ICT implementation stages of primary school teachers: The practices and conceptions of teaching and learning

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Abstract
An OCDE study suggests that in many countries, including Canada, the use of information and communication technologies (ICTs) results in better academic results. However, a recent survey carried out in Quebec revealed that primary and secondary school teachers are not skilled in the use of ICTs, and in fact use them sparsely. Using observation and individual interviews, this study analyzed the teaching practices and conceptions of teaching and learning of eight primary school teachers at various stages in the implementation of ICTs. Teachers in the early stages of ICT implementation exhibited primarily behaviourist teaching practices and conceptions, whereas teachers in later stages exhibited more varied teaching practices. In addition, this latter group exhibited a higher propensity for constructivist conceptions. The necessity of further research on the relationship between the implementation of ICTs on the one hand, and teaching practices and conceptions on the other, is discussed: do ICTs influence theoretical affiliation, or do theoretical preferences condition the way ICTs are used?
Introduction

A study by the OECD (2005) suggests that in many countries, including Canada, the use of information and communication technology (ICT) results in better academic results. However, a recent survey carried out in Quebec (Canada) (Larose, Grenon & Palm, 2004) revealed that primary and secondary school teachers are not skilled in the use of ICTs, and use them sparsely. Although the Quebec department of education, through measures such as computer-purchase programs and the establishment of favourable conditions, has fostered the classroom use of ICTs, these tools have not been fully integrated into teaching and learning (Conseil supérieur de l’éducation, 2000; Larose et al. 2004). A similar situation has been observed in other OECD countries, including the Netherlands (OECD, 2001). There is thus a clear case for studying classroom implementation of ICTs. This article reports a study of the teaching practices and the teaching and learning conceptions of primary school teachers at various stages of ICT implementation. The following sections present the study background, objectives, conceptual framework, methodology, and results; the article ends with a discussion and conclusion.

Problem

The general consensus among specialists and practitioners is that the successful implementation of ICTs into teaching practice depends on, amongst other things, the pedagogical value of the implementation program, the degree to which ICTs are integrated into the curriculum, and the presence of cooperative student activities (Laberge, 2004; Tardif, 1996). For both Karsenti (2004) and Laberge (2004), a transformation of the relationship to knowledge from a teaching-based to a learning-based paradigm (CSE ; 1994; 2000; Tardif, 1998) is also a key condition. For Brossard
(1996a; 1996b), Grégoire, Bracewell and Laferrière (1996), and Morissette (1998),
teachers' assumption of guide and facilitator roles promotes the integration of ICTs.
While some authors have suggested that teachers’ approaches influence the classroom
integration of ICTs (Brossard, 1996b; Laberge, 2004), others have suggested that it is
ICT use that causes paradigmatic changes in practice (Laberge, 2004).

In addition, some researchers have reported that the integration of ICTs leads teachers to
gradually evolve from a teacher-centered pedagogy to a student-centered one (Becker,
Ravitz & Wong, 1999; Wetzel, Zambo, Buss & Padgett, 2001). Furthermore, teaching
practices appear to be strongly associated with teachers' conceptions of the
teaching/learning process. It has been reported that teachers who use ICTs the most
(both by themselves and with their students) and who exhibit the greatest ICT expertise
are more likely to endorse constructivist conceptions and practices (Becker et al., 1999;
Ertmer, Gopalakrishnan & Ross, 2001; Niederhauser & Stoddart, 2001; Ravitz Becker
& Wong; 2000; Riel & Becker, 2000). Studies of teachers’ practices at various stages of
the ICT implementation process suggest that teachers initially see themselves as agents
of knowledge transmission and gradually evolve towards a learner-centered approach
(Dwyer, 1994; Sandholtz, Ringstaff & Dwyer, 1997). However, no study of the ICT
implementation process has taken into account both teaching conceptions and teaching
practices. A further weakness of the published research is the absence of conceptual
definitions and explicit analytical frameworks. For these reasons, our current
understanding of the conceptions and practices associated with the classroom
implementation of ICTs is incomplete.
Purpose of the Study

The purpose of this study was therefore to examine the implementation of an innovation, in this case ICTs, in primary schools, through an analysis of teachers' conceptions and practices related to ICTs. To this end, rigorous conceptual and analytical frameworks were used to investigate teacher's conceptions of teaching, learning, and classroom ICT use at various stages in the implementation process.

