ICT IN EDUCATION POLICY AND PRACTICE IN CHILE: DOES IT CORRELATE?

J. Enrique Hinostroza, Mario Brun
ehinost@iie.ufro.cl; mario.brun@iie.ufro.cl
Institute for ICT in Education
University of La Frontera
Centre for Research on Educational Policy and Practice (CEPPE)[1]
Temuco, Chile

ABSTRACT

SITES 2006 was an international comparative survey on ICT in education aimed at examining the extent of technologies integration in schools and classrooms, and identifying factors contributing to effective inclusion of ICT into learning and teaching. The study administered questionnaires for school principals, ICT-coordinators and math and science teachers. SITES 2006 also administered a national context questionnaire including four clusters of system level questions, viz demographics, education system, pedagogical trends, ICT-related policies. The rationale for this questionnaire was that it is reasonable to expect what happens in schools and classrooms, reflects system-level policies. Data from this questionnaire assist in interpreting patterns at school and classroom level. This paper is one of a set of three case studies of countries that participated in SITES 2006 (namely Chile, South Africa and Australia) all addressing the general question: *to what extent are national ICT- related policies implemented at the school and classroom levels and what factors enable this implementation?*

In this framework this paper presents the main results of Chile in the SITES2006 study regarding the presence of traditional and innovative pedagogical practices with and without ICT in schools, and analyses to what extent factors affecting the implementation of these practices that were found in the international study (i.e. infrastructure, technical and pedagogical support and ICT-related vision) are affecting –or not- the national results. Based on this, the paper also reviews to what extent Enlaces, the Chilean ICT in Education policy implemented since the last decade, has contributed to sustain these results.

Keywords: international comparative studies - ICT in education - developing countries – SITES - Chile

[1] *Research supported by Centre for Research on Educational Policy and Practice, Grant CIE01-CONICYT*

1. OBJECTIVES

The Chilean Information and Communications Technology (ICT) in Education policy, named Enlaces, is being implemented for more than 15 years and although several achievements can be attributed to its implementation (see for example: Hinostroza, Hepp & Cox, 2009); the degree in which it has been affecting teachers integration of ICT in teaching as well as the implementation of innovative pedagogical practices, is still uncertain. Moreover, policy related factors that could foster or hamper the implementation of innovative pedagogical practices and the incorporation of ICT, are still a matter of discussion.

In this context, this paper presents the main results arising from the Chilean application of SITES 2006 study, regarding emerging pedagogical practices involving ICT-use in schools, and analyses to what extent different factors found in the international study (namely, infrastructure, technical and pedagogical support, and ICT-related vision, among others) as well as other factors relevant for the Chilean context, affected –or not- the national results.

Based on this, this paper also analyzes to what extent Enlaces, the national ICT in Education policy implemented, contributes to sustain these results.

2. PERSPECTIVES

Two conceptual frameworks were used to analyze and discuss data at school and teachers' level, first, SITES 2006 framework (Law, Pelgrum, & Plomp, 2008), whose schema can be seen in Figure 1; and –in addition- the ICT in Education Evaluation Framework developed by Wagner et al. (2005) shown in Figure 2.

Figure 1. Overall conceptual framework from SITES 2006 ***(Law et al, 2008; p.19)***

