Study of utilization motives and profiles for adoption of computerized didactic material (CDM) by Quebec Elementary School Teachers

Short version – Foundations and highlights

Report submitted to Mr. Robert Bibeau for the Didactic Resources Directorate of the Quebec Ministry of Education, Leisure and Sport

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September, 2007 – Revised March, 2008

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Acknowledgements

We wish to recognize the participation and excellence in collaboration of the actors of this research by thanking, in particular:

- Messrs. Robert Bibeau and Gilles Allen for their unfailing support in the realization of this research as well as for their patience in the obtaining of the final report…
- The 13 elementary and high school teachers (the thirteenth) for having welcomed us into their classrooms, for the interest shown toward the theme of this research and for having allowed us to observe them, in a recurrent manner, in the exercise of their profession;
- Messrs. Abdelhakim Hammami, Stéphane Palm and Jean Riendeau as well as Miss Annie Corriveau, all four, students in the PhD programme in Education at the University of Sherbrooke and research assistants with the CRIE and the CREAS, for the professionalism that they proved during the various stages of data collecting and for their patience during the successive iterations required for the construction and validation of a coding grid for video observations;
- The Ministry of Education, Leisure and Sport as well as the Social Sciences and Humanities Research Council of Canada[1], both of which contributed financially toward the realization of the research.

We trust that, although we were limited with regard to the sample, the analyses realized and conclusions presented in the following pages will be of some use to the MELS, as the principal sponsor of our process, as well as to the scientific community.

[1] Programme for ordinary research grants, grant # 410-2001-814

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1. Context and research objectives

1.1 *Origin of this research*

On August 4, 2005, following the elaboration of a research project submitted to the Didactic Resources Directorate of the Ministry of Education, Leisure and Sport (MELS) and a request by Mr. Robert Bibeau, we began placing calls for collaboration with school environments. The research that we were given the mandate to conduct stemmed from the national survey on the recourse to information and communication technologies in teaching (ICT) realized by our research team in 2004 (Larose, Grenon & Palm, 2004). We had noticed, notably, the more frequent presence of recourse to computers in elementary than in high school as well as the predominance of word processing and Internet navigators in the general implementation profile of ICT into teaching. At all levels, but notably in elementary school, we observed a relative variability in the nature of computerized tools in support of teaching and learning resorted to by practitioners. Hence, as already mentioned:

> The differentiation in implementation profiles of various ICT resources is accentuated in elementary school among school subjects. If word processing alone occupies the first place in French and shares it with the recourse to the Internet navigator in Science and Technology and Social Studies, it is the use of the navigator that prevails in the Arts and the use of specialized software as well as exercisers and gameware that come first in Mathematics. In French, as well as in Science and Technology, the utilization of gameware and specialized software or exercisers occupies the second rank. In Mathematics, it is the recourse to the Internet navigator that positions itself. In Social Studies, this second position is filled by the utilization of resources of an informative nature, and, notably, by the atlas as well as encyclopedias on Internet support or CD-Roms. In the Arts, the second place is filled by graphic editors and presentation software. Lastly, as for the third position, the variability according to the school subject targeted is on a net increase […] (Larose, Grenon & Palm (2004), p. 77).

It is this variability observed as well as the occasional apparition of recourse to specialized software, in Arts or Mathematics for example, that were underlying the intention at the start of this research What was the distance between recourse declared on the large numbers of real utilization profiles of ICT in the classroom by teachers of "average" profile, therefore outside the bastion of "connected" teachers participating, in a

regular, active and recurrent manner in the activities of the AQUOPS (Quebec Association for users of computers in elementary and secondary schools), for example?

Apart from what is stated above, when the initial request was formulated by the DRD people, special emphasis was placed on the fact that we be able to take into consideration the complementarity, or on the contrary, the parallelism in forms of recourse to different types of didactic material, computerized or not. This request met a concern emanating from the observation. so often made of the predominance of resorting to the textbook as a substitute for school programmes, as well as being a privileged reference with regard to disciplinary knowledge on the part of teaching personnel (Lebrun, 2006; Lenoir, Rey, Roy & Lebrun, 2001; Spallanzani, Biron, Larose, Lebrun, Lenoir, Masselter & Roy, 2001). Therefore, one of our objectives was to observe, on a restricted sample indeed, the place and role that elementary teachers could assign both to computerized teaching material (CTM), but also to the whole of third resources to support teaching of school content or placed at the disposal of the pupil to foster learning.

As of September, 2005 we thus started our work to recruit teachers who would accept to:

- Participate in semi-structured interviews on their rapport with the utilization of computerized resources in teaching;
- Let themselves be observed during four distinct and successive teaching periods.

The main stumbling block we came up against was that our call for participation was sent out at the height of the “negotiation” period of the collective agreement of Quebec teaching personnel and of consecutive “pressure tactics” on their part. Added to this phenomenon were the effects of demoralization of practitioners following the imposition by the State, by decree, of working conditions in December of the same year. In short, if this context did not prevent us from recruiting volunteers to participate in our process, it surely did not help increase their number.

1.2 *Objectives pursued*

At the start of our process, we had set the objectives in the following manner.

- **General objective**

Identify the representations and the pedagogical integration profiles of computerized didactic material by elementary teachers and, when relevant[2], describe the integration profile of this didactic material in relation to that of the elementary school textbook.

- **Specific objectives**

1. Identify the profile of representation and expectations of teachers in the three elementary school cycles with regard to the effectiveness of pedagogical integration of CDM;
2. Describe the complementarity and the specificity of recourse practices by teachers with regard to the textbook or third "conventional" teaching material, as well as of CDM in various elementary school subjects.
3. Analyze the profile of evolution in strategies of instructional intervention implementing several didactical resources, computerized or not, during the course of a term, depending on the school subject targeted;
4. Compare the representations of teachers with regard to the effectiveness of joint or complementary utilization of CDM and, when relevant, of the school textbook between the beginning and end of the experimentation;
5. Identify the principal characteristics, on the pedagogical and didactical plans, of the diverse CDM implemented;
6. Produce an evaluation guide of CDM for elementary school personnel.

