

## Digital Students in a Book-Oriented School: Students' Perceptions of School and the Usability of Digital Technology in Schools

Yifat Ben-David Kolikant

School of Education, Hebrew University of Jerusalem, Mount Scopus, 91905 Jerusalem, Israel // Tel: 972-2-5882056  
// yifatbdk@mssc.huji.ac.il

### ABSTRACT

Today's students were born into a world of digital technology. We investigated the impact of computers and the Internet on the learning preferences of students whose schools do not use this technology in class, specifically, (a) the usability they attributed to the technology for tasks requiring the processing of information; and (b) their attitude towards the technology in relation to their attitude towards the type of learning used in school. Our focus was the history class. To this end, surveys were filled out by three different classes that do not use computers in school: one in a high school that advocates beyond-information activities and two in information-focused public (i.e., state) schools—a high school and a middle school. These attitudes were found to be negatively correlated with the legitimacy ascribed to the form of learning used in school. Specifically, the two public-school classes used digital technology in the belief that they knew better than their teacher how to pursue a school information-focused agenda, whereas the third class legitimized the form of learning used in school. In neither case, however, was there any indication of a fertile human-computer partnership, envisioned as the desired form of learning for the digital age.

### Keywords

Forms of learning, Learning resources, Usability, Human-computer intellectual partnership

### Introduction

Children all over the world use computers and Internet technology, thereby informally learning how to learn with the technology. It is widely argued that technology, computers and the Internet shape how we think (e.g., Bolter, 1984). In school, however, students encounter a form of learning shaped by books. This encounter may feel awkward. Students might doubt the relevance of school as a learning-to-learn institute given their informal learning experience; or they might internalize schooling as a privileged form of learning. In both cases the fertile human-computer interaction needed by for tomorrow's citizens in a rapidly changing world (e.g. Salomon et al, 1991) is not likely to be established. Understanding how students perceive the relationship among school, learning, and digital technology—the goal of the study described in this paper—is important because schools have a responsibility for preparing the new generation for life.

### Digital learning among children

An OECD report (OECD, 2005) shows an increment in children's use of computers in all 40 countries participating in the survey. In Israel, where the study described was conducted, nine out of ten households with teenagers have at least one computer connected to the Internet, according to a survey on e-readiness carried out for the Ministry of Finance (Mizrahi et al., 2005). This survey also pointed out that teenagers have high e-readiness, i.e., they are able to benefit from digital technology.

Harel (2003) refers to today's children as *Clickerati* and as the *three X's generation*; the latter term emphasizes their computer literacy and their learning through bricolage by eXploring, eXpressing, and eXchanging ideas (hence the three X's) using technological means. In this way they differ from previous generations that learned from books. These characteristics of children's learning preferences are also emphasized by other terms used to describe them, such as the *digitally fluent* (Resnick, 2002), the *Net Generation* (Tapscott, 1998), and *digital learners* (Brown, 2002).

Children's tendency to learn by exploration was observed long before computers became common (Holt, 1964). However, computer and Internet technology made bricolage legitimate or even necessary (Turkle, 1995). Turkle asserts that children, like other computer users, "have moved in the direction of accepting the postmodern values of opacity, playful experimentation, and navigation of surface as privileged ways of knowing" (Turkle, 1995, p. 267).

Thus, the use of computers changes not only one's preferred forms of learning but also epistemological beliefs about learning and knowing. Correspondingly, Shaffer and Clinton (2006) assert that the digital media pose challenges to educators because they encourage the development of mental actions that are not at the heart of schooling.

### **The school agenda**

Resnick (2002) claims that the school agenda is focused on information; thus questions of the following sort will arise with respect to teaching:

What are the best ways to transmit that information from one person (a teacher) to another (a learner)? What are the best ways to represent and display information so that it is both understandable and learnable? (p. 32)

Resnick and other scholars contend that instead school could and should move *beyond information*, a phrase that assumes that the citizens of tomorrow who live in a rapidly changing world where knowledge ages quickly do not have to be taught specific information as much as how to effectively consume, create, and communicate knowledge (Papert, 1993, 1996; Scardamalia & Bereiter, 2003, Brown, 2002). Computer and Internet technology should be central to the new pedagogy because of its potential for engaging in an intellectual partnership with humans by sharing the intellectual load and thereby extending human intellectual performance (Salomon et al., 1991; Pea, 1985).