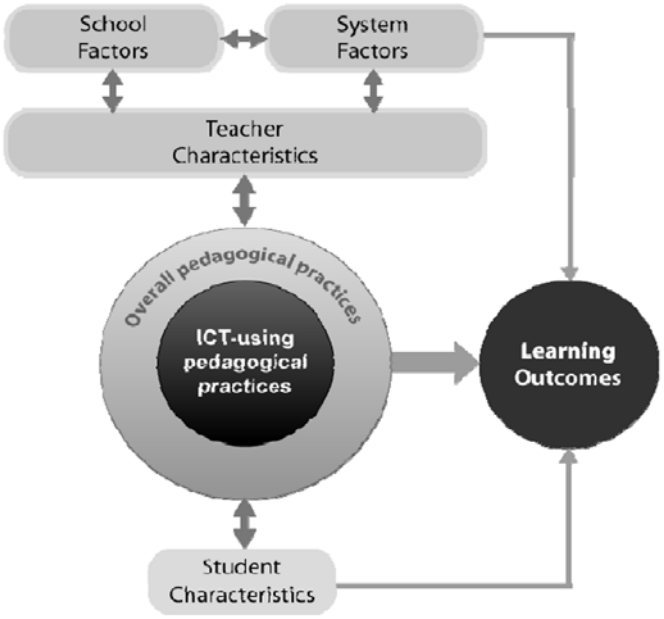
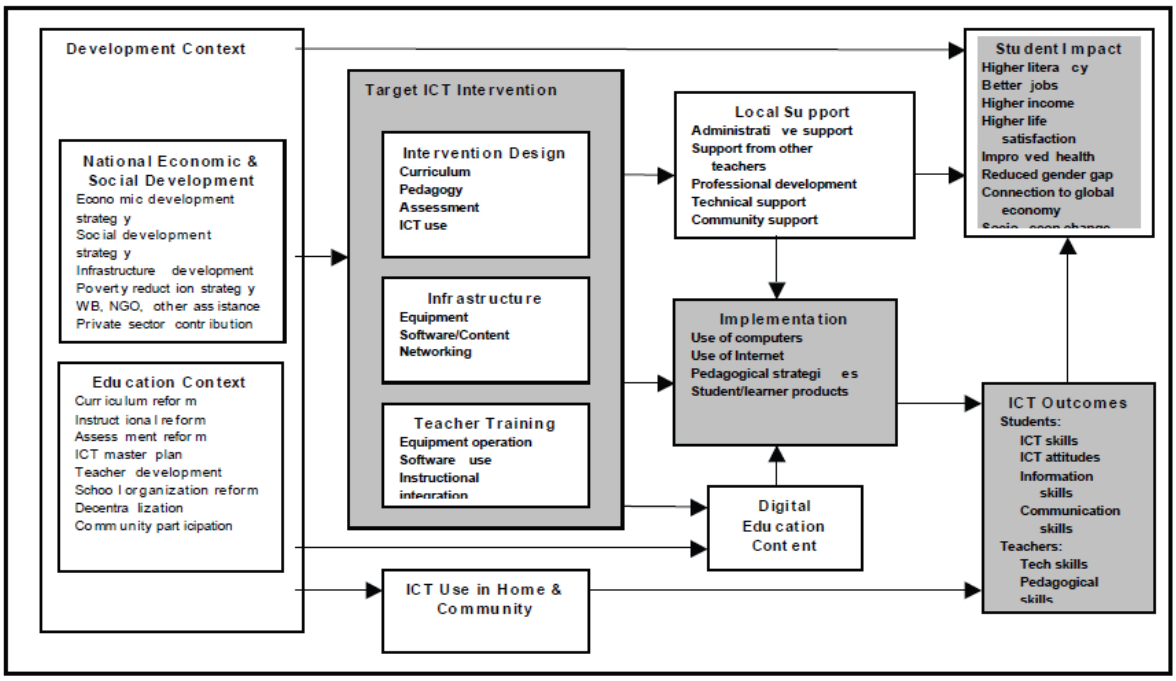


Figure 2. Conceptual framework for ICT impact *(Wagner et. al, 2005; p.8)*



To a certain degree, these conceptual frameworks coincide, since they consider different group of factors influencing the integration of ICT in teaching, which belong to three levels:

1. *Macro* (variables related to education system: e.g. national curriculum)
2. *Meso* (school-related factors, for example, ICT infrastructure and support)
3. *Micro* (variables associated to what happens in the classrooms involving teachers and students, such as the pedagogical practices).

Moreover, there is evidence that the influencing factors alluded above (and the levels to which they belong) are linked by complex, diverse and multidirectional relationships (Dede, 1998; Mumtaz, 2000; Law, 2003; Drent & Meelissen, 2008; Pedró, 2009); therefore, a successful ICT-integration in education would not depend exclusively on an individual aspect but is determined by a dynamic process involving a set of interrelated factors (ten Brummelhuis, 1995; Janssen Reinen, 1996).