Conceptual Framework

This section will outline the key concepts on which this study is based. Following definitions of conceptions and teaching practices, a model of the implementation of innovative ICTs will be presented. Finally, the framework underlying the analysis of teaching/learning practices and conceptions will be described in terms of the two educational perspectives of neo-behaviourism and neo-constructivism.

Teachers' Conceptions

It is important to first distinguish the concepts of "conception" and "belief". We will use the distinction noted by Sinatra and Dole (1998) and used by Lafortune and Fennema (2003): while "conception" is primarily a cognitive construct, "belief" includes affective considerations (Lafortune & Fennema, 2003). Charlier (1998) considers both "conception" and "representation", naive and individual knowledge. While representation is said to be "circumstantial", conception is "regular", in the sense that it takes into account a variety of situations and circumstances. The most judicious terminological choice for the present study thus appears to be "conception". Therefore, drawing on Charlier (1998), we define "conception" as individual, primarily cognitive, knowledge constructed by teachers through contact with their environment.
Teaching Practices

For Altet (2002), "practice" is the singular way a specific teacher does things; as such, it consists of not only observable actions but also situation-specific choices and decision making. This definition is particularly valuable because of the distinction it draws between observed and reported practice. Altet (2002) defines a teacher's observed practice as the sum of all observable acts, i.e. as what students are presented with in and out of the classroom. In Altet's definition, "choices and decision making" refers to intentions and actions that are barely observable and can only be known through teachers' verbalizations — what will be termed "reported practice".

Finally, as Bru (2004) has pointed out, it is reductive to talk about "the" teaching practice, since this presupposes some type of permanence in a teacher’s behaviour, and neglects all that is variable. For this reason, we will speak of teaching practices.

A Model of the Implementation Innovation: The Concerns-Based Adoption Model (CBAM)

The CBAM provides a measure of an innovation's implementation that takes into account concerns about and uses of innovation. As Bhola (1982) points out, tools can only be considered innovations if they call upon specific skills of individuals, groups, or institutions that have not yet functionally integrated it. While computers have been used for educational purposes for decades, ICTs are not fully functionally integrated into Canadian schools and classrooms. In this educational context, teachers’ primary concerns about ICTs therefore revolve around their feelings towards and perceptions of these technologies. For our purposes, "stage of use" refers primarily to what teachers do
or do not do with ICTs. The progression of concerns about and applications of ICTs are presented in Table 1.

### Table 1. Progression of Concerns About and Applications of Innovation (Hall & Hord, 1987; 2001)

<table>
<thead>
<tr>
<th>Concerns</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 0: Awareness</td>
<td>Stage 0: Non use</td>
</tr>
<tr>
<td>Stage 1: Informational</td>
<td>Stage 1: Orientation</td>
</tr>
<tr>
<td>Stage 2: Personal</td>
<td>Stage 2: Preparation</td>
</tr>
<tr>
<td>Stage 3: Management</td>
<td>Stage 3: Mechanical use</td>
</tr>
<tr>
<td>Stage 4: Consequence</td>
<td>Stage 4: Routine and refinement</td>
</tr>
<tr>
<td>Stage 5: Collaboration</td>
<td>Stage 5: Integration</td>
</tr>
<tr>
<td>Stage 6: Refocusing</td>
<td>Stage 6: Renewal</td>
</tr>
</tbody>
</table>

