically significant system level predictor for teachers' reported lifelong learning teaching practices in their classrooms. As we are only interested in exploring system level (level-3) predictors in this analysis, the level-1 (classroom level) and level-2 (school level) components of the model only contain random error terms. We started with *av_P-VISEM98* as the only level-3 predictor in this model. The findings from this analysis are presented in Table 4 under the row for Model 1a. It can be seen that *av_P-VISEM98* is a statistically significant positive predictor with a coefficient of 0.795 (p=0.000).

In order to pursue this analysis further, we tried to introduce another system level predictor, the system mean for the principals' vision for ICT use to support lifelong learning practices in 2006 (*av_P-VISLLL06)*. Table 4 under the row for Model 1b shows the output of this second 3-level model, indicating that the coefficient for *av_P-VISEM98* is still statistically significant (p=0.000), and slightly decreased to 0.721. On the other hand, the coefficient for *av_P-VISLLL06* is not statistically significant at all, confirming the results of the exploratory analysis reported earlier.

Table 4: Summary of the key results for Models 1a and 1b

Model	Dependent Variable	Level-1	Level-3	
		Model Intercept	Coefficient for *av_P-VISEM98*	Coefficient for *av_P-VISLLL06*
1a	TP-LLL06	0.084* (0.031)	0.795*** (0.066)	---
1b	TP-LLL06	0.089* (0.031)	0.721*** (0.106)	0.091 (0.071)

Note: $^{*}p < 0.05$ (2-tailed); $^{***}p < 0.001$ (2-tailed); *s.e.* in bracket; $N = 14$

To summarize, our analyses have indicated that countries with a stronger lifelong learning related policy indicator in 1998 have reported a much greater increase in lifelong learning related teaching practices between 1998 and 2006, while those countries with a low lifelong learning related policy indicator in 1998 have reported decreases in lifelong learning related teaching practices during those eight years. However, as we do not have any other system level policy indicator beyond *av_P-VISEM9* and *av_PVISLLL06*, we have no clue as to the length of delay for policy influence on classroom practice to peak. The findings indicate that there is a delayed effect and that the policy influence is still statistically significant eight years after.

Exploring the impact of principals' vision as school level indicator on teachers' pedagogical practice

Our third research question is whether principals' vision has an impact as school level factor on teachers' pedagogical practice. A multilevel model was constructed (Model 2) to explore of this question using *P-VISLLL06* as a school level (level-2) predictor of teachers' reported lifelong learning teaching practice (*TP-LLL06*) at the classroom level (level-1). Table 5 shows the key results from the HLM model output, which indicates that principals' vision for ICT use to promote lifelong learning practices are positive school level predictors of lifelong learning teaching practices of the surveyed teachers (β=0.065, p<0.001). In other words, teachers are more likely to adopt a lifelong learning pedagogical orientation in their classroom practices if the principals in their own schools have a vision to promote lifelong learning using ICT.

Table 5: Summary of the key results for Model 2

Model	Dependent Variable	Level-1	Level-2
		Model Intercept	Coefficient for *P-VISLLL06*
2	TP-LLL06	0.472^{***} (0.028)	0.065^{***} (0.012)

Note: $^{***}p < 0.001$; *s.e.* in bracket; $N = 20$

Exploring principals' vision as indicators at both system policy and school levels

In the previous sections, we have separately reported on the use of *av_P-VISEM98* and *av_P-VISLLL06* as system level predictors and *P-VISLLL06* as school level predictor for teachers' reported lifelong learning teacher practices (*TP-LLL06*). In this section, we report on a further multilevel analysis to explore when *P-VISLLL06* is added as a school level predictor to Model 1a (to become Model 3), whether both the level 2 and level 3 predictors will still remain statistically significant. Table 6 shows the key results from the HLM model output, which indicate that both the school level predictor *P-VISLLL06* and the system level predictor *av_P-VISEM98* have statistically significant coefficients. This is a very pleasing finding in that we have been able to demonstrate confirmatory statistical support that the effect of system level policy is mediated through principals, and that the national average of principals' vision can be used as a system level predictor with delayed effect in statistical modeling.