In addition, SITES defined three orientations regarding teaching pedagogical practices: the "traditionally important" practices (including practices such as teacher-driven instructions, and students learning individually and responding to tests), the "connectedness" orientation (referred to activities in which students collaborate with or learn from outside peers and experts, to create products and publish results) and the "lifelong-learning" orientation (linked to the ability to become autonomous learners within a context of collaborative, inquiry and production-oriented activities, as well as to the strategies designed in order to take account of individual differences). In addition, in some cases, the last two orientations are grouped and presented as "innovative pedagogical practices", also known as "21st century" pedagogical practices or teaching practices associated to an "emerging paradigm" (Law, Pelgrum & Plomp, 2008). Thus, SITES 2006

particularly addressed the issues related to traditional and/or innovative pedagogical practices, as well as the role of ICT in those practices.

On the other hand, Chilean government's ICT in education policy, better known as Enlaces, has been an important component of the country's educational reform. It has aimed to integrate these technologies as learning and teaching resources for all students and teachers in Chilean public schools. It began as a pilot project in 1992, and became the "official" nationwide initiative for the integration of ICT to the Chilean education system (Hepp, 1998, Potashnik, 1996). In 2005, and after more than a decade of implementation, it ended as a program and became formally part of the Ministry of Education's organization, as CET, Centre for Educational Technology (Hinostroza, Hepp & Cox, 2009).

One of the fundamental premises of Enlaces is that merely supplying information technology to schools is not enough to bring about significant changes in the quality of education (Hinostroza, Hepp & Cox, 2009): ICT can potentially simplify and enhance the learning process in many subject areas (Balanskat, Blamire, & Kefala, 2006; OECD, 2005) acting sometimes as a catalyst for innovation (McDonald & Ingvarson, 1997), a "Trojan Horse" for the teacher (Olson, 1988), or as a lever that must be applied purposefully to a task to be of value (Venezky, 2002). Nevertheless, additional efforts, such as teacher training, technical support, and explicit ICT-based classroom activities must be carried out in order to produce sustainable changes in pedagogical practices and student learning outcomes (Fullan, 1998; Hepp, Hinostroza, Laval, & Rehbein, 2004; Pelgrum, 2001). Among the main strategic objectives of Enlaces, we can mention:

- Develop teachers' skills, competencies, and abilities to use ICT in teaching, through distance education courses, online teaching, and evaluation resources.
- Collect and disseminate models of ICT uses in teaching and learning, promote research projects in schools, and foster international networks.
- Support the use of ICT for educational management at each school, focusing on administrative, curricular, and pedagogical processes.

Table 1 shows the main goals achieved by Enlaces, by 2008:

Table 1. Enlaces' achievements *(2008)*

Type	Accumulated	% of total
Schools incorporated to Enlaces	10.911	98,3%
Primary	8.935	99,9%
Secondary	1.976	91,6%
Students with access to ICT	2.720.796	91,8%
Primary	1.870.598	93,3%
Secondary	852.464	88,9%
Students per computer ratio	23,87	
Internet access	6.835	61,6%
Teachers trained in ICT	>110.000	80,8%

Chilean achievements in this domain could be attached to the priority assigned by Enlaces to teacher-related strategies, emphasizing training and support. Precisely, the underlying

perspective in the present paper assumed that the positive results achieved by Chile in SITES 2006 (Enlaces, 2008) might be related to the emphasis put by Enlaces on two central issues: teacher training -by considering teachers' performance as a cornerstone of the education (Barber & Mourshed, 2007)- and the development of a national technical and pedagogical support network (through *Enlaces' Technical Support Network).*

3. DATA SOURCES

This paper uses data from SITES 2006 database, involving a sample of 1400 8th grade teachers (711 of mathematics and 692 science teachers), as well as the corresponding principals and ICT coordinators from 596 Chilean schools (ENLACES, 2008). These data provided information related to pedagogical practices and the use of ICT in teaching and learning, regarding two main components:

a) School-related factors: such as the principals' beliefs and vision, leadership-related aspects, teacher training offering, institutional infrastructure and support, among others
b) Teacher-related factors: e.g. pedagogical practices, level of professional development, demographic and academic data, ICT competences, etc.

Additionally, documents related to national policies were also reviewed in order to interpret some results on the basis of central guidelines from the national strategy on ICT in Education.