Teachers at Stage 0 ("awareness") of this model do not know that ICTs can be used for teaching purposes or have no interest whatsoever in ICTs. At Stage 1 ("informational"), teachers are aware that ICTs exist and want to obtain information about them. At Stage 2 ("personal"), teachers want to know how ICTs are going to affect them as teachers: they wonder about the way they will have to integrate ICTs into their practices, and the requirements they will face. At Stage 3 ("management"), teachers concerns reflect their initial experiences with ICTs. At this stage, they seek information about, amongst other things, available resources, timetables, and materials. At Stage 4 ("consequence"), teachers' concerns are related to the impact of ICTs on students’ learning. At Stage 5 ("collaboration"), teachers express an interest in the way ICTs are used in other classrooms or schools. Finally, at Stage 6 ("refocusing"), teachers attempt to introduce recent ICT innovations into their practices. It should be noted that at any given stage,
teachers may have concerns about issues associated with other stages, albeit to a lesser extent than their concerns about the issues specific to their current stage.

Turning now to the use teachers make of ICTs, we see that Stage 0 ("non use") teachers do use ICTs at all in class. At Stage 1 ("orientation"), teachers collect and analyze information about ICTs, and make decisions concerning their use of ICTs, although they do not actually use these technologies at this point. At Stage 2 ("preparation"), teachers undertake training concerning the logistics and use of ICTs. Actual ICT use commences in Stage 3 ("mechanical use"); at this point, teachers exhibit control of the mechanical aspects of ICTs. At Stage 4 ("independence and refinement"), teachers' classroom use of ICTs reflects good mastery of the technology. At Stage 5 ("integration"), the ICT applications teachers suggest to students are not limited to the narrow classroom context. Here, teachers attempt more extensive projects, to the extent their colleagues' cooperation permits. Finally, at Stage 6 ("renewal"), teachers re-evaluate their use of ICTs, in order to increase the impact on students. The CBAM is a widely used model for the study of ICT implementation in schools (see, for example, Deaudelin, Dussault & Brodeur, 2002; Snider & Geshner, 1999).

Two Theoretical Perspectives: Neo-Behaviourism and Neo-Constructivism

A number of educational theories suggest a different view of learning and, consequently, of teaching practices. For the purposes of this research, the two frequently contrasted perspectives of behaviourism and constructivism are of interest. This choice reflects the discourse of the popular literature in this field, and the similar choice made by other researchers, such as Becker, Ravitz and Wong (1999), Ravitz, Becker and Wong (2000), and Riel and Becker (2000). More specifically, neo-behaviourism and
neo-constructivism provide a basis for the study of teaching practices and of conceptions of learning and teaching.

The fundamental tenet of neo-behaviourism is that an individual's environment and social interactions are determinants of his or her behaviour (Staats, 1975/1986). Knowledge is considered external to the student and received knowledge held by the teacher. Students' access to this knowledge is primarily through a transmission process founded on deductive methods. More specifically, the object of learning is expressed in terms of specific objectives reflecting observable behaviours such as linguistic-cognitive, emotional-motivational, social, or instrumental behaviours. The learning strategies prioritized by this perspective are modeling, imitation, and drill-and-practice, with the duration of activities primarily dependent on learners’ needs and the number of attempts necessary to master the behaviour. In addition, anyone (teacher, students, and out-of-classroom individuals) who is useful for the purposes of imitation or modelling are welcome social resources. Over the course of the teaching process, the subject to be learned is presented to the students in increasingly complex units. The teacher thus acts in an expert capacity, deciding virtually everything, and the students' role is to perform all the proposed tasks. The main computerized tools used in this approach are tutorial or drill-and-practice software programs.

Students may negotiate some classroom rules and reinforcers, but it is teachers who primarily decide rules related to discipline and pedagogical management. Discussions between teachers and students are mainly about the concepts or tasks at hand, although teachers also provide students with feedback concerning the relationship between the latter's observed and expected behaviours. Students are invited to practice until they
show a satisfactory mastery of the content. Inter-student interactions that involve imitation or emulation of more capable peers are promoted. Unplanned events are out of place in the teaching/learning sequence, as they risk disturbing the progression of the activity. On the other hand, affective events are used to encourage, give direction, and stimulate, thereby creating a more favourable classroom climate.