[2] In fact, in some school subjects, in the Arts, for example, teachers do not always dispose of a textbook as a reference. The relationship with other types of didactical material, non-computerized, will thus be privileged for the comparative dimension.

It is important to mention straightaway that the sixth objective was not realized and will not be with regard to the information gathered during our process. In fact, the production of a CDM evaluation guide would have meant that we had observed or gathered information on a minimally diversified quantity of computerized or, more generally, numerical resources, from our sample. As we shall see in the pages that follow, this was not the case.

Moreover, a "flat with regard to the sample" also affects the realization of the first objective. As expressed in its wording, we were hoping to avail ourselves of a balanced sample of interveners from the three cycles of elementary teaching. In addition, this targeted sample was supposed to enable the observation of recourse to CDM in a comparable manner, for each of the following school subjects:

- French mother tongue
- English as a second language
- Mathematics
- Social Universe
- Sciences and Technology
- Arts

The direct implication of this criterion was the fact that we disposed of a sample of at least six teachers per cycle, each one being observed on at least four occasions, ideally within the framework of recourse to CDM in support of teaching and learning in more than one subject during four sequences of observation. We were meant to dispose of a minimal sample of 18 subjects, generalists and specialists, allowing us to cover the spectre of the regular teaching of subjects in elementary school. The reality of the convenience sample obtained did not allow us to meet these criteria, teaching at the first cycle of elementary was absent from it, as well as the teaching of specialties (English as a second language, Arts).

2. State of the knowledge : the recourse to CDM in the scientific literature

2.1 *Foreword : but what are we talking about in this research ?*

Before drawing up the general portrait, surely summary but inevitable, of the profile of recourse to diverse numerical tools for didactical and pedagogical purposes, it is appropriate to define slightly the concept of computerized didactic material since it constitutes the very motive of this study. In a general manner, the term "computerized didactic material" seems to be more of a "portmanteau word" than the clearly defined concept the meaning of which would be mutually exclusive in relation to third concepts. Although it is frequently used in the francophone scientific literature as in Quebec government and para-government writings, the term is never defined (cf. for example, Fleury, 1994; Government of Quebec, 2002*a*, 2002*b*, 2005; Jobin, 2003).

Failing a clear definition of what computerized didactic material consists of, and after having observed the lack of nuance put forth in the literature relative to education concerning the concepts of didactic material and pedagogical material, it is appropriate to cite Legendre (1993) for whom didactic material consists in

> "…all pedagogical supports (textbooks, apparatus, objects, documents, maps, educational software, audio-visual and laboratory material, etc.) destined, on the one hand, to facilitate the teaching of the agent, and on the other, of learning by the subject […]. In a more precise manner, we consider that didactic material consists of:
> - The basic material necessary for teaching the different programmes of studies at elementary and high school levels as well as the complementary material, regardless of the format;
> - Awakening material (books, games, material for manipulation, etc.) destined for pre-school education ;
> - Instruments for measurement and assessment of knowledges;
> - Documents that may be used by teachers in the framework of their courses (literature documents for young people, reference works destined for young people, documents colligating activities, etc.)".
>
> (Legendre, 1993; p. 815).

In short, any resource useful to support teaching or learning may be considered as being didactic material. Logic therefore, would like any resource useful to sustain teaching or learning, available on numerical support, to be considered as computerized didactic material, while the computer equipment itself, for example, computers, multimedia

projectors, electronic white boards, etc., be categorized as school material just like the rest of the furnishings in a classroom.

In the statement announcing its intervention plan in 1996, the MELS informally defined computerized didactic material as follows: "[…] By that we mean educational software as well as multimedia material and pedagogical and didactic content developed for the information highway" (Government of Quebec, 1996[3]). As for Bibeau (2006), he refers rather to the use of the concept of numerical resources to distinguish the conveyers of content or software resources that enable the support of learning, which already facilitates a clearer distinction between "hardware" and "software" and, above all, between "run-of-the-mill" material and resources destined directly for the support of teaching or learning. As we shall see later on in these pages, the definition of computerized didactic material is no clearer for "user" practitioners than for third authors.

2.2 *The relationship with numerical resources in support of teaching and learning: what the scientific literature has to say*

The scientific literature gives but a sparse description of the relationship of the diverse numerical resources placed at the disposal of pre-school, elementary and high school teachers. What we do know is that the average user profile of technologies in the classroom is relatively similar in the major part of industrialized countries, in this case, that ICT are more systematically integrated with elementary rather than high school teaching, and that it is in the context of realization of learning projects that the utilization of Internet resources is both more frequent and sustained on the part of pupils (Larose, Grenon & Palm, 2004; Postholm, 2003, 2006). Generally speaking, in industrialized countries, we observe a relative under-utilization of computerized material (computers and peripheral networked equipment or not) as well as numerical resources available locally (educational software and other software used for pedagogical purposes) or on the network (Internet sites or resources available) in the daily practices of the major part of pre-school, elementary and high school teachers (European Commission, 2006; Hennessy, Ruthven & Brindley, 2005).

[3] Unnumbered html text.

In this way, in France, even though many conditions favourable to the integration of ICT are met (ratio of 8 pupils per computer and 75% of schools being connected to high speed Internet), the users remain modest. According to Lepetit, Lesné, Bardi, Pecker & Bassy (2007), "teachers are well equipped and make frequent use of their computer and the Internet, for private as well as professional purposes" (p. 8). On the other and, as for use in the classroom, only 66% of French teachers pretended to have recourse to the computer during the last twelve months that preceded the data gathering. The low use of ICT could be explained by the lack or weakness of learning benefits expected of these technologies in accordance with the representation of them shared by practitioners. Among the teachers who do not use a computer in class, 22% attribute this to the lack of benefits expected for their pupils.