4. METHODS OF INQUIRY

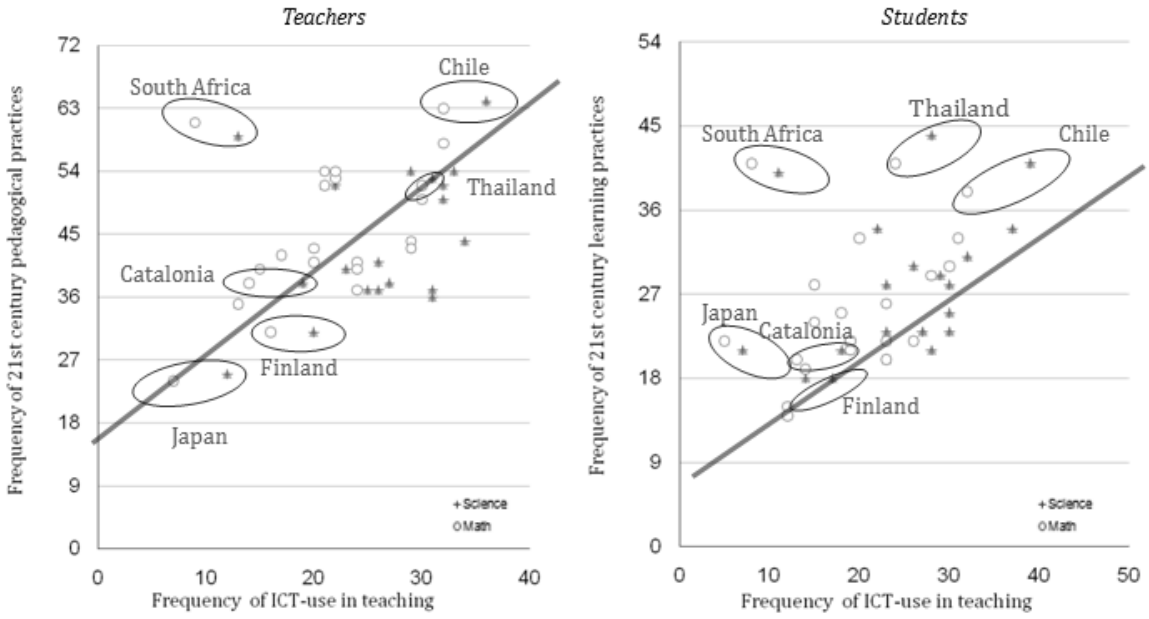
The main data analysis methods used to obtain the reported results consisted in performing a secondary analysis over SITES 2006 database using similar techniques to those utilized in the international study, i.e. linear correlation to show statistical association between factors. The analysis procedures were executed using SPSS Statistics software.

5. RESULTS AND CONCLUSIONS

5.1. ICT-use and pedagogical practices

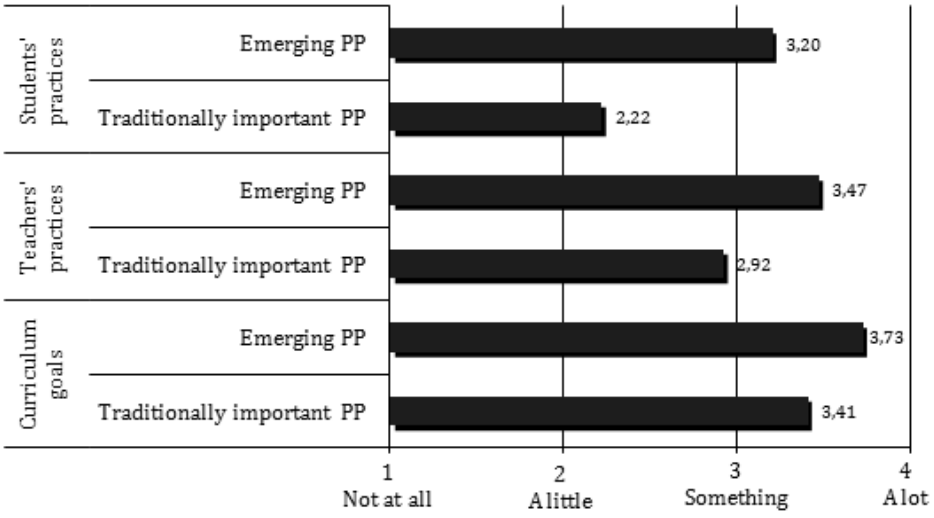
Firstly, the analysis on international data at system level, suggests the presence of a significant and positive relationship between innovative practices (both teaching and learning practices) and the use of ICT in teaching. Although its national results are similar to the international ones (in the sense that the prevailing pedagogical practices are also those related to the traditionally important orientation), Chile highlighted in SITES 2006 among the countries with the highest frequencies of pedagogical practices corresponding to the emerging paradigm, and their teachers as well as students report that they frequently develop innovative practices and practices involving ICT-use (Hinostroza et al., 2008), as Figure 3 shows.