Neo-behaviourism-centered assessment practices are mainly summative and individual, with great emphasis placed on tools, such as tests, that enable the collection of objective data. In general, assessments are performed at precise teacher-determined times that correspond to the point at which students are thought to have finished the learning in question. The assessment serves, amongst other things, to compare student performance to pre-determined performance levels. Assessment is performed at the end of the activity, and its purpose is to determine whether the objectives of the activity have been reached, and whether any adjustments are necessary.

The basic premise of neo-constructivism is that an individual's understanding of reality is in fact a strictly personal construction which emerges from their interactions with the environment. Although several sub-species of constructivism exist (Prawat, 1996), this premise is common to all of them. Authors such as Barth (2002) take issue with this position, pointing out the importance of socio-cognitive conflicts in learning. For these authors, knowledge is a reality internal to the student and is constructed through teaching that relies upon social interactions and inductive methods. Rather than the truth, it is the viability of the knowledge that is sought.
In practices emerging from neo-constructivism, the goal of learning activities is the construction of knowledge. To this end, the goal is formulated by the teacher as a "hypothesis", which is then presented to, and discussed and reformulated with the students. This context prioritizes learning strategies, such as project-based teaching or cooperative guided discovery, that rely on social interaction. The duration of the activity is determined by both teacher and students, but is usually spread over several weeks or months. Anyone (teachers, students or out-of-classroom individuals), who can help construct the reality is a pertinent and useful social resource. Course delivery takes the form of presenting the students with the object of learning in a significant context, and is not directive. Knowledge is thus viewed as a plurality of realities, with each student individually constructing their own and the teacher playing the role of mediator who accompanies students in their construction of reality. Teachers organize space and time, while students make their own decisions and manage their process. Almost all the elements of the teaching situation are thus the object of negotiations.

The primary computerized tools used in this approach are generic software and computerized communication products. Classroom rules intended to pinpoint the expectations and roles of each member of the class are formulated by the entire group. Discussions between the teacher and the students are generally about the procedure used by the students to deal with different situations, whereas teacher feedback aims at stimulating students to think about their learning process. Discussions between students represent opportunities to provide feedback about a peer’s work and identify socio-cognitive conflicts. During these discussions, students are invited to verify the viability of their knowledge, compare their knowledge to others', and make necessary
adjustments. Unplanned events, for their part, enrich the pedagogical situation and constitute problem-solving opportunities. Little attention is paid to affective events.

The assessment of neo-constructivist-inspired learning is above all continuous and formative. The methods of choice for keeping track of all classroom participants are the individual student portfolios and the teacher’s files. Student portfolios contain indicators of their expectations, sources of satisfaction, work, self-evaluation etc. The teacher’s file contains traces of activity preparation, critical events, observations etc. Both these sources of information help identify decisions regarding learning and the execution of current and future projects.

**Methodology**

The following section describes the type of study carried out, presents the tool used to select participants, and describes the data-collection tools and analytical procedures.

**Type of Study**

Two types of study were possible. We could have followed the progress of a group of teachers as they implemented ICTs into their teaching. Such a choice would have required a longitudinal study. Instead, we opted for a cross-sectional one, which requires a shorter data-collection period. With this strategy, the ICT implementation process is seen as a series of "snapshots" collected from different subjects, rather than a series collected from only one subject over all the stages of implementation. This type of study requires selection of study participants on the basis of their progression through the ICT implementation process.
Participants
Participants were selected on the basis of their concerns about ICTs, assessed in terms of the CBAM (Hall & Hord, 2001). The emphasis on concerns rather than utilization reflects our decision to use Hall, George & Rutherford's (1986) SoC (stage of concerns) questionnaire, which operationalizes individual levels of concern related to an innovation. In this study, the SoC questionnaire was used to characterize teachers’ concerns about ICTs. The original version of the questionnaire was translated into French and subsequently subjected to a linguistic review by two trained experts in translation and in research. Since the translated questionnaire was not the subject of cross-cultural validation, it is impossible to specify the metrological qualities of the instrument. However, it should be noted that the original version of the questionnaire is acknowledged to be reliable.