The second phase of a vast survey, realized in each of the 25 member states of the European Union, as well as in Norway and Iceland between February and March of 2006, allows to determine the user profile of ICT in the classroom as a result of responses supplied by over 20 000 teachers in elementary, high school, or schools with particular vocations. Leaders in the area of implementation of ICT into teaching are Great Britain (96.4 %), Denmark (94.6 %) and Sweden (90.9 %). Countries below the European average of 74.5 % are Latvia (34.9 %), Greece (35.6 %) and Hungary (42.8 %). The percentage of teachers whose pupils used computers in the classroom for learning purposes is situated on an average of 66.5 %. In this way, the percentage of pupils having used a computer is lower than that of the teachers (average decrease of 8 %). Two obstacles are identified by teachers who do not use computers, namely: the lack of benefits expected (16 % of respondents) and needs not fulfilled in the area of technical support (75 % of respondents).This situation could be particularly critical in elementary schools where needs in technical support are greater (European Commission, 2006).

The portrait drawn up in the United States by the National Center for Education Statistics (NCES) allows us to obtain, from data gathered in 2003, information pertaining to the use of the computer and the Internet by young Americans, both at home and at school. *A priori*, from 85 % to 91 % of elementary and high school pupils use the computer at school. While 98 % of schools have been connected to the Internet since the year 2000,

only 33 % of elementary pupils claim to have used the Internet in class for learning purposes (DeBell & Chapman, 2006).

Lastly, in Australia, the works of Jamieson-Proctor, Burnett, Finger & Watson (2006), realized in the framework of the *ICTs for Learning Annual Census*, allow us to obtain a user profile of ICT by pupils in keeping with their level of schooling, as indicated by a non random sample of 929 teachers. The rate of utilization of these technologies by pupils in elementary classrooms varies between 83 % and 89 % of the total number, whereas in high school, it's established between 90 % and 93 % of them, depending on the schools.

Generally speaking, the anchorage profile of recourse to ICT in relation to the instructional intervention strategies implemented by teachers seems to be based on implicit theories or on common sense knowledges shared by teachers and founded on a double experiential basis. On the one hand, the relation to ICT and to the benefits expected from them in the area of support for teaching and to sustain learning is founded on the first relation established by teachers with school subjects of relative importance granted to their contents (knowledge facts and cognitive skills sustained by their learning). In this respect, there is a direct rapport with the effects of prioritization of school subjects by teachers, amply documented at the international level (Bernstein, 1997; Goodson, 1997; Lenoir, Larose, Grenon & Hasni, 2000) and recently recognized as a determinant of the form and importance of implementing ICT, notably in high school (Deaney, Ruthven & Hennessy, 2006).

On the other hand, this relationship is founded on the reading of the effectiveness of technological or numerical resources as a means to support teaching in a relation of " cost-benefit " where different factors come into play, such as the quality of availability of resources, their reliability, accessibility for technical support, etc. (Arnold, 2007; ChanLin, 2007; Deaney, Ruthven & Hennessy, 2006; Hartley, 2007; Larose, Grenon & Palm, 2004; Tondeur, Van Braake & Valcke, 2006). It is this double observation and mostly the primacy of the relationship with school subjects, as well as the type of device privileged to sustain learning, that make Lepetit, Lesné, Bardi, Pecker & Bassy (2007) associate the relatively weak utilization of ICT and notably of the Internet in the

classroom by French practitioners with a marginal profile of recourse to project pedagogy in the school institutions of that country.

To what degree do the elements of explanation that we just touched upon through this brief overview of the state of the scientific literature in the area find themselves in the discourse as well as in the real practice profile of Quebec teachers? This is what we shall explore in the following pages.

3. Methodology of the research

3.1 Gathering of data

3.1.1 Sample and thematic structure of interview

From February 1st to June 1st, 2006, two semi-structured interviews were conducted, one at the start and the other toward the end of participation in this research with each of the subjects in a convenience sample composed of twelve third cycle elementary teachers, and, as requested by the head of the DRD, a teacher in first year high school. This subject, apart from the initial research design, was using a particular type of material on an experimental basis: the electronic white board. The reader will find in a specific section added to this report, a particular interpretation of data gathered pertaining to this subject's representations and practices to integrate ICT into teaching. Moreover, eleven of the thirteen subjects who participated in this research were observed and filmed during four teaching periods of variable length. One subject invited us to two of the four periods during which the instructional intervention was assumed by a student teacher and, lastly, a last subject was the object of three of the four valid observations due to technical problems resulting in the alteration of a mini-DVD cassette (cf. appendix1).

The two semi-structured interviews realized respectively at the start and at the end of the process were made up of both zones or specific and distinct items as well as recurrent items that allowed us to compare the evolution in representations of the subjects, notably with regard to their own representations of the foundations of their practices (cf. appendix 2).

The first interview guide consisted of nine specific questions dealing with:

- The definition and motives of integration of CDM into teaching;
- The type of context foreseen, justifying recourse to this material;
- The source or origin of discovery of this material by practitioners;
- The technical obstacles met and modes of problem-solving implemented.

The second guide, on the other hand, consisted of thirteen specific items dealing with:

- The definition of school material and types of material implemented during the first three terms of the school year;
- The complementarity or autonomy perceived with regard to the different types of school material implemented and their relationship with the utilization of the textbook;
- The advantages and characteristics that electronic school textbooks should possess;
- The concrete illustration of complementary utilization of recourse to diverse school material, computerized or not, pertaining to the teaching of a particular school subject;
- The impact of recourse to CDM on the motivation of pupils and the difficulties they encounter when resorting to them;
- The school subjects that lend themselves more to CDM recourse.