Table 6: Summary of the key results for Model 3

Model	Dependent Variable	Level-1	Level-2	Level-3
		Model Intercept	Coefficient for *P-VISLLL06*	Coefficient for *av_P-VISEM98*
3	TP-LLL06	0.071^{*} (0.030)	0.063^{***} (0.011)	0.734^{***} (0.064)

Note: $^{*}p < 0.05$ (2-tailed); $^{**}p < 0.01$ (2-tailed); $^{***}p < 0.001$ (2-tailed); *s.e.* in bracket; $N = 14$

SUMMARY AND DISCUSSIONS

In this paper, we have used both exploratory and confirmatory statistical methods to investigate whether there is evidence based on the data collected in SITES-M1 and SITES 2006 that system level policy influences teachers' adoption of lifelong learning practices in classrooms. This exploration is stimulated by the observation of an apparent "pendulum swing" in the percentage of principals reporting a lot of emerging/lifelong learning practices in their schools between 1998 and 2006. A

substantial decrease was observed in some European countries, Slovenia, Norway and Denmark. On the other hand, a substantial increase was observed in all the participating Asian countries. This is a very surprising finding since the policy rhetoric in both European and Asian countries emphasize on the need for education to prepare students for lifelong learning in order to face the challenges brought about by globalization and the knowledge economy. The statistical investigations reported in this paper seem to confirm the possibility that the pendulum swing is associated with differences in national education policies in the countries concerned, which suggests that deeper explorations involving comparative policy analyses are warranted. Such analysis is outside the scope of this paper. However, just to demonstrate that this line of investigation is likely to be a fruitful one and to stimulate research in this area, we report in this closing section some preliminary features of the ICT-related policies in Japan, Singapore, Denmark and Norway gathered through a review of literature that seem to indicate that some substantive differences in the education policy and implementation in these countries which may have contributed to the observed pendulum swing.

In both Japan and Singapore, since the end of the last millennium, there has been a consistent and focused set of policy initiatives involving curriculum, infrastructure, professional development and support strategies to encourage and support ICT-use for lifelong learning oriented teaching and learning. The national ICT policies and practices in Japan described by Shimizu *et al.* (2003) and Sakayauchi, Maruyama and Watanabe (2009) indicate a consistent focus on reforms in curriculum structure through the introduction of new, cross-disciplinary subjects and increasing support for ICT use in schools to support lifelong learning and learning beyond the school walls: the “100-schools Networking Project” launched in 1997, the introduction of a cross-disciplinary compulsory subject “Integrated Study” in 1998, the introduction of

"Information" subjects to lower and upper secondary schools in 2002 and 2003, the launch of the "e-Japan Strategy" in January 2001 from which an e-learning component was developed in 2006 to focus on social reform through ICT and integrated learning between school and lifelong learning. Yeo, Kan and Tham (2003) and Koh, Lee and Foo (2009) document the specific policy and implementation details for the two ICT in Education Masterplans in Singapore, launched in 1997and 2003 respectively, showing that both Masterplans were developed in the context of wider educational reform goals under the slogan "*Thinking Schools, Learning Nation*" (TSLN). Implementation strategies include the launched of Intelligent Nation 2015 (iN2015) with a focus on equipping teachers with a wider repertoire of ICT-based pedagogies and competencies, and the FutureSchools@Singapore project launched in 2007 to foster innovations in curriculum, instruction, and assessment by fully leveraging ICT to bring about engaged learning for students.