The research project was presented to groups of teachers during workplace training sessions offered by their employers, and their participation solicited. During the course of these meetings, teachers were invited to evaluate, on a voluntary basis, the 35 items of the SoC questionnaire on an eight-point Likert scale. The eight teachers (four women and four men) who participated in the study were all from the province of Quebec (Canada) and taught various primary school grades (one taught first grade, one third grade, three fourth grade, two fifth grade and one sixth grade). The results of the SoC questionnaire indicated that there were four Stage 3 teachers, with concerns related to the logistics and the organization of ICTs, one Stage 5 teacher, who was interested in sharing and cooperating with colleagues, and three Stage 6 teachers, who were interested in the latest advances in ICTs.
First Data-Collection Tool: Interview

Our interest in teacher’s conceptions of the teaching/learning process necessitated collecting data through individual interviews. Each teacher took part in two semi-structured interviews of approximately 50 minutes each. In general, the interviews collected information on teachers' conceptions of their ICT practices and the educational process. More specifically, the interview schedules comprised three components. The first component addressed the planning, execution, and assessment of observed activity or activities integrating ICTs of interest. The second component addressed teachers’ conceptions of teaching and learning. Finally, data on ICT-related conceptions were collected in the third component.

Second Data-Collection Tool: Observation

Observation is, as Bru (2002) has pointed out, the most valuable way of collecting data on teacher actions during teaching and learning activities. The advantage of these observational tools is that they allow us to collect facts from real classroom situations. Two 50-minute non-participative observation sessions were held in each of the participants’ classrooms. The first observation was held immediately after the first interview, which was used, as previously stated, to specify the activities to be observed. The time of the second observation was dictated by teacher availability. These observations were framed by a technical intermediary, in the form of an observation guide comprising eight items related to neo-constructivist and neo-behaviourist target indicators. These indicators were: sequence of events of the activity; unplanned events; social resources; temporal resources; computerized resources; tasks to complete; presentation of content; and feedback.
Data Processing

The verbatim of each interview and the observation reports were transcribed. The data collected was subjected to thematic analysis, a form of content analysis. This type of analysis allows a document's themes and ideas to be identified through the coding, counting, and comparison of syntactic units (Van der Maren, 1995). The interview and observation material was divided into syntactic units, and analysed with the ATLAS/ti program.

The analytical framework used for the coding of the syntactic units is based on sequence of neo-constructivist and neo-behaviourist indicators (Deaudelin, Lefebvre, Brodeur, Mercier, Dussault & Richer, 2005). The twenty categories that constitute the analytical framework include: the object of learning, teaching methods, resources, anticipated results, roles of the participants, classroom rules, interactions between participants, relationship to knowledge, affective and unplanned events, learning assessment, activity assessment, and the purpose of the assessments of learning and activities. Each one of these categories was operationalized in terms of the neo-behaviourist and neo-constructivist perspectives of this study. Additionally, syntactical units that could not be classified as neo-behaviourist or neo-constructivist were classified as "other theoretical perspectives".

Results

The results are presented here in order of the stage of concern with regard to ICTs.
Stage 3 Teachers

Lorraine\(^1\), Corinne, Véronique and France were all at Stage 3 of concern. As Table 2 indicates, the conceptions of Lorraine, Corinne and France were primarily associated with behaviourism (48.2%, 52.7% and 56.1%). Lorraine and France also exhibited tendencies towards other theoretical perspectives (35.5%, 38.1%). Véronique displayed a different profile. Her conceptions were primarily associated with another theoretical perspective (46.7%) although there were some elements of neo-behaviourism (33.8%).

