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Introducing 1 to 1 in the Classroom: A Large-scale Experience in Chile

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ABSTRACT

This paper presents the results of a study that sought to understand how a strategy of Mobile Computer Labs (MCL) has been integrated into 3rd and 4th grade teaching-learning practices in 1,591 state schools in Chile. In particular, the study aims to identify the most important factors related to MCL integration into these practices a year after its implementation. The findings obtained by applying a survey and performing classroom observations show that, although the schools are willing to use this resource, it has been used sporadically for searching information and drilling and practicing contents related to Mathematics and Language, in addition to motivating students. Furthermore, the classroom observations do not reveal any innovative teaching strategies, related to the use of this new technology. The study shows that amongst the main reasons for this traditional and sporadic use of the MCL are a lack of targeted teacher training and preparation time, and insufficient technical and pedagogical support during the phases of implementation and integration to the pedagogical practices.

Keywords

ICT in the classroom, One-to-one initiatives, Teaching practices with ICT, ICT strategy evaluation, Teacher support

Introduction

The Chilean ICT in education policy (Enlaces) started in 1993 and has equipped schools with computers, local networks, educational resources, productivity software, free or subsidized Internet access, as well as providing technical and pedagogical support in partnership with 24 universities from across the country. Computers have been placed in special rooms called Computer Labs and, since 2007 classrooms have been equipped with a multimedia package that includes a personal computer, audio equipment and a projector. By the year 2010 90% of students going to publicly financed schools had access to computers, 60% of schools had Internet access, 110.000 teachers (there are around 180.000 teachers working today in the system) had been trained to use computers as a part of their instruction process, and the Country reached a national average of 9,8 students per computer in schools (Donoso, 2010; Hepp et al., 2004; Sánchez & Salinas, 2008).

For the past few years, the primary concern in Chile has been investigating the effects of these policies. In particular, studies have looked at how these new resources are being used and whether or not there has been any impact on student learning. In Chile, the evidence is consistent with other international studies and reports which show that the frequency of ICT use in teaching and learning activities in schools is relatively low (Cuban, 2001; Hinostroza, et al., 2005; Plomp &Voogt., 2009; OECD, 2010) and that they are mostly used to support "traditional" teaching practices (i.e., instruction based lessons) (Plomp & Voogt, 2009; Trucano, 2005; Balanskat et al., 2006). In fact, data collected through a 2009 national survey of all state-subsidized schools and a sample of private schools showed that ICT is not frequently used in teaching and learning in the classroom. When used, it is to support teacher's current practices instead of changing or revolutionizing them (Hinostroza et al., 2010).

In terms of the impact on student learning, international and national research has not been able to provide conclusive statements about their positive or negative effects. On the contrary, findings are most often inconsistent between studies or difficult to generalize. These studies are commonly country-specific or developed under particular conditions; such is the case with pilot projects or case studies. Additionally, there are very few experimental studies that allow for empirically sound conclusions related to causality between ICT and student performance (Balanskat et al., 2006; Kozma, 2006; Ungerleider & Burns, 2003; McFarlane et al., 2000; Cuban & Kirkpatrick, 1998). Where evidence seems to converge is in indicating a non-linear and complex relationship between ICT and learning.

The lack of impact of ICT in schools has been explained in different ways by educational researchers and experts. One such explanation is related to the inability of technologies and technological school settings to adapt to real educational needs (Means, 2000; Watson, 2001). As previously mentioned, in Chile ICT resources are found mainly in computer labs, which implies that activities built around these technologies change the natural context of classroom teaching and tend to focus on the purely technological aspects. In this sense, the technologies "(…) are not truly integrated into the classroom teaching dynamic, which may limit their impact on teaching styles traditionally used in schools" (Nussbaum et al., 2009, p. 295). As Watson (2001) argues, having to book a timetabled fixed resource and moving the class to a separate room for a limited time does not allow for open-ended exploratory work, which the technology could facilitate. Software is increasingly seen as having the potential to support and enhance curriculum initiatives based on a conceptual understanding and the development of process skills. Nevertheless, hardware's physical location and management threaten this potential benefit. Consequently, from this point of view, as technologies adapt to real educational needs, ICT should tend be used more appropriately and achieve the desired learning results (Means, 2000).