Items common to the two guides (concerning the themes approached) referred essentially to the following:

- The practices planned and the real practices of recourse to CDM and to school computer technology during the period covered by our observations;
- The profile of pupils having the most systematically benefited from the utilization of CDM;
- The self assessment of the integration experience and modifications brought to the profile of recourse to computerized didactic material in the future;

- The impact of recourse to CDM on school learning and the school subjects that benefited most from them.

3.1.2 Sample of observation and variability

The video observations filmed in class were of variable length, from periods of 50 to 150 minutes, according to the organization and school time management proper and particular to each subject. As we shall see when presenting the modalities of analysis of observation data, this variability directly influenced the statistical model of analysis of data emanating from the coding grids for observations in *situ.*

3.2 Method of data analysis

3.2.1 Textual data

The initial interviews as well as the follow-up interviews were realized according to a double modality either in the presence of the teacher, or again by telephone. In most cases, the subjects chose the second option, which, as evidence of interviews previously realized on large numbers, does not significantly affect the volume of content of discourse gathered (Larose, Grenon, Bourque & Palm, 2004; Terrisse, Larose, Lefebvre & Bédard, 2005).

3.2.2 Video observation data

In this section, we shall present the data analysis emanating from the four moments of data gathering by video observation. It is important to recall that data serving to constitute the data tables come from the percentages of apparition of indicators retained in the different intervals that served to make up the video observations.

For purposes of this report, we retained 66 variables (or indicators) allowing us to characterize the utilization of more " conventional " didactic material as well as didactic material called " computerized" by the teachers and pupils visited during the video observations. The thirteen teacher partners were visited on four occasions between December, 2005 and May, 2006. We were thus able to produce four data tables gathered from thirteen individuals on four different occasions. Unfortunately, the lack of periodicity of measurement, linked to the constraints of teachers pertaining to observation

moments, does not allow for the use of conventional statistics methods enabling us to follow dimensions of stability, or on the contrary, the temporal evolution in individuals. Indeed, these models tested, the chronological series stationary or not, require a certain number of invariant parameters such as the stability of periodicity of data, the equivalence of the temporal periods taken into consideration, etc. (Hamilton, 1994; Hedeker & Gibbons, 2006).

To make up for the lack of periodicity in the collection of data, we had recourse to the STATIS[4] method, which enables the analysis of several data tables made up of the same variables observed on two individuals on different occasions (Dazy, Le Barzic, Saporta & Lavallard, 1996). It is important to specify that in this method, the variables or indicators must appear in each of the tables to be retained. The absence of observation of an indicator in one of the four tables (absence in one or the other of the thirteen video observations that constitute the table) requires the withdrawal of this one for all tables. The method does not allow for the analysis of variables for which the variance is null. From a maximum of sixty-six variables at the beginning, we had to eliminate twenty-five as the ratios were too weak to be analyzed. This does not mean that these variables were never observed during the fifty-two periods of observation. However, despite a presence that can be strong for one of the teachers observed, on the average, these twenty-five variables are found to have a presence of less than 5 % for all subjects. Table 1 illustrates the variables withdrawn from the analysis.

It remains nevertheless interesting to notice that from the indicators retained emanating from an inventory of material generally available in classrooms, those in table 1 are, on the whole, not used much by the teachers visited. It is understandable that recourse to the classroom blackboard by pupils or again, use of conventional encyclopedias because of the systematic absence of this resource in the classroom are low, but that conventional and computerized material is rarely suggested to pupils and that the indicators remaining are those where the imposition of material on pupils (SO63 and SO64) gives rise to fundamental questions.

[4] Structure of tables of three indices of the dual statistic.

Table 1

List of variables withdrawn from the factorial analysis of operators (FAO)

Variable code	Wording
Teacher	
PR09	Present – CDM utilization strategies
PR13	Instructions – work at home
Teacher uses or makes reference to – conventional material	
CP20	Workbook
CP22	Material displayed in the classroom – on walls
CP23	Dictionary
CP24	Grammar – (*Bescherel* included)
CP25	Encyclopedia
CP26	Books - reading or reference
CP27	Copybooks – diverse
Teacher – CDM	
MP30	*PowerPoint*
MP31	*Video clip*
MP32	*Excel*
MP33	*Word*
MP35	ICT - creation of web pages
MP36	E-mail
Pupil uses – conventional	
CE38	Chalkboard
CE42	Material displayed in the classroom – on walls
CE44	Grammar - (*Bescherel* included)
CE45	Encyclopedia
CE46	Books – reading or reference
CE47	Copybooks – diverse
Pupil – CDM	
ME55	E-mail
Source - selection of material	
SO61	Teacher suggests CDM
SO62	Teacher suggests conventional material
SO65	Pupil freely selects CDM

In order not to entirely avoid taking them into account, we proceeded toward a last series of calculations, non specific to the longitudinal data. Concretely, we used a normalization by ratio to structure the tables, starting with a Euclidian metric enabling the realization of cluster analysis by comparable groups of objects with teachers, with pupils and between distinct categories of subjects (Eiser & Busing, 2004; Everitt, Landau & Leese, 2001).