Table 2: Teachers’ Conceptions and Practices, by CBAM Stage

<table>
<thead>
<tr>
<th>CBAM Stage</th>
<th>Teacher</th>
<th>Items</th>
<th>NB (%)</th>
<th>O (%)</th>
<th>NC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Lorraine</td>
<td>Conceptions</td>
<td>48.2</td>
<td>35.5</td>
<td>16.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RP</td>
<td>49.2</td>
<td>34.2</td>
<td>16.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OP</td>
<td>69.6</td>
<td>21.8</td>
<td>8.6</td>
</tr>
<tr>
<td>3</td>
<td>Corinne</td>
<td>Conceptions</td>
<td>52.7</td>
<td>25.1</td>
<td>22.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RP</td>
<td>57.1</td>
<td>21.8</td>
<td>21.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OP</td>
<td>68.0</td>
<td>13.3</td>
<td>18.7</td>
</tr>
<tr>
<td>3</td>
<td>Véronique</td>
<td>Conceptions</td>
<td>33.8</td>
<td>46.7</td>
<td>19.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RP</td>
<td>43.7</td>
<td>30.4</td>
<td>25.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OP</td>
<td>57.4</td>
<td>19.7</td>
<td>22.9</td>
</tr>
<tr>
<td>3</td>
<td>France</td>
<td>Conceptions</td>
<td>56.1</td>
<td>38.1</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RP</td>
<td>77.2</td>
<td>18.6</td>
<td>4.2</td>
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<tr>
<td></td>
<td></td>
<td>OP</td>
<td>86.6</td>
<td>11.9</td>
<td>1.5</td>
</tr>
<tr>
<td>5</td>
<td>Yves</td>
<td>Conceptions</td>
<td>37.5</td>
<td>25.3</td>
<td>37.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RP</td>
<td>21.1</td>
<td>24.2</td>
<td>54.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OP</td>
<td>40.0</td>
<td>17.4</td>
<td>42.6</td>
</tr>
<tr>
<td>6</td>
<td>André</td>
<td>Conceptions</td>
<td>23.3</td>
<td>34</td>
<td>42.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RP</td>
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<td>59.5</td>
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<td>OP</td>
<td>42.9</td>
<td>13.1</td>
<td>44.0</td>
</tr>
<tr>
<td>6</td>
<td>Alain</td>
<td>Conceptions</td>
<td>33.5</td>
<td>20.5</td>
<td>46.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RP</td>
<td>39.1</td>
<td>23.5</td>
<td>37.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OP</td>
<td>51.4</td>
<td>16.4</td>
<td>32.2</td>
</tr>
<tr>
<td>6</td>
<td>Gilles</td>
<td>Conceptions</td>
<td>28.9</td>
<td>38.9</td>
<td>32.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RP</td>
<td>40.6</td>
<td>23.0</td>
<td>36.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OP</td>
<td>39.9</td>
<td>27.0</td>
<td>33.1</td>
</tr>
</tbody>
</table>

NB = neo-behaviourism  
RP = reported practice  
O = other  
NC = neo-constructivism  
OP = observed practice

\(^1\) These are fictitious names.
Most of these teachers described teaching as preparing concepts to be taught in order to attain learning objectives, presenting material of progressively greater difficulty, and offering additional exercises as necessary. Learning, on the other hand, was viewed as the testable outcome of a process involving the acquisition of desired behaviours. These teachers appear to view learning as a process that is dependent on student involvement and that is realized through modeling or deductive teaching methods.

Teachers believed that ICTs, particularly drill-and-practice software, help them stimulate students to review previously taught concepts (in French or mathematics, for example). They also recognize the possibilities inherent in the Internet, email, and word processing. In a broader sense, they believe that ICTs allow students to develop abilities — such as computer, mouse, and keyboard skills — that will be essential in tomorrow’s society. Nevertheless, Stage 3 teachers’ use of ICTs is primarily conditioned by their lack of knowledge concerning available products, technical problems encountered in the laboratory, and the matching of proposed tasks to classroom material.