Figure 3. Relationship between ICT-use in teaching and 21st century teaching and learning practices



What is also interesting is that Chile not only ranked well among the other participating countries regarding the frequency of pedagogical practices with ICT, but also was the country with the highest ICT-use in lifelong-learning pedagogical practices (Law et al, 2008). Figure 4 shows the corresponding frequencies of pedagogical-practice orientations as reflected in teachers' reports of students' practices; teachers' practices and teachers' declared curriculum goals (according science teachers). It is possible to see that in every case, frequencies reported as corresponding to emerging practices are higher than those related to traditionally important practices.

Figure 4. Frequencies of pedagogical-practice orientations *(science teachers)*

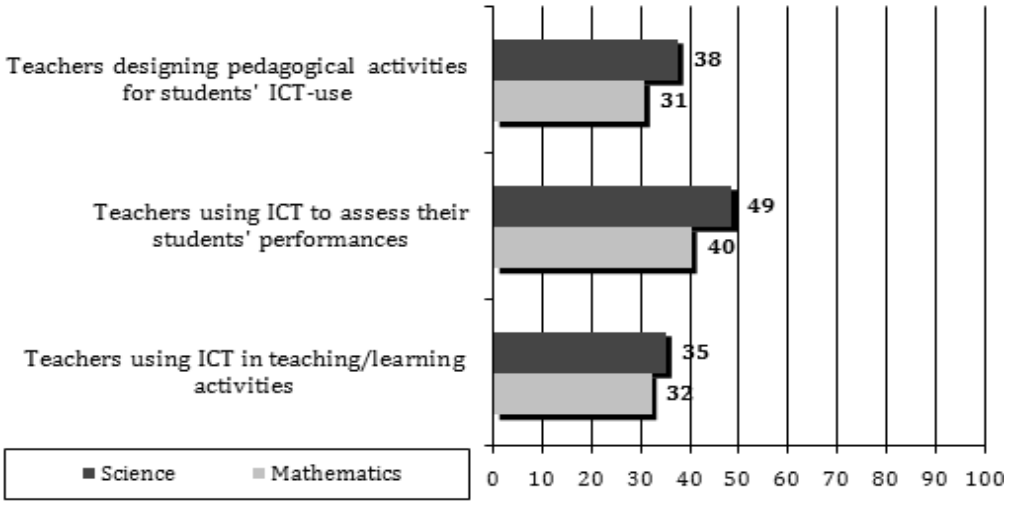


***Note**: PP = Pedagogical Practices*

Accordingly, is not unexpected that these positive results contribute to a moderate but positive and significant relationship ($r=0.291$ $p<0.01$) at a national level, between the frequency of innovative teaching-learning practices and the use of ICT in teaching.

In addition, Figure 5 shows the main uses of ICT reported in SITES 2006 by Chilean teachers. Results reveal that science teachers performed a higher ICT-use than their math colleagues, and that the highest use is that related to the students' assessment.

Figure 5. Percentage of teachers' reporting different uses of ICT in Chile



5.2. Correlations between school-level factors

The international study found significant variations within and between education systems regarding schools' conditions. These factors are not only conditional for teaching and learning practices, but some of them are also interdependent. The international correlation matrix presented in Table 2 *(Pelgrum, 2008: p. 116)* shows some interesting relationships, such as the strong correlation between the emerging visions, and the high correlations between the infrastructure indicators.