Engaging students in an effective intellectual partnership with computers is not a trivial matter. Merely placing computers near the students is not enough; rather, a suitable pedagogy must be developed. In reality, however, although many schools have set the goal of equipping schools with computers and Internet technology, as can be seen from the OECD report (OECD, 2005), the school system—unlike other cultural institutions such as banks, hospitals, the entertainment world, and the press—has not re-thought the goals and practices of schooling in the digital age. Instead, computers are perceived by the school system as tools for enhancing the achievement of existing goals (Papert, 1996, 1998). Moreover, Cuban and associates (Cuban, 2001; Cuban et al., 2001; Peck et al., 2002) found that school practices did not change even when students and teachers had ready access to computers and the Internet. Except in a few teachers' classes, instruction remained teacher-centred and the use of the technology was sparse, mainly involving the social sciences, where students used a word processor or searched the Internet for information. Furthermore, they point out that the school agenda in many developed countries, such as Israel and the US, is focused on achieving high scores on standardized tests; because teachers already have pedagogical tools to accomplish this, they are rightfully dubious about the need for computers.

### **The encounter between digital and school forms of learning**

When students enter school they encounter an institution that was designed before computer and Internet technology was envisioned and thus is based extensively on book technology. Brown (2002) describes the shifts in learning brought about by the digital Internet medium, pointing out the differences between the form of learning used by the generation raised on books and that used by the digital generation. He claims that learning has shifted from being authority-based to being discovery-based. In contrast to the book generation, which tended not to try things unless it was clear how to use them, digital learners are not afraid to try new environments; in fact, they prefer to learn about them through exploration and trial. Digital learners are able to navigate “through confusing, complex information spaces and feel comfortable doing so” (p. 14). They can get used to new, rapidly changing Internet genres, whereas the book generation are used to more stability and hierarchy. Reasoning has shifted from the linear, deductive, and abstract style of the book generation to the bricoleur style, an extreme demonstration of which is that when something “works”, no further justification is required.

*The usability of books and the Internet.* Given that the teachers themselves were raised on books, the encounter between competing epistemologies and the associated forms of learning might feel awkward to both teachers and students. Teachers and students might attribute different usability to the two types of learning resources, the Internet and books, for students. Usability is defined as an attribute that assesses how easy products are to use (Nielsen, 2000; also see Nielsen's website). Usability spans five categories, three of which are relevant to this work: (a) Efficiency: assuming that I know how to use an artefact, how quickly will I perform tasks? (b) Errors: How many errors do I

make, how severe are these errors, and how easily can I recover from the errors? (c) Satisfaction: How pleasant is it to use the artefact? The other two categories are learnability (how easy is it to accomplish basic tasks the first time one encounters the artefact?) and memorability (when returning to the artefact after a period of not using it, how easily can one regain proficiency?).

Teachers, although probably aware of students' affinity for the technology, might be concerned about the possibility of *error* inherent in navigating confusing, complex realms of information with varying degrees of reliability. Furthermore, being used to teaching in an ordered and hierarchical manner (Brown, 2002), they might find the overlapping presentations confusing and thus *inefficient*. Moreover, being loyal to the school's current agenda, teachers may experience computer and Internet technology as unnecessary or even as hindering learning (and thus *unsatisfactory*), such as when technology distracts students or computers crash, thereby consuming valuable class time. In contrast, books have proven themselves for generations to be *reliable* and *efficient* resources.

Students—being used to and capable of navigating the Internet—may perceive the Internet as *efficient*, especially when working on a paper assignment, because it enables them to rapidly choose the most helpful presentation of information from among myriad websites. In contrast, the number of books people have in arm's reach is usually limited and even then, books are *inefficient*, since it takes time to locate the required information and more time to manually summarize the contents; thus they are *unsatisfactory*. The greater assumed reliability of books is probably not valued as much as by the book generation because children are used to judging the information they find, though probably not the way the generation that grew up on books legitimize (Brown, 2002).

*School as a venue for culture clash, compliance, or acclimation.* Given that in the near future almost everyone in the Western world will grow up with computers and thus will experience the “digital” form of learning, it is important to study the nature of the encounter between digital children and the book-oriented, “analogue” school. Papert (1993, 1998) predicts a culture clash. Similarly, Salomon (2000) warns that unless schools change, the encounter between the two forms of learning will lead both teachers and students to consider each other “urban barbarians” as far as knowledge and learning are concerned. Papert (1998) believes students will try to make the school adopt their form of learning. He calls them “an army for change”: “We have an army. It's this army of children, of kids coming into the school with a better image of learning and with the technical knowledge to implement that better image of learning.”

In a previous study in the field of computer science education, it was evident that students' informal learning experience had brought about a culture clash. Students and teachers differed on what they considered a significant problem, appropriate approaches to problem-solving, and even a satisfactory solution. They delegitimized each other, causing bitterness on both sides (Ben-David Kolikant, 2004). For example, nearly half of the 138 computer science students insisted that a particular program was correct even though they knew it did not fulfil one of the requirements of the assignment. Their claim was that this requirement did not solve any significant or real problem, since a user could not tell whether it had been met. Consequently, the teachers were perceived as being petty. Additionally, consistent with Papert's prediction, these students negotiated for an alternative curriculum with more emphasis on the exploration of new technologies and questioned the need for learning the theoretical principles (Ben-David Kolikant & Ben-Ari, 2008).