4. Results

4.1 Detailed description of sample

As mentioned earlier, our sample was one of convenience made up of volunteer teachers who had manifested their interest in participating in the research and, therefore, in collaborating in two semi-structured interviews as well as four periods of video observations. Almost all subjects, namely twelve out of thirteen, were intervening in the third cycle of elementary school, the thirteenth in the social universe programme in first year high. The sample was composed of six women and seven men. Apart from the high school teacher who was in a phase of professional insertion, all subjects could have been considered as experienced or seasoned teachers, having 6 to 25 years of teaching experience. The average age of the group was 41 years of age, with a standard deviation of 8 years, the real variation range extending from 26 years (high school teacher) to 57 years. In elementary the class welcomed an average of 25 pupils, the variation space being situated between 21 and 30, the fact that the institutions were public (9 schools) or private (3 schools) not affecting the ratios.

Nor did the status of the public or private institution affect the more or less important presence in the classes of immigrant children with language or school difficulties, nor that of pupils with mild or severe learning difficulties. On the other hand, classes in the private sector welcomed not more than one pupil with behaviour problems each, whereas those in the public sector, on the average, each integrated an average of three to four (t = 4,16 [10], $p < 0{,}002$).

The number of computers, networked[5] or not, available to pupils in class or, as a general rule, between the classroom and the computer laboratory, is not significantly different according to the status of the public or private institution. The number of networked computers accessible in class is, on the average, situated at five, this number varying from one to fifteen machines. The class that benefits from this last quantity of computers belongs to the public sector and participates in a school with a particular vocation focused on computer technology. Accessibility to computers beyond school hours, in a laboratory

[5] By networked computer we mean a computer supplied with a functional Internet connection for the purposes of this text.

also varies quite a lot from one school to the other, independently of its public or private status. Beyond class hours, computers are available on an average of three hours a day, this accessibility varying from one to seven hours, according to the institutions. The frequency (number of periods) of utilization of these resources outside of class also varies immensely. It is situated on an average of 3 periods a week per teacher but varies from one to ten periods. With the absence of a significant correlaton between the frequency of utilization of resources outside the classroom and the availability of networked resources in class, we can suppose that, for our sample, it is neither the availability nor the proximity of computer resources that affects their profiles of usage.

4.2. *Synthesis of results of analyses of interviews and observations and their connection to research objectives*

At the beginning of this report, we mentioned the two general objectives pursued in this research, namely, to:

- Identify the representations and the pedagogical integration profiles of computerized didactic material by elementary teachers;
- Describe the integration profile of this didactic material in relation to that of the elementary school textbook.

In the pages that follow, we shall present the highlights relevant to each of the two objectives by integrating, in a thematic manner, the principal observations resulting from the textual data as well as observations realized in the framework of this research

Principal research observations

- ***Definition of CDM***

For the subjects in our sample, CDM represents the whole of software tools, CD-Roms as well as material accessible on the Internet, insofar as the usage that practitioners and their pupils make of them be of a pedagogical nature or be associated with the learning process. The Internet plays a major role as a tool enabling access to specialized information which serves as content sustaining the learning of certain school subjects, notably in Social Universe, Sciences and Technology, French and Mathematics.

- ***Definition of school material***

Our subjects define school material as all tools or material useful in class, the use of which facilitates pupil learning. Besides the reference to the Internet and to computers available in class, the school material identified or illustrated by their remarks is usually limited to textbooks, to didactic sets, workbooks and exercises destined for pupils, as well as school supplies (ex. : paper, pencils, etc.). This material also includes "classical" instruments for the support of learning in all classrooms: the dictionary, grammar book, geography maps and other mural illustrations associated with the teaching of school subjects.

The principal school material utilized go from the Internet site, considered as a resource integrating learning situations or scenarios, *Piste*, for example, to more conventional "interdisciplinary" sets such as *Cyclades*, while passing by the didactic sets specialized in Mathematics, *Complices*, *Presto* and *Défi-Mathématique*, as well as certain software available on CD-ROM, such as *Clicmath.* In general, fields of application of the school material, and of CDM in particular, remain essentially those of "tool subjects", namely Mathematics and French and, more marginally, those of two "secondary" subjects, Social Universe and Sciences and Technology.

- ***Role and importance of the school textbook***

For our subjects, the school textbook is something unavoidable. If they have recourse to it daily, they do so in different ways. For some, recourse is essentially in the context of a project, the textbooks serving as back-up resources in the same way as third readings coming from diverse works or sites designated on the Internet. For others, the textbook is a source of information and inspiration for structuring the lesson or teaching activities that will be presented to pupils.

Textbooks are considered as complementary material of recourse to CDM, inasmuch as their structure is perceived as ill-adapted to the reality of teaching and learning processes in the classroom, and not too dynamic. The complementary use of the textbook is equally made by recourse to the workbook accompanying it, mainly in French and Mathematics.

Specificity of the electronic textbook

Our subjects are favourable to the recourse to the electronic textbook (online), inasmuch as it would offer a product that is correct and of quality. This type of didactic material would present certain advantages over the conventional manual, notably flexible character on the plan of utilization (facility of internal navigation for pupils) and the possibility of disposing of constantly updated information, with no need for reinvestment, contrary to the purchase of successive editions of the printed material.

The electronic textbook should present a certain number of characteristics that correspond to those sought in conventional material. The pupil should be able to find easily the information that is being looked up. The textbook should also be easy to use and contain a bank of exercises that teachers could update or enrich as they wish. It should conform to the programme of its subject of reference or of subjects covered in the case of an "interdisciplinary" manual, and must be approved by the MELS.

- ***Complementarity of resources***

The discourse of subjects tends to show the advantages of every type of material that is accessible to them. The most conventional material allows pupils to touch and manipulate, something that the mere fact of pressing on a computer button does not permit. Numerical resources, on the other hand, allow for the consultation of Internet sites and to see with images, the dynamic elements that the textbook or conventional material is not able to recreate.

