The New Millennium Learners: Digital technologies, educational results and learning expectations. Some considerations

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Introduction

The following text corresponds to an exercise with constraints. We were asked to reflect on the following questions:

- Is there sustained evidence regarding the effects of technology on educational achievement?

- Is there a contradiction between how NML manage knowledge outside and inside schools?

- How do NML see the school education they are getting as regards the use of ICT?

- Are they supportive of ICT-based educational innovations or, rather, they would prefer keeping teaching as traditional as it can be?

- Do they mostly welcome more flexible ways of ICT-enhanced learning such as e-learning or not?

These questions correspond to a domain where we have been researching for quite a while now. However, we find it very difficult to answer them, for several reasons. For example, technology evolves very quickly, while educational systems evolve rather slowly, seldom in less than a decade. Besides, if educational achievement can be measured, relating it to technology usage (or to any other single factor) is an almost impossible endeavour. So, looking for sustainable evidence of the effects of technology on educational achievement is probably a desperate challenge. Identifying what technologies can bring to the system seems to us to be a more interesting issue. We are going to briefly analyze here the links between digital technologies and learning in the French school context, therefore taking some liberty with the initial questions. Our endeavour, while anchored in our scientific activities, has fundamentally a reflective character and is not linked to a single set of recent empirical data.

French educational system and ICT in a nutshell

France is among the pioneer countries implementing technological innovations in schools and leading strong policies aiming at equipping schools and developing technology usage in school. It has a good Internet infrastructure and new technologies for communicating are no longer an innovation reserved to well-off people. Regarding ICT in schools, and to be brief (for an extended presentation, see for example Baron & Bruillard, 2003), ICT has ceased to be considered as an innovation more than 20 years ago (even if, as in every other country there is a cutting edge of innovation, continually moving forward). Perhaps, one of the major points is that there is an ongoing process of decentralization of education, leading to a potential

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management problem: local and regional governments pay for much of the educational expenses (except for teachers' salaries). They have rather wide responsibilities regarding the attribution of hardware and software to schools. But, according to legal dispositions, they have no responsibility for curricula and pedagogy, which remains an attribution of the national state.

However, attributing equipment to school bears pedagogical consequences. For example, local governments currently show a great interest for electronic whiteboards (a "visible" technology that can be easily accounted for), as a way to "integrate" ICT without changing to much "traditional" pedagogy.

Regarding ICT usage with students, the data we have about effective practice in classrooms and students ICT competencies rather point to difficulties.

A recent European survey (Empirica, 2006) shows that France does not rank very high, among European countries, regarding ICT usage. But it should be noticed that ICT is no longer a subject-matter in secondary education. Besides, some teachers have reservations regarding it. In particular, 20% of teachers saying they do not use it invoke as a reason that there are no clear benefit attached to it (European mean: 16%). Those 20% represent only 7% of teachers, and this can be considered a small minority. But they are not a silent minority.

Data from PISA 2003 (Eurydice, 2005) provides results, in a comparative study about 15 years old boys and girls, showing, for example, that less than half of students are familiar with activities such as using a spreadsheet to plot a graph. But such studies rely on declarative statements from students. It remains problematic to know whether students under or over estimate their ICT competencies.

On the difficulty to look for sustainable evidence

So far no clear evidence has been found regarding the effects of technology on educational achievements. But it must also be considered that France has no tradition of standardized tests and that traditional exams do not give much importance to ICT usage, except in technological fields. However, a new practical exam is currently being installed in mathematics at the baccalauréat, where students will have to solve problems using ICT instruments. It is interesting to notice that a first experiment, concerning more than two thousands 12th graders, has been done, ten years after the importance of including ICT use for the baccalauréat has been clearly underlined (Bruillard, 1995).

However, all observations concur: using ICT may lead to innovative ways of learning existing subject matters. The problem is that these innovations are seldom sustainable. When they seem to be, they do not exactly disseminate equal to themselves. They are progressively adapted to the educational system, integrated in a whole and it is difficult to estimate their neat impact on the changes that occurred. In fact, our experience as French researchers has taught us that technologies are not homogeneous and that three different cases should be considered.

1. Educational technology (as a set of tools for the teacher) spreads very slowly and brings almost no visible results regarding students' achievement. This does not really mean, of course, that it is useless. A few "compatible" technologies end up being completely integrated in teachers' activities, bringing some change in the learning process, among which presentation technologies.

2. Some general software tools widely disseminated within the society make their way into the classroom, with uncertain effects (word processors, spreadsheets, search

engines…). They change the way people communicate, access to information, produce and exchange texts…

3. Finally, specialized software are also common in different subject matters (computer algebra systems, computer assisted drawing, computer assisted experimentation…).

Reflecting how NML knowledge inside and outside of school can be considered, mainly refers to case 2.

NML knowledge inside and outside of school

As has often happened in the past for more ancient technologies, there is a growing gap between Internet usage within and without school. Now, communication technologies have become completely pervasive. They are playing an increasing role in juvenile sociability and even the construction of identity. For example, a series of recent research (e.g. Fluckiger, 2006) pointed at the importance of SMS and blogs at junior high-school level. Technologies and Internet resources are also used for the purpose of school work, but not always as teachers would like it to be. What is at risk is the very notion of individual work. Much time and effort can be easily saved by surfing the internet and pasting chunks in a report, with however worrying side-effects like the lack of faulty or disreputable learning, the dependence upon arcane page-ranking algorithms and the learning of unwanted knowledge. NML therefore certainly use ICT differently within and outside of school. This is confirmed by recent reports underlining the gap between home and school uses (Mediapro, 2006). Is it also reported by Gansmo in her PHD thesis (2004), arguing that computers are nowadays a natural and trivial part in the teenagers' life (p. 218), but that school computing is considered by them as boring.