These results inspired the study described in this paper. Further work was required to examine whether the impact of students' informal experience with digital technology is limited to computer science classes or whether it is relevant to the broader community of educators. One may argue that the situation described in computer science education is unique since much of it involves learning by doing with a computer, an area where students can claim mastery. Other subjects are less closely associated with computers; hence students would not feel that they are experts in the field and would adopt the form of learning presented. Indeed, Shor (1992) claims that students are acclimated to the “culture of silence” of mass education. Teachers are authorities, so they are supposed to do most of the talking. Moreover, students gradually internalize the idea that being a good student means keeping quiet, absorbing information, and agreeing with the teacher. Shor, however, wrote this thesis in 1992. Today, a decade and a half later, things have changed: many students have lived all their lives with computers and the Internet and computers have become common in school.

Consequently, this research project was launched in order to understand the influence of computers and the Internet on the learning preferences of students whose schools' practices have not been invaded by this technology.

Specifically, two objectives were pursued: (a) exploring students' perceptions of the usability of computers and the Internet for school, especially in tasks requiring the processing of large quantities of information; and (b) understanding students' attitude towards the technology in the context of their attitude towards the form of learning used in school, especially the absence of digital technology.

### **History as a venue for exploring the encounter**

History, the subject on which this study focuses, is a good venue for exploring the encounter of digital children with an information-focused agenda and its consequences. It is a compulsory subject in Israel, rich with textual information and constantly accused of focusing on information rather than on the practices and thinking processes of "doing history", i.e., going "beyond information" (e.g., Loewen, 1995; Wineburg, 2001). For example, Loewen (1995) claims that "textbooks are full of information—overly full. These books are huge" (p. 3).

Students can choose to deal with the mass of information by using the Internet instead of or in addition to books. In fact, history can show how an agenda can be transformed even though practices have not changed. In the past, history provided opportunities to learn how to learn as students struggled with the main learning resource—books—thereby practising important skills such as distinguishing between the main idea and ancillary ones. Today, the use of the Internet might absolve students of having to invest the mental effort required when working with books; this may reinforce their impression that school learning means simply acquiring information. Students might also debate the need for and the benefits of school, given that the information acquired in school is accessible online.

This study was preceded by preliminary research, including interviews with 10 history teachers and 20 students from high schools that do not use computers in history classes. The interviews were with five triads of a teacher and two of his or her students (for a total of 15 interviews), plus five other teachers and 10 other students (another 15 interviews). All the teachers taught in urban public schools with good reputations in six different Israeli cities. Interestingly, most of the students thought history classes should remain compulsory. Nonetheless, most also found the Internet usable for history studies even though the teachers did not encourage its use. Students explained that "googling" is easy and comfortable, whereas books were described as exhausting and irritating even for a short summary. The most common use of the Internet was searching for information about an event or personage in order to write a paper or a short summary. Another common use was exchanging information as the matriculation exams approached. All of the students were aware of the reliability issue of using Web sources exclusively. Most of them therefore compared information from about three sites. Finally, most of the students believed that incorporating the use of the Internet in history class was a good idea but were not sure what, besides increasing their motivation, would be the benefit.

The teachers were ambivalent about technology as well as about their students. Some teachers described trying to introduce the use of computers in the hope that their students would learn more and told how they were pained by their students' refusal to work hard. The Internet was thus experienced as a hindrance to meaningful learning because it absolved students of having to invest cognitive effort and thereby diminished learning. In fact, some teachers asserted that they now require that students hand in summaries and hand-written assignments because that way something gets into their heads. Students were described, on the one hand, as being smarter than the teachers were at their age but, on the other hand, as being unable or unwilling to do anything requiring cognitive effort beyond memorization. Finally, most of the teachers emphasized the need for books in history as well as their personal love for the medium. Thus, students and teachers ascribed different usability to books and the Internet as learning resources.

### **Methods**

Based upon the preliminary research, a three-part survey was composed and filled out by three history classes. The survey and the participants are described below.

## Survey

Part A inquired about students' use of computers and Internet technology *after school hours* for leisure and for schoolwork. The decision to explore students' use of computers and the Internet for schoolwork *in their free time* was based on the following assumption about students' behaviour during school hours:

Teachers hold the ultimate authority over what occurs in classrooms on a day-to-day basis. Students are thus subject to the pedagogical choices of their teachers. If teachers choose not to use technology, students will receive little exposure to the machines" (Peck et al., 2002, p. 478).