Among the technologies available, interactive whiteboards and laptops, provided on a one-to-one (1:1) basis, have been introduced in the classroom. With regard to laptops it is argued that ubiquitous or 1:1 computing environments may enhance learning. This is because they can provide all students and teachers with continuous access to digital teaching resources within the same classroom dynamics, something that computer labs outside the classroom do not allow for (Bonifaz & Zucher, 2004). Furthermore, 1:1 models of ICT use in education are promoted with the idea that they can provide personalized and student-centered experiences to students within schools and beyond (Severin & Capota, 2011). For example, the One Laptop per Child (OLPC) initiative promised to transform education for world disadvantaged students by giving them the means to teach themselves and each other (Kenneth et al., 2009). The OLPC project was strongly shaped by the visions of the founder of the Massachusetts Institute of Technology (MIT) Media Lab, Nicholas Negroponte and Seymour Papert's constructionist learning theory. From Paperts' perspective students learning depends on constructing ideas and individual laptop computers can be essential for carrying out such construction in today's world. Through the OLPC program, Negroponte, Papert and others have sought to develop and distribute a low-cost "children's machine" that could empower youth to learn without, or in spite of, their schools and teachers (Warschauer & Ames, 2010; Kenneth, 2009).

However, recent studies do not show clear evidence regarding the benefits of 1:1 models of computer use in schools and homes (Warschauer & Ames, 2010). In Latin America and the Caribbean, the Inter-American Development Bank (IDB) recently published a study that concluded that there are still uncertainties relating to the impact of 1:1 programs and that further evaluation is needed (Chong, 2011). The evidence collected in this study and others, so far indicates that programs that overlook teacher training and the development of specific software may yield very low returns (Chong, 2011; Karsenti & Collin, 2011; Severin & Capota, 2011). Additionally, evidence related to projects that give students, the opportunity to take their computers home is not positive, especially when it comes to poor students. In fact, Chong et. al (2011) found that children with weak adult supervision at home may not spend their time using computers for homework and studying, and therefore this may have no positive impact in their educational achievement. Some studies have even found that access to computers at home may have a negative impact on academic achievement (Vigdor & Ladd, 2010; Malamud & Pop-Eleches, 2010).

In summary, studies that look at ICT use in schools in Chile and around the world show that there is still some way to go before we really understand how to naturally integrate technologies into the teaching and learning process in the classroom and, subsequently, impact learning. Although significant efforts have been made to use technologies that can adapt to natural teaching conditions in the classroom, the benefits are still not clear.

In 2009, Enlaces launched a Mobile Computer Labs (MCL) strategy with the main purpose of developing the capacity of third grade students to read, write and perform basic mathematical operations through the integration of computer equipment. This equipment allows 1:1 learning strategies to be developed. This strategy consisted in providing 1,591 state primary schools with a cabinet of netbooks, one netbook for each student in each third grade classroom and one for the teacher with software that allows them to control and communicate with the class. The cabinet makes possible to move the computers between classrooms, as well as offer storage, security and a means for charging the batteries. It also provides integrated wireless networking technology that allows communication between computers and classroom collaboration (Mineduc, 2009). The strategy also includes a web page that provides information about the project, as well as digital educational resources in Mathematics and Language to support class lessons.

In this context, the main purpose of this study was to evaluate how Chilean schools implemented and used the MCL in the classroom and whether this new strategy had any effect in teaching practices. More specifically, our interest was to study how this new strategy of providing 1:1 technology in the classroom had been integrated into the teaching and learning process of Chilean third grade classrooms. More specifically, our purpose was to identify the most important variables associated with key dimensions in the process of implementation and integration of MCLs in schools and classrooms during its first year of implementation. The research questions were driven by the work of Zhao et al. (2002) who identified three key domains that should be considered when trying to understand the processes involved in implementing new technologies:

- The innovator that uses the technology, in this case, the teacher.
- The innovation or project to be developed with the technology, in this case, the pedagogical use of the MCL.
- The context in which the innovation takes place (i.e., technology infrastructure, human infrastructure and organization culture), in this case the school.

In this study we aimed to identify and analyze the different factors related to these three processes that explain a higher or lower level of integration of the MCL in third grade Chilean classroom teaching practices. Consequently, the research questions were:

- In what way and to what extent are teachers using this technology in their teaching practices?
- What have been the aids/facilitators and barriers for integrating these technologies into teaching practices?
- Which factors associated with human, technological and contextual school conditions are more closely related to the integration of MCL into teaching practices?

Methodology

Instruments

A quantitative method was used based on the design and application of a self-administered questionnaire completed by the participating schools. The questionnaire was built taking into consideration the main elements of the MCL strategy, as well as the results of interviews with representatives from the Ministry of Education and other school figures (principals and teachers) from participating institutions.