The reported and observed teaching practices of Lorraine (49.2%, 69.6%), Corinne (57.1%, 68%), Véronique (43.7%, 57.4%) and France (77.2%, 86.6%) were all associated with neo-behaviourism. In addition, the reported practices of Lorraine and Véronique also reflected other theoretical perspective (34.2%, 30.4%).

In general, those four teachers stated that their ICT-based activities involve students transcribing texts, answering specific questions, or applying previously taught concepts. They thus tended to encourage the use of drill-and-practice software, the Internet and word processing. They all tended to offer hierarchical learning activities. Furthermore,
these activities included tasks which were independent of the others. For example, some tasks cause students to apply mathematical and grammatical concepts or transcribe a text. The teachers' feedback tended to take the form of reminders of expected behaviours, reactions to student behaviours, verbal and non-verbal encouragement, and reprimands.

**Stage 5 and 6 Teachers**

Yves was the sole Stage 5 teacher, while André, Alain, and Gilles were Stage 6 teachers. As Table 2 indicates, the conceptions of Yves and Alain reflected both neo-behaviourism (37.5%, 33.5%) and neo-constructivism (37.2%, 46%). André’s had clearly neo-constructivist (42.7%) conceptions, although another theoretical perspective was also present (34%). Finally, Gilles' conceptions were primarily associated with another theoretical perspective and secondarily with neo-constructivism (38.9% and 32.2%).

Broadly speaking, Stage 5 and 6 teachers view teaching as the realization of experiences integrated in contexts students find significant. To achieve this end, these teachers favoured learning activities spread out over several weeks. In addition, these teachers saw learning as dependent on student involvement and assumption of responsibility. For them, learning must be experienced by students through real-life situations such as projects and teamwork. These teachers applied a diversity of ICT applications, ranging from drill-and-practice software to the whole range of generic software, and view ICTs as an assessment tool that gives access to new material. For many of them, ICTs represent the tool of the future.
The reported practices of Yves and André were primarily associated with neo-constructivism (54.7%, 59.5%), while their observed practices were split between neo-behaviourism (40, 42.9%) and neo-constructivism (42.6%, 44%). Alain's practices, both reported and observed, reflected both neo-behaviourism (reported: 39.1%, observed: 51.4%) and neo-constructivism (reported: 37.4%, observed: 32.2%). The same split between neo-behaviourism (reported 40.6%, observed: 39.9%) and neo-constructivism (reported: 36.4%, observed: 33.1%) was observed with Gilles.

Teachers at stages 5 and 6 of the CBAM all stated that their students' classroom tasks are part of a significant project, and that their assessments of learning tend to reflect process as much as knowledge. Some of them stated that they used assessment grids, portfolios, self-evaluation, finish products or test-like exercise sheets to assess students’ learning. Observation of actual practice revealed that these teachers tended to offer tasks that were part of significant projects, require student involvement, and were amenable to integration with computerized products (e.g. drill-and-practice software, generic software and the Internet).

**Comparison of Stage 3 teachers and Stage 5 and 6 teachers**

The four Stage 3 teachers formulated their conceptions of teaching primarily in neo-behaviourist terms, whereas Stage 5 and 6 teachers tended to adopt a neo-constructivist discourse. While most Stage 3 teachers view teaching as essentially the preparation of concepts to be taught in order to reach learning objectives, Stage 5 and 6 teachers view it as the deployment of inductive methods in order to provide students with access to subject-specific knowledge.

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2 Results related to stage 5 and 6 teachers are presented together in order to facilitate reading.
The situation is similar for conceptions of learning. Stage 3 teachers essentially address learning through a neo-behaviourist lens, whereas Stage 5 and 6 teachers view learning as above all linked to neo-constructivism. For the former, learning is a testable outcome of the acquisition of desired behaviours, whereas for the latter it is something that must be experienced by students through real-life situations such as projects and teamwork.