- ***Usefulness of CDM for learning***

For our subjects, recourse to CDM is of equal benefit for all categories of pupils, as much for pupils at risk as for those who present a more regular profile. This material allows the stronger ones to surpass themselves and to get ahead. For the weaker ones, recourse to computer technology is an additional source of motivation for learning in general and particularly sustains interest in reading. Recourse to CDM allows pupils to have a certain control on what they do on the computer and to learn to make choices, both criteria referenced and consequential. For some pupils, the fact of being identified as good on the computer reinforces their sentiment of efficacy in reading and transposes itself on the

quality and frequency of their practices in this area. On the pedagogical plan, CDM opens up many possibilities. It enables pupils to have the impression of exercising greater control on the task, compared to what is possible for them with material known as conventional.

In a more general manner, teachers observe that the implementation of CDM, notably within the framework of writing projects, positively affects the building of competencies of pupils in French, in this dimension. In this sense, real recourse to CDM is done essentially with the purpose of sustaining the building of subject-related competencies in French and Mathematics, as well as cross-curricular competencies of a methodological order. This recourse occurs mostly in the context of projects, more collective in French, and more individual in Mathematics.

Recourse to CDM fosters the mastery of ICT competencies, and more particularly of those relative to the creation and management of computer technology files. Their utilization could also sustain the development of more autonomous attitudes by pupils with regard to their learning. The effect observed or expected is however proportional to the capacity of teachers to create frequent and regular situations for use of these resources by pupils.

Lastly, access to Internet considered as a CDM, allows to compensate for the lack of interest for the treatment of certain notions when these are approached using " conventional " didactic material, in particular the reference book or the textbook This mostly because of the live and interactive nature of the presentation being sought or covered.

- ***Obstacles or limits in utilization of CDM***

The utilization of CDM is not without pitfalls. They are of two orders:

Obstacles associated with competencies and pupil pre-requisites;

These last-mentioned are essentially associated with the utilization of new software by pupils and the necessary exploration, as well as with the learning of their functions or their particular ergonomics. This phase requires time and supervision, but pupils generally learn how to proceed quickly. The other pitfalls correspond to the

implementation of competencies required - not systematically on the part of pupils. They must read the instructions or contents on the screen, and this poses problems when they don't go to the end of the process, which they tend to avoid. Lastly, recourse to some CDM, such as online learning tools, implies the building of methodological competencies on the level for example, of logic in selection and matching of keywords, of selection of relevant information, etc., that pupils tend to avoid and without which the research process has no value on the level of learning support.

Obstacles associated with resources available to teachers

The teachers in our sample would like to dispose of quality CDM, designed and deployed in a manner adapted to the teaching of the basic subjects, namely French and Mathematics. This is generally not the case. Apart from the software for word processing that teachers use regularly in the framework of the teaching of the mother tongue and that they evaluate as being maladapted to this function, they underline the few resources accessible and the poor quality of the exercisers they dispose of.

Our subjects also regret the impact of limited access to laboratory resources as well as the restricted number of networked computers accessible in the majority of classes on the frequencies of utilization of these environments for their pupils. They would appreciate having more regular and easier access to the numerical resources and, particularly, to software adapted to the needs and characteristics of their pupils that the latter would understand easily and manipulate.

- ***Profiles and contexts of recourse to CMD***

Our subjects are relatively autonomous with regard to the integration of ICT. In general, the principal external resource that they call upon is for technical services should problems arise, such as breaks or malfunctioning of the equipment. When they call upon other external resources, it is for individuals associated with the implementation of learning activities, such as colleagues, the school principal, student teachers who are advanced in their course of studies, parents, etc. Unless there is an exception, teachers make relatively little use of CDM in a classroom context. They do so mostly in a laboratory context, in a teaching sequence that is rather traditional. With a close difference with the high school teacher who uses the electronic whiteboard in class, the

type of CDM used by teachers in the laboratory requires a multimedia projector (cannon) accompanied by a Web navigator and other material, which is essentially:

- *Excel* and *PowerPoint*, during traditional sequences of Mathematics teaching;
- Marginally, video clips for the situation scenario during start-up sequences in French and Mathematics;
- Electronic mail in the framework of "school correspondence" for writing projects.

Most of the subject content, with or without support of CDM by the teacher, is covered in a class context, essentially in a frontal, therefore traditional form, whereas intervention is more individualized and deals more with elements of computer literacy in a laboratory context. In this last situation, teachers have the tendency to take the time to explain to their pupils what has to be done, and often substitute themselves for them during problem-solving with CDM. General instructions on the utilization of CDM are not frequent and cannot be associated directly with individual work or the functioning of a group. Instructions for utilization of conventional material, for their part, are characteristic of the classroom intervention and are more generally present in a group teaching context in a traditional style.

Regardless if the group is in class or the laboratory, it is the teacher who generally imposes recourse to CDM. The teacher also imposes recourse to third, more conventional material, but the contexts of recourse to these two types of material are distinct. Moreover, if the analysis of the subjects' discourse brought out the complementarity of these two types of material in the diverse contexts of observation of practices, few occasions of complementarity were able to be observed.

5. Analysis of the specific profile of recourse to ICT and to the electronic white board by a novice high school teacher

Introduction

When we obtained the research mandate, the DRD asked us if it was possible to integrate in our sample a young high school teacher, a novice in her career at the moment we were realizing the interviews and video observations. We did it, while maintaining the original research design, meaning to say, without any particular adaptation, only taking into account the fact that the teacher experimentally disposed of an electronic white board in her classroom. It was a loan of material from the *De Marque*[6] company in the framework of its marketing strategy of electronic white boards for the *Promethean company*. When we were gathering our data, the enterprise was lending a certain number of this computerized school material, four or five simultaneously, to as many institutions, most of them in the private sector. For the MELS, the interest that we were integrating the teacher in our process stemmed from the capacity to document, in a relatively systematic manner, the real report that the practitioner would establish with this material. In so doing, the Ministry would be more apt to orient its posture to meet the offensive of distributors in the context of reinvestment announcements aimed at updating numerical resources as well as hardware in the Quebec school network.