The questionnaire comprised 147 items, organized in four sections or dimensions: (1) personal characteristics of the respondent; (2) teaching and ICT in the school; (3) use and organization of the MCL; and (4) MCL Project. The first dimension asked about the role of the respondent at the school (i.e., teacher, school director, ICT coordinator), his/her age and ICT access and use at home. Dimensions two and three were related to the organizational conditions found after a literature review, i.e. the context for integrating the MCL in the school and the classroom, such as time for teacher preparation (Jones, 2004, Cox et al., 2004), technical and pedagogical support (Kirkland & Sutch, 2009; Law et al., 2008; Trucano, 2005), the school directors' support and leadership (Law et al., 2008) and schools' ICT plans and strategies (Kozma, 2003). Finally, the fourth dimension asked about the expectations, evaluation and future perspectives related to the MCL project at the school. The questionnaire presented different types of questions: 53 multiple-choice questions, 11 multiple answer questions, 82 4-point Likert scale questions and one open-ended question. Originally the items did not belong to predefined scales. In the data analysis phase, scales were created to facilitate analysis and interpretation of data (see Data Analysis section). The design of the questionnaire considered that it could be answered online in approximately 30 minutes.

Sample design and data collection

The study's sampling frame comprised the 1,591 schools that participated in the MCL project. Stratified random sampling was applied, using the criteria of Region (Chile's first-order administrative division) and 'rurality' to form the required strata. A probabilistic sampling of schools was then applied to each stratum in order to maintain the proportion of schools in each stratum and guarantee the representativeness of the sample. The sample size was calculated using a 95% confidence interval and 5% margin of error. For each of the selected schools, two 'replacement' schools were also chosen randomly. These schools would be successively incorporated in case the original school failed to answer the survey.

A total of 565 schools were contacted in three successive calls. An email with the URL to access the survey was sent to each school. Only one representative from the school could answer the survey (teacher, Principal, Head of Curriculum and Instruction or Head of ICT). This representative had to be someone who had participated in the MCL project. A total of 242 valid survey responses were gathered for analysis. The follow-up after the third call revealed that 70% of non-responses were due to causes not related to the project (e.g., a nationwide student strike).

Unit non-response was treated by post-stratification weighting based on the known information about the population frame (region and rurality) (Holt & Elliot, 1991). Weighting is the most widely used strategy for handling unit non-response in order to reduce non-response bias (Armoogum & Madre, 1998; Little & Vartivarian, 2004), especially in cases where non-response is not related to the phenomena under study. Weighting coefficients were calculated by dividing the expected number of respondents by the actual number of respondents in each stratum. Table 1 shows the details of the composition of the sample and the weighting coefficients.

Table 1. Sample Characteristics

	Expected Sample Size			**Achieved Sample Size**			**Weighting Coefficients**	
Region	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**	**Urban**	**Rural**
1	1	1	2	1	1	2	1.00	1.00
2	4	0	4	4	0	4	1.00	-
3	5	2	7	5	2	7	1.00	1.00
4	13	10	23	10	5	15	1.30	2.00
5	18	10	28	12	8	20	1.50	1.25
6	17	18	35	11	15	26	1.55	1.20
7	18	24	42	11	22	33	1.64	1.09
8	35	19	54	25	16	41	1.40	1.19
9	20	7	27	18	5	23	1.10	1.40
10	13	11	24	10	7	17	1.30	1.57
11	2	1	3	1	1	2	2.00	1.00
12	1	0	1	1	0	1	1.00	-
13	53	12	65	37	8	45	1.43	1.50
14	3	2	5	3	2	5	1.00	1.00
15	1	0	1	1	0	1	1.00	-
TOTAL	**117**	**204**	**321**	**150**	**92**	**242**		

Data analysis

Three types of analysis were carried out:

- The data were analyzed using descriptive statistics for each item (analysis of frequency and percentages). Chi-square values were estimated in order to study the possible differences between sub-groups (e.g., differences due to the role in the school; rurality of the school).

- Given the large quantity of items and sub-items in the questionnaire, new variables (scales) were created using an Optimal Scaling procedure (Greenacre, 2007). Scales were created following two criteria: theoretical coherence of the items and an internal consistency of the scale (Cronbach's alfa) above 0.7. A total of 57 items were grouped in 10 different scales. After quantification, different quantitative analyses were done (e.g., averages, correlations, t-tests and ANOVA) on the aggregated variables.