Whereas the conceptions underlying Stage 3 teachers' use of ICTs primarily reflects a neo-behaviourist approach, the conceptions of Stage 5 and 6 teachers are a blend of neo-constructivism and neo-behaviourism. Broadly speaking, Stage 3 teachers believe that ICTs, particularly drill-and-practice programs, allow them to stimulate students to review previously taught concepts. In a broader sense, they believe that ICTs enable students to develop skills that will be essential in tomorrow’s society. Stage 5 and 6 teachers view ICTs as useful teaching tools because they provide, amongst other things, access to new material. For many Stage 5 and 6 teachers, ICTs must be taught because they are the tools of the future.

Stage 3 teachers exhibited reported practices typical of neo-behaviourism, whereas Stage 5 and 6 teachers had a tendency to describe their practices in neo-behaviourist and neo-constructivist terms. In general, the four Stage 5 and 6 teachers claimed to offer ICT-based activities that involve students transcribing texts, answering specific questions, or applying previously taught concepts. They tended to favour the use of drill-and-practice software, the Internet and word processing. In addition, they claimed to offer tasks that are part of a significant project and to use a diversity of applications ranging from drill-and-practice software to the entire range of generic software.
Finally, Stage 3 teachers’ observed practices are mainly illustrative of neo-behaviourism, in contrast to the neo-behaviourist and neo-constructivist practices of Stage 5 and 6 teachers. On the whole, Stage 3 teachers tended to offer activities based on hierarchical learning. Stage 5 and 6 teachers all offered significant projects that require students’ contribution and favour the use of a range of computerized products, such as drill-and-practice software, generic software and the Internet.

**Discussion and Conclusion**

While Stage 3 teachers exhibited conceptions and practices typical of neo-behaviourism, Stage 5 and 6 teachers exhibited a more heterogeneous portrait. However, it should be noted that it is in stages 5 and 6 that neo-constructivist conceptions of teaching and learning are more commonly observed.

These results are consistent with those reported in the literature, notably by Sandholtz *et al.* (1997), who stated that the more a teacher integrates ICTs into pedagogical practice, the more classroom work reflects a constructivist or socio-constructivist perspective. Our results show that teachers at stages 5 and 6 claim to establish more such practices than did Stage 3 teachers. Although most studies maintain that ICTs should change the role of the teacher, the present research does not clarify the direction of the relationship between theoretical position and the stage of ICT integration. It is therefore logical to ask whether ICTs influence the choice of a theoretical affiliation, or whether the choice of a particular theory leads to different uses of ICTs in teaching practice. Further research on this question is indicated.
In addition, the limitations of this study suggest avenues for future research. It should be emphasized that the small number of participants prevents generalization of our results to larger populations. Furthermore, our analytical framework only took into account two theoretical perspectives. It should be remembered that this choice was justified by previously published studies, which tended to contrast these theories (even if the terminology used was not consistent). Taking into account other perspectives would certainly allow for a more precise reading of the comments grouped in the "other" category. Qualitative analysis of our results reveals, for example, that one teacher (Véronique) oriented her conceptions and practices along humanist lines. Unfortunately, the analytical framework of Deaudelin et al. (2005) used in this study does not take into account such a theoretical position, and all the richness and meaning that could have emerged from these comments has, as a result, been lost. Consequently, the use of tools that take into account more than two theoretical perspectives, such as Lenoir’s (1991) educational intervention models or the teaching perspectives developed by Pratt and his colleagues (Pratt, 2002; Pratt, Collins & Selinger, 2001), would certainly be beneficial.

Finally, according to Nisan-Nelson (2001), the control teachers perceive as necessary for teaching may limit ICT integration. It may therefore be that Stage 5 and 6 teachers, who exhibit primarily constructivist practices, are more likely than Stage 3 teachers to consider a lack of classroom control not detrimental to students. This is another avenue to explore.
References