Table 2. Correlations between school-level indicators aggregated at the system level *(Pelgrum, 2008: p. 116)*

	Indicator	A	B	C	D	E	F	G	H	I	J	K
A	Existence lifelong learning pedgagogy											
B	Vision lifelong learning	.42										
C	Vision connectedness	-.03	.78*									
D	Vision ICT for lifelong learning	.45	.52*	.18								
E	Leadership development priorities	.50*	.72*	.52*	.58*							
F	Requirements for teacher training	.13	.18	.10	.10	.37						
G	Pedagogical support	.31	.35	.22	.47*	.08	-.07					
H	Technical support	.24	.42	.31	.69*	.36	-.13	.66*				
I	Student:computer ratio	-.14	.00	.19	-.37	.30	.32	-.32	-.35			
J	Student:Internet computer ratio	-.12	-.03	.11	-.42	.28	.38	-.37	-.42	.98*		
K	Software availability	-.06	-.09	-.16	.12	-.40	-.70*	.39	.42	-.74*	-.75*	
L	Years experience with ICT	-.03	-.47*	-.48*	-.13	-.58*	-.42	.00	-.15	-.66*	-.64*	.58*

* Significant at $p < 0.05$

In Chile, a similar correlation analysis between different school-related factors was also performed and is presented in Table 3. Results are, in general, consistent with the international findings, showing: a) a strong relation between the emerging paradigm pedagogical visions; b) a positive and significant correlation between leadership development priorities and the indicators

related to emerging visions (lifelong learning, connectedness and ICT for lifelong learning); c) a positive and significant correlation between the ICT-vision for lifelong learning and support indicators (however, whereas the international results show a higher correlation between that vision and technical support, Chilean results show a higher relation related to pedagogical support); d) a negative correlation between ICT-vision for lifelong learning and the infrastructure indicators (student: computer ratio and software availability)

Table 3. Main correlations between different school-level factors

		A	B	C	D	E	F	G	H	I	J
A	Vision Lifelong learning	-									
B	Vision connectedness	.65 **	-								
C	Vision ICT for Lifelong learning	.35 **	.45 **	-							
D	Leadership development priorities	.19 **	.16 **	.35 **	-						
E	Pedagogical support	.09 **	.07 **	.26 **	.31 **	-					
F	Technical support	.02	.04 *	.04 **	.02	-.01	-				
G	Student: computer ratio	-.06 **	-.09 **	-.21 **	-.08 **	-.02	-.15 **	-			
H	Student: Internet computer ratio	-.05 **	-.04 *	-.08 **	-.06 **	-.06 **	-.11 **	.90 **	-		
I	Software availability	-.08 **	-.09 **	-.21 **	-.12 **	-.10 **	-.07 **	-.11 *	.08 **	-	
J	Years experience with ICT	-.00	-.02	-.01	-.07 **	-.04 *	.04 *	-.01	.02	-.09 **	-

** Significant at p<0.01
* Significant at p<0.05

These results could be revealing some impacts on the pedagogical practices, coming from the strategies developed and fostered by Enlaces regarding teachers' professional development as well as technical and pedagogical support.

5.3. Correlations between school-level factors and pedagogical practices

In addition, the international study showed correlations between school-related factors and ICT-using practices related to the orientations traditionally important, lifelong learning and connectedness (performed by science teachers). Main findings (see Table 4) were: a) principal's vision for ICT-use to support lifelong-learning correlated positively to both emerging pedagogical orientations; b) technical support correlates to traditionally important and lifelong learning orientations; c) pedagogical support only correlates to the traditional orientation; and d) principal's priority for leadership development correlates to lifelong learning orientation (Law, 2008).

Table 4. Correlations of specified school-level factors and the ICT-using teacher-practice orientations of science teachers (Law, 2008)

School factors	Pedagogical orientation in ICT-using teacher practices		
	Traditionally important	Lifelong learning	Connected-ness
Principal's vision for ICT-use to support LLL	0.53	0.84 **	0.72 **
Student–computer ratio	0.05	0.51	0.34
Technical support in minutes per student per week	0.21	0.50	0.33
Technical support for ICT-use	0.69 *	0.77 **	0.36
Pedagogical support of ICT-use	0.80 **	0.45	0.08
Principal's priority for leadership development	0.38	0.64 *	0.55

Notes:

Only the 12 systems for which the teacher questionnaire data met the IEA minimum participation rate and followed all required administrative procedures in the data-collection process

* Correlation is significant at 0.05 level (2-tailed)

** Correlation is significant at 0.01 level (2-tailed).

Results in Chile (see Table 5) showed that: a) factors such as principal's vision for ICT-use to support lifelong-learning, principal's priority for leadership development and teacher training level, correlates positive and significantly to all pedagogical orientations; b) student-computer ratio correlates to traditionally important and lifelong learning orientations in a significant but extremely low way; c) pedagogical support shows a low but positive and significant correlation to both emerging pedagogical orientations; and d) infrastructure factors appear to be less relevant within this analysis, when compared to those factors related to principal's visions.