In Denmark and Norway, there have also been very strong education policy support and investment programmes to promote digital literacy and readiness for the information age (Ottestad 2009). However, Bryderup, Larson & Trentel (2009) report a change in educational policy in Denmark where a mostly reform-oriented policy is being replaced by an increased interest in tests and subject-related matters, which may account for the decrease in that the presence of reform-oriented practice as reported by principals in Denmark. This is echoed by Larson's (2009) report of increasing control over what is learned through more precise descriptions of the curricula at both national and institutional levels and expanding use of tests and examinations. The ICT in education policies in Denmark have been focusing on how ICT integration can enhance the understanding and development of curriculum subjects, and hence lie in the realm of knowledge deepening rather than knowledge creation based on the UNESCO (2008) definition. There is a strong emphasis on the attainment of high

academic standards as measured by tests and examinations (Danish Ministry of Education, 2007). The presence of competing policy foci and strategies is similarly evident in Norway. There is a strong emphasis on digital literacy and a continuing interest in leveraging ICT to bring about new forms of learning and assessment (as evidenced by Norway's active participation in the OECD New Millennium Learners project, see Pedró, 2006), and at the same time a strong focus on the importance of having substantial basic skills as one main element of lifelong learning, as well as a focus on assessment through tests and examinations. Hence, in both Denmark and Norway, there appears to be competing policy priorities, which impose demands on teachers that might have discouraged the adoption of lifelong learning practices by teachers.

To conclude, the findings reported in this paper provide statistical and documentary evidence that the "pendulum swing" observed in the percentage of principals reporting a lot of emerging/lifelong learning practices in their schools between 1998 and 2006 is related to system level policy. There is also statistical evidence that principals' vision can be used as a mediating factor through which system level policy impacts on classroom pedagogical practices. The use of national means of principals' vision as an indicator of system level factor in multilevel analysis is a methodological innovation (or experiment). Preliminary results show that the use of this indicator sheds valuable insight on empirical observations of perceived changes in practice, including evidence that there is a delayed effect of policy on practice. However, we are very much aware that this study is a preliminary exploration, both methodologically and in providing a substantive understanding of policy changes and their impacts on practice. We hope that this study will stimulate further research on the problems explored in this paper as well as methodological debates and discussions on quantitative explorations of educational policy.

REFERENCES

Anderson R. E. & Plomp, T. (2008) National contexts. In N. Law, W. J. Pelgrum & T. Plomp (Eds.), *Pedagogy and ICT in schools around the world: findings from the SITES 2006 study* (pp. 37-66). Hong Kong: CERC and Springer.

Banathy, B. H. (1991). *Systems design of education: A journey to create the future*. Englewood Cliffs, NJ: Educational Technology Publications.

Bryderup, I. M., Larson, A., & Trentel, M. Q. (2009). ICT-use, educational policy and changes in pedagogical paradigms in compulsory education in Denmark: From a lifelong learning paradigm to a traditional paradigm? *Education and Information Technologies, 14*(4), 365-379

Danish Ministry of Education. (2007) *Denmark's strategy for lifelong learning*. Copenhagen: Author.

Davis, N. (2008). How May Teacher Learning Be Promoted For Educational Renewal With IT? In J. M. Voogt & G. Knezek (Eds.), *International Handbook of Information Technology in Primary and Secondary Education*. New York: Springer.

EMB (Education and Manpower Bureau HKSAR) (2001). *Learning to Learn - The Way Forward in Curriculum*. Retrieved 11/09/2009 from http://www.edb.gov.hk/index.aspx?langno=1&nodeID=2877.

Engeström, Y. (2005). *Developmental work research: Expanding activity theory in practice*. Berlin: Lehmanns Media.

Fullan, M. (2007) *The new meaning of educational change*. New York: Teacherís College Press.

Fullan, M., Cuttress, C., & Kilcher, A. (2005). Eight Forces for Leaders of Change: Presence of the Core Concepts Does Not Guarantee Success, but Their Absence Ensures Failure. *Journal of Staff Development, 26*(4), 54-64.

Hargreaves, A., & Fink, D. (2003). Sustaining leadership. *Phi Delta Kappan, 84*(9), 693-700.

Hargreaves, A., & Fink, D. (2004). The seven principles of sustainable leadership. *Educational Leadership, 61*, 8-13.