- Finally, a Binary Logistic Regression analysis was carried out to establish the factors associated with a successful implementation of the project. For the Ministry of Education, investing in the MCL project and implementing the national strategy was worthwhile if the technological resources were frequently used to support learning of third graders, and if the technology was being used to promote diversity and innovation in teaching practices. The frequency of use of the MCL in schools and the pedagogic diversity of use of the MCL

were therefore the two scales chosen as dependent variables. The scale for frequency of use was constructed based on the 6 items that captured information about how much the MCL was used in different subjects. The scale for diversity of use was constructed based on the 8 items that referred to the frequency of use of the MCL in different pedagogical activities. Schools were assigned to two groups (higher/lower frequency of use and higher/lower diversity of use) according to the values attained in each scale. So as to find the optimum number of predictive factors for each of the dependent variables (i.e. find the model with the lowest possible number of variables and maximum predictive capacity), it was decided to carry out a logistic regression analysis with a sequential extraction method based on likelihood (*Forward Stepwise Likelihood Ratio*).

Results

Characteristics of the survey respondents

A large number (44.4%) of those who answered the survey were the Head of ICT at their school (Table 2).

Table 2. Percentage of answers per position within school

Position	Frequency (N)	Percentage
Teacher	38	15.8
Head of Curriculum and Instruction	40	16.6
Head of ICT	107	44.4
Principal	53	22.0
Other	4	1.2
Total	242	100.0

The distribution for gender was quite even between men and women, albeit with a slightly higher percentage of women (53%). However, if this is analyzed per position or school role, 70% of principals were men and 79% of teachers were women. Additionally, 43% of respondents were between 41 and 55 years of age and the majority had been at the school for more than 2 years. Finally, with regard to access and use of ICT, 97% answered that they used ICT on a daily basis, 97% that they had a computer at home and 90% that they had a wireless Internet connection.

Perceptions of ICT and the MCL as a school resource

At the level of believes or perceptions of ICT, the great majority said that, in general, ICT have been well accepted and used as a resource to support new pedagogical practices at their school. In effect, the majority of respondents agreed or strongly agreed that ICT are important for their school (96.6%), that ICT has begun to be used for teaching and learning school subjects (94.7%), that all teachers within the school use ICT in their classes (72.5%) and that there is an institution-wide plan for the pedagogical use of ICT (86.3%).

With regard specifically to the MCL, 92.8% said that their school saw it as an opportunity to promote more innovative pedagogical practices, 82.6% as a way to motivate students (i.e., gain their interest and enthusiasm with the class lesson), 77.3% as a means of improving their students' digital literacy levels, 70.1% as an opportunity to have increased ICT infrastructure for teachers and students, 68.8% as a way of supporting the Institutional Educational Project and 63.6% as a means of accelerating the pedagogical integration of ICT.

Use of the MCL

The great majority (90.5%) of respondents indicated that their school has been using the MCL for a year or more and in third grade this percentage rises to 95.6%, which was the target class level of the project. As shown in Table 3, the respondents said that the MCL was used with regular frequency (the most frequent answer being "often", followed by "sometimes") in mathematics and language, although more frequently in language than mathematics. If the answers 'often' and 'always' are added together, then 59.5% of respondents used the MCL in mathematics, while 70.7% used it in language. This use can be explained by considering that the aim of the project was to use the MCL in these two subjects, although the majority of respondents said that they were also used sometimes or often in other

subjects such as natural science, history & social science and technology. It is interesting to notice that 33.1% reported never using the MCL for the technology subject, which can be partly explained by Enlaces' strategy to teach technology in the ICT laboratory (Table 3).

*Table 3.*Frequency of Use of MCL per Subject

	Mathematics	**Language Arts**	**Natural Science**	**History & Social Science**	**Technology**	**Other subjects**
Always	20.9	24.3	9.8	7.7	5.7	4.6
Often	38.6	46.4	30.8	31.0	21.6	17.3
Sometimes	37.0	27.4	43.3	42.7	39.5	46.9
Never	3.5	1.9	16.1	18.7	33.1	31.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

The correlation analysis showed that the per-subject frequency of use of the MCL is not related to general beliefs or perceptions about ICT, nor the expectations that the schools had with regard to the Enlaces project. Also, there was no significant difference in frequency of use between rural and urban schools, with the exception of Language, where urban schools used the MCL with greater frequency ($X^2_{(1,317)} = 13.00$, $p < 0.05$).

With regard to the activities that the majority of respondents said that teachers performed 'often' or 'always' with the MCL, the main responses were exercising previously acquired concepts and skills, searching for information and motivating the students. Also, the majority said that teachers used the MCL sporadically (sometimes or never) to evaluate learning, carry out research projects, process and analyze data, give instruction-based classes and introduce contents (Table 4).