Table 5. Correlations of school-level factors and ICT-using teacher-practice orientations in Chile (Science teachers)

School factors	*Pedagogical orientation in ICT-using teacher practices*		
	Traditionally important	*Lifelong Learning*	*Connectedness*
Principal's vision for ICT-use to support LLL	0.14 **	0.15 **	0.18 **
Ratio alumnos:PC	-0.10 **	-0.08 **	-0.03
Technical support available for teachers	0.07 **	0.09 **	0.14 **
Pedagogical support available for teachers	0.01	0.07 **	0.09 **
Principal's priority for leadership development	0.17 **	0.29 **	0.17 **

*** Correlation is significant at 0.01 level (2-tailed)*

Although the overall situation is consistent with the international results, correlations in Chile are lower than the international ones, probably due to the great deal of variation between schools indicators. Therefore, both international and Chilean results show that principal's vision for ICT-use to support lifelong-learning, principal's priority for leadership development and technical support, are factors that correlate significantly to lifelong learning and/or connectedness orientations. In addition, Chilean results showed that pedagogical support is also an important factor to foster emerging pedagogical practices. Moreover, a teacher-level factor (the level of teacher training, representing the general level of participation in professional development courses or workshops), showed a positive and significant correlation to all pedagogical

orientations, but particularly to the emerging ones ($r= 0.16$ $p<0.01$ for the lifelong learning orientation, and $r=0.12$ $p<0.01$ for connectedness).

These results show different aspects when compared to the international ones, mainly by assigning a relevant role to factors related to teachers' training as well as to technical and pedagogical support. This is an essential issue, since these factors, emerged as the most relevant to impact on 21st century pedagogical practices, are precisely those related to Enlaces' main strategic action lines implemented and fostered for improving education quality: technical support (through the *Technical Assistance Network*, a cornerstone of the policy) and pedagogical support and teacher training (emphasizing the key role of teachers). Therefore, it's reasonable to attach, to a certain extent, the overall positive results of Chile in SITES 2006 to the main achievements of Enlaces.

6. SIGNIFICANCE

The value of this paper lies on showing the role of Chilean national policies in supporting and fostering teachers practices associated to innovative teaching and ICT integration in education, through the strengthen of system and school related factors that impact teachers' ICT competences, such as the institutional offering of professional development courses and the provision of technical support in teaching. Moreover, considering that fostering teachers' innovation through the use of ICT in general, and particularly the quality assurance of teachers' professional level via training opportunities and support are issues that constitutes the very core of the current strategies of Enlaces, presented results and conclusions might help to put appropriate emphasis in the corresponding ongoing strategies.

7. REFERENCES

Balanskat , A., Blamire, R., & Kefala, S. (2006). The ICT impact report: A review of studies of ICT impact on schools in europe: European Communities.

Barber, M., & Mourshed, M. (2007). *How the world's best-performing school systems come out on top*: McKinsey & Company.Dede, C. (1998). The scaling-up process for technology-based educational innovations. En C. Dede (Ed.), *Learning with Technology, 1998 Yearbook of the Association for Supervision and Curriculum Development* (pp. 199-215). Alexandria, VA: Association for Supervision and Curriculum Development.

Dede, C. (1998). The scaling-up process for technology-based educational innovations. En C. Dede (Ed.), *Learning with Technology, 1998 Yearbook of the Association for Supervision and Curriculum Development* (pp. 199-215). Alexandria, VA: Association for Supervision and Curriculum Development.

Drent, M. & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education, 51*, 187-199.

ENLACES (2008). Second Information Technology and Education Study - SITES 2006. Resultados nacionales SITES 2006. Retrieved June 18, 2009 from http://www.enlaces.cl/tp_enlaces/portales/tpe76eb4809f44/uploadImg/File/seccion_actualidad sites2006.pdf

Fullan, M. (1998). The meaning of educational change: A quarter of a century of learning. In A. Hargreaves, A. Lieberman, M. Fullan, & D. Hopkins (Eds.), *International handbook of educational change* (pp. 214-228).