Hargreaves, A. & Fink, D. (2005) Sustainable leadership. *The essentials of school leadership*, 173-189.

Harrison, C., Comber, C., Fisher, T., Haw, K., Lewin, C., Lunzer, E. *et al.* (2002) *ImpaCT2 The Impact of information and communication technologies on pupil learning and attainment*. London: Becta.

Jamieson-Proctor, R., & Finger, G. (2009). Measuring and Evaluating ICT Use: Developing an Instrument for. In L. Hin & R. Subramaniam (Eds.), *Handbook of Research on New Media Literacy at the K-12 Level: Issues and Challenges* (pp. 326-339): Information Science Reference.

Koh, T. S., Lee, S. C., & Foo, S. F. (2009). National Policies and Practices on ICT in Education: Singapore. In T. Plomp, R. E. Anderson, N. Law & A. Quale (Eds.), *Cross-national Information and Communication Technology Policy and Practices in Education* (2nd ed., pp. 601-618). Greenwich, CT: Information Age Publishing Inc.

Kozma, R. B. (2003) *Technology, innovation, and educational change: A global perspective*. Eugene, OR: International Society for Technology in Education.

IEA (2008) SITES 2006 Questionnaire. International Association for the Evaluation of Educational Achievement. Retrieved 14/9/2009 from http://www.sites2006.net/exponent/index.php?section=37

Larson, A. (2009). National Policies and Practices on ICT in Education: Denmark. In T. Plomp, R. E. Anderson, N. Law & A. Quale (Eds.), *Cross-national Information and Communication Technology Policy and Practices in Education* (2nd ed., pp. 237-255). Greenwich, CT: Information Age Publishing Inc.

Law, N. (2008). In Search of Explanations. In N. Law, W. J. Pelgrum & T. Plomp (Eds.), *Pedagogy and ICT in schools around the world: findings from the SITES 2006 study* (pp. 251-262). Hong Kong: CERC and Springer.

Law, N. & Chow, A. (2008) Pedagogical Orientations in Mathematics and Science and the Use of ICT. In N. Law, W. J. Pelgrum & T. Plomp (Eds.), *Pedagogy and ICT in schools around the world: findings from the SITES 2006 study* (pp. 121-179). Hong Kong: CERC and Springer.

Law, N., Chow, A., & Pelgrum, W. J. (2009). Scale and Indicator Construction for the School and Teacher Levels. In R. Carstens & W. J. Pelgrum (Eds.), *IEA SITES 2006 Technical Report* (pp. 93-125). Amsterdam: IEA.

Mallik, U. (2009). National Policies and Practices on ICT in Education: India. In T. Plomp, R. E. Anderson, N. Law & A. Quale (Eds.), *Cross-national Information and Communication Technology Policy and Practices in Education* (2nd ed., pp. 369-381). Greenwich, CT: Information Age Publishing Inc.

Monseur, C., & Zuehlke, O. (2009). Sampling Design. In R. Carstens & W. J. Pelgrum (Eds.), *Second Information Technology in Education Study SITES 2006 Technical Report* (pp. 93-125). Amsterdam: IEA.

Ottestad, G. (2009). *Innovative pedagogical practice with ICT in three Nordic countries - Differences and similarities*. Paper presented at the Annual Conference of the American Education Research Association.

Owston, R. (2003). School context, sustainability and transferability of innovation. In R. Kozma, J. Voogt, W. Pelgrum, R. Owston, R. McGhee, R. Jones, R. Anderson (Ed.), *Technology, Innovation, and Educational Change: A Global Perspective* (pp. 125-161). Eugene, OR: ISTE.

Pedró, F. (2006) *THE NEW MILLENNIUM LEARNERS: Challenging our Views on ICT and Learning*. Paris: OECD-CERI.

Pelgrum, H. (1999). Curriculum and Pedagogy. In H. Pelgrum, & Anderson, R. (Ed.), *ICT and the Emerging Paradigm for Life Long Learning* (pp. 89-117). Amsterdam: IEA.