Table 4. Types of Use of the MCL

	Evaluate learning	**Exercise contents**	**Research projects**	**Search for information**	**Process and analyze data**	**Give instruction-based classes**	**Introduce contents to be developed**	**Motivate students**
Always	7.3	24.2	6.2	20.3	10.9	14.7	12.6	38.9
Often	21.6	43.5	16.7	31.9	24.4	29.7	32.5	37.3
Sometimes	55.3	30.2	44.9	34.0	42.0	44.7	46.8	22.9
Never	15.8	2.2	32.2	13.8	22.7	10.8	8.1	0.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

By comparing the types of use by rurality, urban and rural schools made different use of the MCL. Urban schools made greater use of the MCL for giving instruction-based classes, drilling contents and motivating the students, while rural schools used them more to process and analyze data, evaluate learning and carry out research projects. Urban schools made significantly greater use of the MCL for exercising contents ($t(287) = 2.09$, $p = 0.03$) and giving instruction-based classes ($t(281) = 2.06$, $p = 0.04$). These data are interesting, as they suggest that use of the MCL in urban schools tends to be more 'traditional', focusing in teachers giving out contents to students. Instead, in rural schools the tendency seems to be using the technology to explore constructivist didactics more focused on promoting active involvement by the students in research activities and the construction of knowledge.

School conditions for MCL use

During the interview stage, two important conditions for using the MCL came up. One of them was that schools needed to have the administrative measures to allocate the necessary time and space for training and preparing classes. Another one was that teachers also had to have technical and pedagogical support in the classroom. Therefore, these two variables were deemed as essential for measuring the conditions for the use of the MCL.

In terms of administrative measures adopted by the schools, the most frequently cited measures, adopted by around three quarters of schools, were the following: appoint a professional to be responsible for the security and care of the

MCL (79.6%), have a calendar, schedule or timetable for the use of the MCL (79.2%), set a minimum for the amount of hours' use per subject (71.1%), and organize a time and space for training teachers so as to improve the use of the MCL in their subject (71.8%). Following these came initiatives related to appointing a professional to support the teachers during the teaching process using the computers (68.6%), allocating time to teachers for preparing computer-based lessons (62.1%) and leaving the use of the MCL up to each teacher's own initiative (60.4%).

However, here the view of the teachers and the principals turned out to be statistically significantly different for several of these measures (Table 5), with the principal's view being more positive than the teacher's for every measure. Although in general principals' perceptions were more positive than teachers' perceptions, they turned to be statistically significant in those questions related to administrative measures and school conditions for MCL use. In the rest of the scales no statistical differences were observed.

Table 5. Teacher and Principal's Perception of Administrative Measures for Use of the MCL at School

	Position		**X^2**
	Teacher	**Principal**	
Use of each teacher's own initiative	80.0%	48.6%	$X^2 = 12.19$, $p = 0.000$
Allocate a minimum amount of time to the teacher for preparing computer-based lessons	45.7%	74.3%	$X^2 = 9.76$, $p = 0.002$
Organize a time and space for training teachers so as to improve the use of the MCL in their subject	65.3%	85.3%	$X^2 = 6.40$, $p = 0.011$
Appoint a professional to support the teachers during the teaching process using the computers	51.0%	75.4%	$X^2 = 7.49$, $p = 0.006$
Appoint a professional to be responsible for the security and care of the MCL	72.9%	87.1%	$X^2 = 3.80$, $p = 0.051$

With regard to pedagogical support, the general perception was that it was not very frequent. The majority said that the different school actors either never or only sometimes supported teachers, with the exception of the Head of ICT at the school, where the majority stated that this person often or always offered support (Table 6). With respect to technical support, the responses were very similar.

Table 6. Frequency of Pedagogical Support for Using the MCL at School

Pedagogical support	**Colleagues**	**Management**	**Head of ICT**	**Head of Curriculum/ Instruction**	**External support**
Always	14.2	15.5	42.4	21.0	6.7
Often	30.4	17.7	22.5	25.7	17.9
Sometimes	43.4	35.2	27.8	33.7	46.0
Never	12.0	31.6	7.3	19.7	29.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

To analyze the aids and barriers of the strategy, the different participants were asked whether or not they agreed with the various statements shown in Table 7. As it can be observed, main barriers were technical and pedagogical support for using ICT during lessons and availability of time for teachers to prepare, develop and implement new activities using ICT. In line with the results reviewed in the above section about perceptions of ICT, the great majority felt that in general there is a willingness in their school to use technology. Additionally, the majority did not see student or teacher ability or teachers' confidence in using ICT as barriers. Finally, an important majority believed that the infrastructure is adequate.