5.1 *The electronic white board: state of the scientific literature*

Although in full expansion, the scientific literature relative to the identification of profiles of interactive[7] white boards (IWB) or electronic white boards (EWB) by teachers, as well as the impact of their utilization in class on pupils, remains relatively limited. The major portion of this emerging scientific literature, moreover, is British, since Great Britain is still the one and only country where the implementation of this school material has been the object of a specific policy of major consecutive investments. Indeed, for various reasons, notably economical, in 2003-2004 and 2004-2005 the Ministry of Education of England and, in a lesser measure, those of third States of Great Britain such as Wales,

[6] http://www.demarque.com/fr/ca/a-propos/historique/

[7] Most of the authors we refer to having adopted this terminology which corresponds to the effective keywords in the data bases consulted, we shall adopt it for the rest of the text.

decided to invest massively in this type of material. England injected, notably, more than 25 million pounds sterling, which is approximately 58 million constant dollars, for the purchase of about 300 000 of these pieces of equipment and their implementation in all the schools of its network during this period of time.

> "[…] by autumn 2005, approximately 93 per cent of primary schools, 96 per cent of secondary schools and 85 per cent of special schools had at least one IWB".
>
> (Condie & Munroe, 2007; p. 16).

Most evaluative research conducted on the implementation effects of this material arrive at a limited number of observations which confirm the principal meta-analyses recently published (Higgins, Falzon, Hall, Moseley, Smith & Wall, 2005; Higgins, Miller & Beauchamp, 2007; Moss, Jewitt, Levačić, Armstrong, Cardini & Castle, 2007). The principal impact of recourse to this type of material happens to be the support of motivation as well as attention capacities sustained by the child, notably because of the " big screen" effect. This effect, coupled with a tendency in teachers who resort to IWB regularly, has increased teaching time in large groups, most of the time in a perspective of a frontal or traditional type of teaching (Smith, Hardman & Higgins, 2006). Some studies conducted in elementary school observe an effect of decrease in recourse to teaching in small or individual groups in a perspective of projects when this technology is implemented in the classroom on a regular basis (Condie & Munroe, 2007).

The principal evaluative researches conducted with samples consisting of school populations suggest that the main "benefits" observed were in elementary, essentially with regard to the teaching of certain competencies in the mother tongue (competencies associated with reading) and Mathematics as well (geometry). However, these beneficial effects are observed in a more temporary fashion only when the utilization of IWB is made in regular alternation with the individual recourse of pupils at the working stations (personal computers) in the framework of personalized tasks or in that of group activities where the pupil happens to be more proactive. Some British government studies (Office for Standards in Education, 2004, 2005) observe that benefits in terms of impacts on learning were not really able to be documented, except under particular teaching conditions addressed to some pupil clienteles at risk in special classes (children with severe learning difficulties; autistic children; etc.).

In a more general way, the studies mentioned state the positive effects of recourse to IWB when strategies used by teachers are marked by support for constant and regular interactions with pupils, and when they are able to interact in a particular manner with the technology. This signifies, among other things, the recourse to third devices and, therefore, a more important investment in terms of infrastructures, for example like the acquisition of individual electronic interactive shelves in a relatively large number.

Most practitioners observed in the framework of studies by Higgins and coll. (2005) and Moss and coll. (2007) emphasize that the implementation of a more marginal utilization of IWB requires a major investment in time and energy on their part during the first two years of their implementation. The investment corresponds essentially to the development of material and resources adapted to the specific needs of the teacher and useful or relevant to the curriculum.

It seems useful to underline here that these observations are made within a context, that of the British school system, where the Ministry tutelar of Education sustains in a parallel way, constantly and massively, the development of CDM and, notably, of software in conformity with its programmes. This takes place through the recurrent annual budgets granted to its specialized agency, the British Educational Communications and Technology Agency (Becta), to the order of several tens of millions of pounds annually to orient local school authorities in the acquisition of equipment and CDM, and to sustain the professional improvement of its teaching personnel in the integration of ICT. To the preceding are added measures of importance aimed at supporting local authorities in matters pertaining to the purchase and updating of the computer technology park and associated resources, measures translated, for example by an investment of 40 million pounds (81 million dollars) in 2006 for the purchase of various electronic platforms in support of elementary and high school learning.

Nevertheless, even in this ideal scenery, in the framework of a literature review focused on the integration of ICT, and most particularly that of the IWB, Tanner, Jones, Kennewell & Beauchamp (2005) observe that :

> "Interactivity has long been regarded as a key affordance of ICT that teachers and learners should exploit in support of effective learning. Interactivity was defined « as the function of ICT which enables rapid and dynamic feedback

> and response » (DfEE, 1998, p. 11). Many case studies demonstrate that pupils are able to use ICT to sustain two-way communication with learning resources and environments in support of learning (Kennewell et al., 2000). With the development of interactive presentational tools such as interactive white boards (IWB), it might be expected that such affordances could be exploited to support teachers in their development of interactive whole class teaching approaches. […] The IWB does not naturally afford an increase in learner autonomy in the way that, for example, individual or paired use of laptops to sustain interaction with learning resources does. Access to the technology is controlled and mediated by the teacher. In the early stages of use, the IWB is treated typically as a black/whiteboard substitute and serves to reinforce traditional pedagogies as teachers pass through a period of de-skilling and technological vulnerability. During this period interaction is often reduced as teachers restrict the use of the board to themselves, sometimes expressing concern that pupils might put the board into a state that they would not be able to undo due to technical ignorance"
>
> (Tanner and coll., 2005; p. 725-726).