Students generally use technology outside of schools for practical purposes, to satisfy immediate needs. They do not show much interest for underlying principles and seldom have enough competencies to solve by themselves the technical problems they face.

It has been observed that, in the context of homework, students tend to be satisfied by the first answers they found to any problem (the syndrome the first page of results for a search engine). However, observation shows that, when they are really motivated by a problem, they are able of sophisticated activities, cleverly mobilizing a social network, trying different solutions if they do not find at once what they want.

Within school, students have to perform tasks prescribed by teachers that are often organized so as to need reflection, detours and the confrontation with planned difficulties. They often like innovative tasks that do not belong to the common routine (provided there is no evaluative pressure). But, when those tasks happen to become routine, they generally lose a part of their attractiveness.

However, we would not answer a blunt "yes" to the question "is there a contradiction between how NML manage knowledge outside and inside schools?". Things are more complex. Firstly, and this is no groundbreaking news, NML are not homogeneous and much seems to depend upon the social milieu and the cultural capital of families. This means that compulsory school does have a crucial responsibility to educate youngsters, in particular for what regards responsible usage of ICT.

Secondly, everything is not dark in the school landscape. Some very interesting learning strategies can be observed, even with tools like wikipedia, which lend themselves to application in different disciplines.

Thirdly, in the field of what is prescribed by teachers, new ways of coping with disciplinary knowledge have been demonstrated; new learning activities have been observed.

Educators (not individual educators but as a group) do therefore have a leading role for inventing and disseminating new learning activities. In fact, there are currently a number of teacher associations engaging themselves in cooperative work to offer free resources to their colleagues and even to teachers. Such initiatives may play a part in how the future is going to be shaped[3].

NML, school education and ICT

It seems to us hardly possible to answer in general and we shall focus here on a specific subject: the issue of spreadsheets because it illustrates the case of what has happened to this powerful class of software. In order to get a more comprehensive picture of the ICT current situation in French schools and to obtain a better knowledge of ICT uses and competencies of students, we have launched a research project two years ago focusing on spreadsheets, inasmuch as they are a good indicator of ICT mastery. This project called DidaTab (didactics of spreadsheet) is a three year project (2005-2007) founded by the French ministry of research.

Among the first results (Blondel & Bruillard, 2006 a&b), a near complete cartography of spreadsheets uses in the French secondary education could be established, including an overview of personal uses (according student profiles) and differences emerged in uses according to student profiles (secondary school streams, gender, social background…).

To check the effective mastery of spreadsheets by students, we have designed specific computer tests and have done several experiments at different school level (grade 9, grade 12, undergraduate university students). Our experiment with 12th graders has showed that, if communication skills are quite common among them, using a spreadsheet appears to be infrequent and difficult. Partly, it is certainly due to lack of mathematical skills, but also to some difficulties in interacting with the computer. For communication activities, doing again and again the same procedures (the same *gestures*) may provide sufficient confidence and mastery for current use. But it is not the case for spreadsheets. In fact, there is a deficiency in the conceptualization of issues at stake. This poses a complex curricular problem. It seems that intrinsic difficulties for understanding spreadsheet concepts are not sufficiently taken into account in mathematics education, even in the school streams where mathematics objectives and views are connected to every day life.

Students in technical and vocational fields, who are mostly supposed to use the spreadsheet, are unfortunately those who are precisely blocked by difficulties in the algebraic domain. In that sense, our research raises important issues also about mathematic learning and teaching in French secondary schools.

Differences between home and school usage are unavoidable. But what is really at stake is how the educational system may allow all students to profit from the opportunities of new software tools. Currently, school education takes spreadsheets into account only very partially. Students therefore mainly get partial views of what they allow and cannot develop the kind of competencies they might use for solving complex problems. But the situation is not immutable and more observation is in order.

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[3] For example SESAMATH in mathematics (http://www.sesamath.hautesavoie.net/), CLIONAUTES in history and geography (http://www.clionautes.org/).

New flexible e-learning modalities and NML opinions

This is another difficult issue, for which we cannot rely, at least regarding school education, on many research results. What we observe is that a new kind of offer is gaining audience in secondary education, aiming at accompanying students in their study of various disciplines. This offer is mainly proposed by private companies, which provide support for what the public system does not offer. Existing results show that their impact may be rather limited (Artigue, 2005), specially when they are not integrated in a set of tasks defined by teachers.

In higher education, new flexible modalities are being offered to students, using various forms of e-learning, different kinds of collaborative work and so on. This trend appears to be strong and sustainable. Higher education institutions are willing to disseminate new modalities of training, in order to better adjust to their public. On the other hand, many higher education students are also willing to experiment more flexible solutions for gaining their diploma. Using forums as means to enhance learning does work rather well in teacher education (Baron & Bruillard, 2006). But integrating e-learning modalities will raise new issues. One important of them concerns the separation between public space and private space.

Perspectives

ICT tools are now an integral part of NML environment. They offer not only new ways to teach but also new ways to learn, provided users have received an education about them. Educational systems are driven by social finalities. They evolve slowly and tend to resist innovations and technological fads. As a consequence, the usage of technology is liable to remain different within school and outside of it. The main problem is probably not to integrate existing ICT in the system *as it is*, but rather to spark off and sustain changes in subjects matters and curricula in order to take into account ICT dissemination in the society. Therefore, a crucial issue at stake is to understand by which processes innovative actions may generate everyday learning situations and eventually equip all students with the necessary scientific and cultural references. A good news is that things are steadily moving on, however slowly.

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