Table 7. Barriers for Using the MCL at Schools

Aids / Barriers	**% Yes**
ICT are considered useful	99.1
Using ICT in teaching-learning is a goal	92.3
Infrastructure for using ICT is adequate	79.0
Technical support for teachers is sufficient	46.0

Pedagogical support for teachers is sufficient	40.8
Teachers have the necessary ICT skills	54.7
Students have the necessary ICT skills	66.3
Teachers have the necessary confidence	63.2
Teachers have the necessary teaching skills	60.1
Teachers have enough time	32.8
There is an overload of projects	44.2

At the end of the survey, the respondents were asked to give an overall evaluation of the different stages of the MCL project. In line with the answers for the previous item, training and support were mainly rated 'normal', while implementation and quality of equipment were rated 'good'. The evaluation by the users of the MCL was not related to the rurality of their school, i.e. there were no significant differences between the evaluation by users at urban schools and rural schools.

The correlation analysis showed that the overall evaluation of the project had a weak correlation with the frequency of use of the MCL, while there was a moderate correlation with some of the factors related to teacher support and ICT confidence. In particular, there was a moderate correlation between the existence of adequate pedagogical and technical support and the presence of teachers within the establishment with a sufficient level of confidence for using the ICT ($r = 0.45$, $r = 0.39$ and $r = 0.37$, respectively).

Explanatory factors for use of the MCL

From the Binary Logistic Regression two models were obtained based on the two dependent variables, which were deemed to be indicators of a more or less successful implementation. In the first model, where the dependent variable was the frequency of use of the MCL, six significant predictive factors ($p < 0.05$) were found (Table 8). From this analysis it could be concluded that there was a greater possibility of an increased use of the MCL in schools where there was a perception that students had greater ICT skills, where there was better pedagogical support from colleagues, and more class observations. These last three aspects are consistent with the per-item descriptive analysis, where the importance of teachers feeling supported in their use of the MCL was also evident. The other two aspects (better organization and having basic skills) appear to be relatively necessary conditions for any ICT strategy that is implemented in a school. Better technical support appeared to be a not statistically significant factor ($p > 0.05$), although it contributed to the overall model significance.

Table 8. Model for Frequency of Use of the MCL

Predictor	**B**	**B S.E.**	**Wald**	**df**	**P**	**e^B** (odds ratio)
Level of student ICT skills	1.2	0.393	9.269	1	0.00	3.3
Existence of planning for MCL use	0.97	0.281	12.002	1	0.00	2.64
Pedagogical support for teachers from colleagues	0.78	0.344	5.117	1	0.02	2.17
Technical support for teachers using the MCL	0.64	0.341	3.503	1	0.06	1.89
Observation of teachers using the MCL	0.97	0.445	4.779	1	0.03	2.64
Person in charge gives Technical Support Network (TSN) training	-1.16	0.529	4.813	1	0.03	0.31
Using ICT to teach or learn is a goal of the establishment	-1.97	0.841	5.513	1	0.02	0.13
Constant	2.52	0.871	8.396	1	0.00	12.4
Overall model evaluation						
-2Log Likelihood	117.95					
Model Chi square	91.009					
Cox & Snell R square	0.452					
Nagelkerke R square	0.604					

The second model, where the dependent variable was diversity of types of use, seven significant predictive factors were found ($p < 0.05$) (Table 9). With this analysis it was evident that the variables of greatest weight were the presence of a calendar for use of the MCL, the existence of lesson planning, the fact that a professional is appointed

to support teachers and support from colleagues. It can be concluded from this analysis that there is a greater probability that teachers will use the MCL in diverse teaching practices if in the school there is a calendar for its use, if there is a plan for integrating the MCL into the different subjects and if the teachers are supported by their colleagues and by a technical professional. As such, the involvement in lesson planning training by the school administration appeared to be a factor favoring the use of the MCL in both traditional and constructivist teaching practices. Although contributing to the overall model significance, lesson planning training given by the company which supplies the equipment appeared not to be a significant explanatory factor.

Table 9. Model for Diversity of Types of Use of the MCL

Predictor	**B**	**B S.E.**	**Wald**	**df**	**P**	**eB** (odds ratio)
Level of student ICT skills	0.577	0.249	5.365	1	0.02	1.781
Existence of planning	0.601	0.257	5.491	1	0.02	1.825
Have a calendar for MCL use	2.805	0.786	12.726	1	0.00	16.534
Offer specific digital resources for each subject	-1.547	0.622	6.177	1	0.01	0.213
Assign a professional to support the teachers (e.g. Technician)	1.492	0.512	8.497	1	0.00	4.444
Lesson plan training (Company)	1.897	1.097	2.99	1	0.08	6.665
Lesson plan training (Administration)	1.74	0.779	4.984	1	0.03	5.699
Frequency of pedagogical support for teachers by colleagues	1.365	0.37	13.593	1	0.00	3.915
Constant	-2.231	0.92	5.882	1	0.02	0.107
Overall model evaluation						
-2Log Likelihood	130.28					
Model Chi square	98.856					
Cox & Snell R square	0.449					
Nagelkerke R square	0.599					

Classroom observations

Considering that the survey responses were based on the respondents' perceptions of how the MCL had been working at their school, it was decided to observe some schools that reported a frequent use of the MCL. This analysis cannot be considered as representative of all of the schools that showed a greater use of the MCL. However, these observations do allow for a more in-depth investigation of the types of practices that are being carried out, as well as to learn more about the conditions in which they are implemented and the role played by the MCL in the process.