Apart from the preceding, in the framework of a more recent research including the observation of teachers in a context of pedagogical integration of ICT, with or without IWB, in a perspective of increase of interactivity among pupils, between practitioners and pupils and among these different actors, learning contents and technologies, the authors observe that with an appropriate pedagogical approach, interactivity happens just the same, regardless of the computer tools implemented. In a more general way:

> "It is clear that the transformation of pedagogy towards more pupil autonomy and personalization of the learning experience, which the early adopters of ICT envisaged, has not yet been widespread in the UK. Indeed, the advent of the IWB may be seen as a backward step, in that it gives a new impetus to traditional, teacher centred approaches"
>
> (Kennewell, Tanner, Jones & Beauchamp, 2008; p. 72).

On the other hand, as long as there is adoption of a pedagogical paradigm more centred on the pupil and on the implementation of active pedagogy, the conjugation of a set of technological tools, of which the computer is used in a network by pupils and recourse to IWB is in a more traditional teaching context, there is an increase in volume of the frequencies of interactions described earlier, as well as in the volume and quality of learning realized by pupils. In short, what the scientific literature tells us once again concerning a technological tool adopted as school material, is that the type of pedagogy taken up by the teacher determines the use of technology, and not the opposite…

5.2 *Specificities of data gathered relative to the high school teacher*

Connecting the result of the specific analysis of interviews and observations realized with subject 06 as well as the integration of data gathered during the meeting with the teacher on July 6, 2006, a member of the *De Marque* personnel and a representative from the DRD, allows us to make a certain number of observations. Firstly, in conformity with the state of the scientific literature, the principal effect attributed to the use of IWB remains support in motivation of pupils in a teaching context that is rather traditional.

The dimension of direct interaction involving pupils is relatively limited but could have been superior had the teacher disposed of more than two electronic interactive shelves. Moreover, the integration of the IWB implies a major investment on the part of the teacher with regard to the development of her didactic material, as the commercial resources or software resources supplied were limited. It is easy to understand that the material developed in the framework of implementation by sector of the IWB in high school in France is not too relevant with the spirit, letter and disciplinary contents of the Quebec programme of studies at this level of teaching.

Secondly, our subject already systematically used the access to computers available in her classroom in the framework of her previous pedagogical intervention strategies. The integration of the IWB that she realized corresponds therefore to the profile of interactivity observed in a minority of teachers in Great Britain. It is a profile corresponding to a schema where the IWB is used for the initial lesson and for assessment feedback, whereas computers and the remaining didactic material available are used by pupils in an appropriation phase, for example during drill sequences or for the realization of projects.

> "I use the IWB for each course. It is during the preparation phase that I use the IWB and during the realization phase that pupils will realize it with computers. As for the integration phases for feedback, I will revert to the IWB. Therefore, it is really during each of the learning phases, not one more than the other".

Thirdly, as is often the case, the weak quantity of specific didactic material is accompanied by training and rather summary support in the implementation of the IWB by the supplier.

> "They only sent me the software and also sent the Hachette encyclopedia. I learned on my own as there was no user guide. We have to click and try. It's trial and error.
>
> I would have liked to have someone in the subject I teach who had already prepared some things, as I had to do everything myself. And someone also with me the day I received the board because three months earlier, the company quickly showed me, in forty-five minutes, how to use it. I had my class at the same time at that moment and would have liked to have someone show me how to use it ".

Lastly, the remarks of our subject confirm that recourse to the IWB, in conformity with what is underlined in the scientific literature, to register oneself in a perspective of interactivity and complementary implication of the pupil means that the teacher who disposes of one be already experimented with the integration of technologies in his or her daily practice. It was her case as she had her pupils use the computers available in her classroom daily since her professional insertion, the IWB simply becoming an addition to the arsenal available: " (…) just because it's been the same material for three years. The interactive white board because I like being ahead of the game, trying new things, new experiences, that's a bit what my experience is about, trying new experiences".

6. By way of conclusion

Contrary to what we may think in the context of pedagogical renewal, the suggestion of CDM by the teacher or free selection of CDM by pupils is not too present in our observations. Knowing that our participants are teachers who should have an above average interest than the majority of Quebec teachers with regard to practices of integration of CDM and of ICT and considering the circumstances having characterized their recruitment, we are in position to question ourselves on what goes on in "more regular" classes regarding the integration of technologies.

Our participants had classes that benefited from a larger number of computers than the average ratio in elementary school, and, more so in high school. In comparison with the previous national survey data that we dispose of, these teachers deploy an important level of systematic reflection on the relevance of pedagogical integration of ICT, but hesitate to

suggest an autonomous use or to allow free use of it by their pupils (Larose, Grenon & Palme, 2004; Larose, Grenon, Bourque & Palm, 2004). In this context, it becomes difficult to believe that pupils can really be project managers in the recourse of technologies in their learning and that they will develop some autonomy allowing them to identify and select good material if we do not give them the space necessary to do so. Indeed, we find here a relatively systematic observation that is stated in the scientific literature. Generally speaking, in the selection of CDM as well as in recourse to the Internet in support of school learning, the major part of teachers hardly ever favour practices and contexts that would foster the development of critical judgement and methodological autonomy of pupils (Hennessy, Ruthven & Brindley, 2005; Kuiper, Volman & Terwel, 2005).

Changes in this regard can only be consecutive with the modification in profiles of the relationship to knowledge, to school subjects, as well as to the representation that practitioners have of the learning process. On this point, our position is in agreement with the observation and position of Tanner, Jones, Kennewell & Beauchamp (2005) and of Hennessy, Ruthven & Brindley (2005) for whom, without prior modification in the paradigmatic posture of interveners, it is difficult to conceive that the integration of computer technology or numerical resources in school environments will lead to something other than a minimal diversification of the school material implemented, essentially for purposes of support and motivation of pupils.

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