Pelgrum, W. (2008) School Practices and Conditions for Pedagogy and ICT. In N. Law, W. J. Pelgrum & T. Plomp (Eds.), *Pedagogy and ICT in schools around the world: findings from the SITES 2006 study* (pp. 67-120). Hong Kong: CERC and Springer.

Pelgrum W. J. & Anderson, R. E. (eds.) (1999) *ICT and the Emerging Paradigm for Life Long Learning: a Worldwide Educational Assessment of Infrastructure, Goals and Practices*. Amsterdam: IEA.

Plomp, T., Anderson, R. E. & Kontogiannopoulou-Polydorides, G. (1996) *Cross national policies and practices on computers in education*. Dordrecht, Netherlands ; Boston, MA: Kluwer Academic Publishers.

Plomp, T., Anderson, R. E., Law, N. & Quale, A. (Eds.) (2003) *Cross-national Information and Communication Technology Policies and Practices in Education*. Greenwich, CT: Information Age Publishing.

Plomp, T., Anderson, R. E., Law, N. & Quale, A. (Eds.) (2009) *Cross-national Information and Communication Technology Policies and Practices in Education*, 2nd edition. Greenwich, CT: Information Age Publishing.

Ramboll Management (2006) *Elearning Nordic 2006: Impact of ICT on Education*. Denmark: Ramboll Management.

Raudenbush, S., Bryk, A., Cheong, Y. F., Congdon, R. & du Toit, M. (2004) *HLM 6: Hierarchical Linear and Nonlinear Modelling*. Lincolnwood: SSI Scientific Software International.

Rudd, P., Teeman, D., Marshall, H., Mundy, E., White, K., Lin, Y., *et al.* (2009) *Harnessing Technology Schools Survey 2009 Analysis report*. Coventry: Becta.

Sakayauchi, M., Maruyama, H. & Watanabe, R. (2009) Cross National policies and practices on ICT in education: Japan. In T. Plomp, R. E. Anderson, N. Law & A. Quale (Eds.), *Cross-national Information and Communication Technology Policies and Practices in Education* (2nd ed., pp. 441-457). Greenwich, CT: Information Age Publishing Inc.

Shimizu, K., Watanabe, R., Shimizu, Y., Miyake, M., Yamade, K., Horiguti, H., *et al.* (2003) National policies and practices on ICT in education: Japan. In T. Plomp, R. E. Anderson, N. Law & A. Quale (Eds.), *Cross-national Information and Communication Technology Policies and Practices in Education*, (pp.335-355). Greenwich, CT: Information Age Publishing.

Singapore Ministry of Education (1997). Masterplan for IT in Education. Retrieved 1/3/2006 from http://www.moe.gov.sg/edumall/mpite/index.html

Singapore Ministry of Education (2002). Masterplan II for IT in Education. Retrieved 1/3/2006 from http://www.moe.gov.sg/edumall/mp2/mp2.htm

Tarragó, F. R. (2009). National Policies and Practices on ICT in Education: Catalonia (Spain). In T. Plomp, R. E. Anderson, N. Law & A. Quale (Eds.), *Cross-national Information and Communication Technology Policy and Practices in Education* (2nd ed., pp. 135-152). Greenwich, CT: Information Age Publishing Inc.

UNESCO (2008) *ICT Competency Standards for Teachers: Policy Framework*. Paris: UNESCO.

Yee, D. (2000) Images of school principals' information and communications technology leadership. *Technology, Pedagogy and Education, 9*(3), 287-302.

Yeo, H. M., Kan, E., & Tham, Y. C. (2003). National Policies and Practices on ICT in Education: Singapore. In T. Plomp, R. E. Anderson, N. Law & A. Quale (Eds.), *Cross-national Information and Communication Technology Policies and Practices in Education*. (pp. 495-508) Greenwich, CT: Information Age Publishing.

Zhao, Y., & Frank, K. (2003). Factors Affecting Technology Uses in Schools: An Ecological Perspective. *American Educational Research Journal, 40*, 807--840.