Frequency and diversity of use of the MCL within the school was used as a first selection criterion. Only schools that said they 'always' use the MCL in Language and Mathematics were chosen. In addition, half of the schools selected declared to use the MCL with more traditional teaching methods (e.g. exercising contents, giving instruction-based lessons) and half said that they made frequent use of the MCL for more constructivist activities (e.g., research projects, data analysis). Geographical location of the schools was used as a second selection criterion, due to time constrains. All schools selected were from Santiago (capital of Chile), which is located in the region with the highest concentration of schools that 'always' used the MCL (30.3%).

A total of 11 schools were visited by the observation team, of which five (four urban and one rural) used the MCL with more traditional methods and six (four urban and two rural) with more constructivist methods. In each school a 45-minute Language or Mathematics class was observed. The observation had been previously agreed with both the school and the teacher, meaning that the teacher could plan the use of the MCL. The observations were carried out by two members of the evaluation team following an observation guideline, which allowed them to record information regarding the integration of the MCL into the class lesson, how the teacher handled the technology, the type of activity carried out using the MCL, as well as the student-teacher and student-student dynamics related to the use of the technology.

The analysis of the observations showed that in five of the eleven classes there were technical problems, making it difficult to carry out the activities and to integrate the MCL with the defined pedagogical objectives. In fact, in one case the technical problems made it impossible to develop the planned activity. It was also observed that the majority of teachers did not have the sufficient knowledge to deal with and solve these technical issues on their own.

In four of the eleven observed classes, the teachers had an assistant who offered technical support in how to manage the technology. Two of these cases reported in the survey a constructivist approach and the other two a traditional approach and two of them delivered a lesson in Mathematics and the other two in Language. Therefore having or not an assistant did not seem to be related with the contents or types of use of the technology. In one of these cases the assistant was the schools' ICT coordinator that had planned in advance the class with the teacher, which allowed the teacher to concentrate in the pedagogical process and obtain a better control of the class. In the classes observed where this support did not exist, the occurrence of technical problems affected the normal development of the class, reducing the effective amount of class time by up to 30 minutes of the 90 minutes class. In two of the cases observed, the students had a high level of ability when it came to handling netbooks, being capable of identifying and resolving technical issues.

By comparing the schools which were identified as either more traditional or constructivist in terms of their use of the MCL, the main differences could be seen in the interaction between the students and the teacher. Even when students used the technology individually, the teachers in the more constructivist schools tended to encourage greater interaction between students and with the teacher.

Despite taking into consideration these differences in teaching methods between the schools, the observations showed that schools used the MCL mostly with the aim of motivating the students, and not to implement more innovative teaching practices by using the technology. In only one of the classes the teacher presented a less traditional teaching activity, using a play-based dynamic that required the students to play an active role and generated a different type of interaction between the students and with the teacher. This was the case where the assistant of the class was the ICT coordinator, which allowed for a better flow and continuity of the class. However, even in this case the activity could have been done without the computers, meaning that the technology supported the innovation but did not drive it.

In summary, the analysis of classroom observations indicates that, even in those schools in which the MCL program could be considered successful due to the reported frequency and type of use of the technology, the introduction of the MCL has not driven teaching practices that differ to traditional paper and pencil activities. In all of the classes that were observed, the MCL was used mainly as a resource to motivate the students and not as an essential tool for carrying out activities that would only be made possible by the use of technology. Moreover, the observed pedagogical activities were strongly affected by technical problems, and thus a frequent use of the MCL did not always imply an effective use from a learning perspective. The observations also showed that in schools in which the MCL is being used in less traditional activities, a greater level of interaction among students and the teacher is being fostered. However we do not know if the teacher followed this practice before the technology introduction.

Conclusions and discussion

The objective of this study was to learn how a new strategy of Mobile Computer Labs providing 1:1 technology in the classroom had been integrated into the teaching and learning process of Chilean third grade classrooms, identifying the most important facilitators and barriers in this process during its first year of implementation. The following conclusions are based on the three main research questions of this study.