London: Kluwer Academic Publishers.

Hepp, P. (1998). Chilean experiences in computer education systems. In C. de Moura Castro (Ed.), *Education in the information age* (pp. 116-130). New York: Inter-American Development Bank.

Hepp, P., Hinostroza, J. E., & Laval, E. (2004). A systemic approach to educational renewal with new technologies: Empowering learning communities in Chile. In A. Brown & N. Davis (Eds.), *World Yearbook of Education 2004: Digital technology, communities and education* (pp. 299-311). London: Routledge Falmer.

Hinostroza, E.; Labbé, C.; Filsecker, M. & Isaacs, S. (2008). ¿Mejora la enseñanza con el uso de las TIC? Políticas de Informática Educativa y los Resultados del Estudio Internacional SITES 2006. *Enlaces, 9*.

Hinostroza, J. E., Hepp, P., & Cox, C. (2009). Policies and practices on ICT in education in Chile: Enlaces. In T. Plomp, R. E. Anderson, N. Law & A. Quale (Eds.), *Cross-National Information and Communication Technology: Policies and Practices in Education* (Revised Second Edition ed., pp. 153-170). Greenwich: Information Age Publishing.

Janssen Reinen, I. A. M. (1996). Teachers and computer use: The process of integration IT in the curriculum. Enschede: University of Twente.

Law, N., Pelgrum, W. J., & Plomp, T. (2008). *Pedagogy and ICT use in schools around the world: Findings from the IEA SITES 2006 study*. Hong Kong: Springer, Comparative Education Research Centre.

Law, N. (2003). Innovative practices and the teacher of the future. En C. Dowling, & K. Lai (Eds.), *Information and communication technology and the teacher of the future* (p. 171-182). Dordretch: Kluwer Academy Publishers.

Law, N. (2008). In search of explanations. In Law, N. & al., *Pedagogy and ICT Use in Schools Around the World: Findings from the IEA SITES 2006 Study* (pp. 251-262). Hong Kong: Springer and Comparative Education Research Centre, University of Hong Kong.

McDonald, H., & Ingvarson, L. (1997). Technology: A catalyst for educational change. *Journal of Curriculum Studies, 29*(5), 513-527.

Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of Information Technology for Teacher Education, 9* (3), 319–341.

OECD. (2005). Are Students Ready for a Technology-Rich World? What PISA Studies Tell Us. France: OECD Publications.

Olson, J. (2000). Trojan Horse or teacher's pet? Computer and the culture of the school. *Journal of Curriculum Studies, 32*(1), 1-8.

Pedró, F. (2009). *The New Millennium Learners: ICT in Initial Teacher Training.* OECD/CERI. Recuperado el 28 de abril de 2010 de http://www.oecd.org/dataoecd/33/50/42031549.pdf

Pelgrum, W. J. (2001). Obstacles to the integration of ICT in education: Results from a worldwide educational assessment. *Computers and Education, 37*, 163-178.

Pelgrum, W. (2008). School Practices and Conditions for Pedagogy and ICT. In Law, N. & al. (2008) *Pedagogy and ICT Use in Schools Around the World: Findings from the IEA SITES 2006 Study* (pp. 67-120). Hong Kong: Springer and Comparative Education Research Centre. CERC Studies in Comparative Education.

Potashnik, M. (1996). *Chile's learning network* (Education and Technology Series Vol. 1, No. 2): Washington, DC: The World Bank.

ten Brummelhuis, A. (1995). *Models of educational change: The introduction of computers in Dutch secondary education* (doctoral dissertation). Enschede: University of Twente.

Venezky, R. L. (2002, March, 6, 2002). *Quo Vademus? The transformation of schooling in a networked world.* Retrieved May, 2007, from http://www.oecd.org/dataoecd/48/20/2073054.pdf

Wagner, D., Day, R., James, T., Kozma, R. B., Miller, J., & Unwin (2005). *Monitoring and evaluation of ICT in education projects: A handbook for developing countries*. Washington, D. C.: The International Bank for Reconstruction and Development / The World Bank.