With respect to the first question, related to the way and extent to which teachers are using MCL in their teaching practices, it can be concluded that the technology has been used sporadically in Mathematics and Language, with greater frequency in Language than in Mathematics. With regard to the types of activity carried out, the most frequent tended to be exercising previously acquired knowledge and skills and searching for information. Also, more than two thirds of the respondents stated that their school always or often used the MCL to motivate their students. When analyzing the types of use according to rurality, it was observed that urban schools tended to use the MCL to carry out more traditional activities, while rural schools to do more constructivist activities, like developing more

research projects. It is unclear as to what could explain this difference between rural and urban schools, but one possible hypothesis is that in rural areas oral culture takes precedence. In this culture, face-to-face communication and interaction between people play a central role and therefore it could be argued that constructivist methods are adopted more naturally as they promote collaboration and encourage students to play a more active role when interacting with their peers.

In relation to the second question regarding the aids and barriers for integrating the MCL into teaching practices, it was found that the barriers to using the MCL included lack of time for planning, project overload and little technical or pedagogical support. Consistently, the logistic regression analysis found that students' ICT skills, planning activities and technical or pedagogical support all facilitated the use of the MCL in Mathematics and Language.

With regard to the third question of this study related to the human, technological and contextual school conditions related to the integration of MCL into teaching practices, first, in terms of the human factors or conditions, it was found that:

- With respect to participants' beliefs or perceptions, the results consistently showed that there was a willingness and acceptance amongst the different users of both ICT in general and of the MCL in particular. It was also found that the frequency of use in subjects had no correlation with beliefs and perceptions about ICT or general expectations for the project.

- However, it was also found that the principals' view was more positive than that of the teachers in relation to the conditions of training and support for integrating ICT into teaching practices. This is an important finding when considering that different views of reality between participants on the same project (specifically between those that run the project and those that implement it) can be an important cause of difficulty when implementing public policies and strategies. This is also relevant considering that other studies show the importance of a shared vision of the innovation for a successful implementation (Kirkland & Sutch, 2009; Law. et al., 2008; Fullan, 2001).

Second, in terms of the technological conditions, these were consistently positively evaluated. The respondents indicated that they valued the MCL as a resource and the availability of the technology in general was not considered an obstacle to its pedagogical integration.

Finally, with respect to the institutional or contextual conditions, the findings were that:

- As far as the administrative measures implemented in the schools, those related to making the MCL resource more readily available were more positively evaluated than those related to the organization of time and space for planning, teacher training and support.

- Nevertheless, the institutional conditions of pedagogical and technical support emerged as insufficient and an essential condition for integrating the MCL into teaching practices. Even more, the classroom observations showed that those teachers that had technical assistance during the class were able to achieve the defined pedagogical objectives of the class while those that did not have technical assistance during the class failed to achieve these. The relevance of permanent technical and pedagogical support is consistent with other studies findings (Trucano, 2005; Jones, 2004; Cox et al., 2004).

The above conclusions show that the measures taken until now by the MCL project have been insufficient and that teachers require much clearer and more systematic guidance and orientation in order to use the new resources. This is identified as being the main failure of the project and is in line with other studies that have found that the absence of teacher training and development of specific software severely limit the benefits of technology in the classroom (Chong et al., 2011; Karsenti & Collin, 2011; Severin & Capota, 2011). In future stages of this project, or similar projects, teachers cannot be left alone during the process of adoption and implementation of a new technological resource. The classroom observations clearly showed that having someone who supports the teacher before and during the class is an essential condition for a well-implemented activity with MCL. This suggests the need for teachers to plan and work collaboratively with others to integrate ICT into the pedagogical process. It is important to

consider that new technological resources add complexity to the classroom and imply changes in teaching practices and culture that do not occur overnight and which require time and support in order to be adopted and understood by the participants. Therefore, only by generating adequate conditions under which the adoption process is developed, with at least time for preparation and planning, and well designed technical and pedagogical support, can we expect teachers to acquire the necessary skills and new resources to obtain significant effects on student learning.

Finally, some limitations of this study were that it was based on the perception of one schools' representative that answered the survey and not over objective data. In fact, some differences between the perceptions of these representatives (depending in their role in the school) were observed, therefore to a certain extent the evaluation of the project could be determined by the role of the respondent. In addition, the classroom observations were performed within time constraints that did not allow for a complete in-depth study to give a more detailed description of the variables associated with a more frequent and innovative use of MCL. Finally, this study was performed only after a year of implementation of the MCL project in Chile. It is important to continue following up this strategy considering previous limitations and the lessons obtained in this study.

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