In contrast, after school students have more freedom to make their own decisions regarding how to work on school assignments, and in particular which of the two technologies to use: real-paper technology, such as their books and notebooks, or digital technology, such as the Internet.

Specifically, in order to determine their use of digital technology for schoolwork, we asked students to fill in a table where each row was devoted to one of the following school assignments: studying for a test, doing homework, or writing a paper/doing a project. The students were asked to list *all* the school subjects for which they had used digital technology at least once in the previous school year and to describe what they had done with the technology.

Part B described the work done by two imaginary students, Yossi and Miriam, on a graded paper assigned in a history class. Yossi works as follows. He (a) types the topic in Google; (b) chooses three sites, usually from the first and second pages of Google's results; (c) verifies that the content of these sites is similar to make sure he can use the sites ;(d) merges them into one paper; and (e) if necessary, simplifies the language. Miriam works differently. She (a) looks for information in books; (b) looks for additional information on educational websites such as that of Ministry of Education; (c) plans the paper with the information she has in mind; (d) writes the paper; and (e) adds a list of her references. The students were asked to indicate how similar their approach is to Yossi's and Miriam's on a scale of 1 to 5 (where 1 means "very different" and 5 means "very similar") and to list the differences between the way they work and they way each imaginary student does.

We chose writing a paper as the assignment because it leaves more room for the students to make decisions regarding the learning process than homework or tests do and thus could tell us something about students' perceptions of the usability of books and technology for schoolwork. The choice of history is explained in detail above. The imaginary students were in the typical situation of doing work to be handed in to and graded by the teacher. Yossi's profile was based on the students' description of their Internet use during the preliminary research. Thus, Yossi produces his paper by merging three sources (as most students reported doing) that he found on the first or second page of Google results. Then, if necessary, he translates the product. Miriam's profile was based on teachers' descriptions of the ideal process for learning history. Miriam uses books as her main source. She uses the Internet as well, but only official sites like that of the Ministry of Education. Also, she plans her paper and then writes it, whereas the emphasis in Yossi's work is on merging, in which case planning is unnecessary.

Finally, in part C the students were asked to rate, on a scale of 1 to 4, their agreement with statements about their self-perception as independent learners, their learning preferences (in particular the use of computers and the Internet), and their intellectual gain from school and history class. We deliberately asked about the intellectual gain from their history class the previous year in order to minimize the influence of the most recently studied topic on their responses. The statements are listed in table 5. The survey was administered about three months into the school year in order to give students enough time to form an opinion about what school offered.

## Participants

The three classes that participated in the survey were carefully chosen to capture different characteristics of schools, including grade levels, the presence of the matriculation exams in the background, and topics taught. The first was Yaakov's eleventh-grade class comprising 26 students in a well-regarded public school. Like most eleventh-graders in Israeli public schools, they would be taking the summer matriculation exam on Jewish and Zionist history. The second class consisted of Serge's 29 eighth-graders in a well-regarded public school. This class did not have to take any external exams in history. They, too, were studying Jewish and Zionist history. In Serge's and Yaakov's schools, as in most Israeli public schools, project assignments, though they exist, are not at the heart of school life.

Nonetheless, both teachers assign at least one history project during the school year. Typically, both Yaakov and Serge would present a topic in class and explain it. Students were active in these lessons because they were asked to analyze maps and texts, yet the instruction was teacher-centred since the teachers controlled the information presented to the students. Note that both classes were starting their second year in their school. Furthermore, both classes were having the same history teacher for the second year in a row.

The third class, in contrast, was Gidi's tenth-grade class (19 students) in an elite boarding school where admission is selective and is based on students' intellectual abilities. This was their first year in the school. This school advocates a learner-centred approach and therefore projects are common. For example, each year students choose a topic and are given free time to investigate it. In addition, teachers assign various projects; for example, in history students did a project on a topic of their choice having to do with ancient Greece. Gidi's support focused on historical issues, while another teacher helped them with aspects of the work process, such as what constitutes a good research question and how to construct an argument. Additionally, unlike in most Israeli high schools where students take one matriculation exam in history in the tenth grade and another in the eleventh grade, in this school tenth-graders learn about ancient Greece—a topic that is not on the matriculation exam—in the first semester before moving on to topics required by the Ministry of Education, and they take the first exam the next winter (in the eleventh grade) and the second in the summer. The idea is to give students the experience of meaningful learning without the distraction of the matriculation exam.

These classes were chosen after in-depth interviews with the teachers, observations of their classes, and conversations with several students. The first criterion for choosing the classes was good teachers, i.e., teachers whose students do well and consider their teachers good. This criterion was important in order to minimize the impact of students' rejection of the teacher on their responses. Conversations with arbitrarily chosen students assured us that these teachers qualified. The second criterion was the teachers' pedagogical decision not to merely force-feed the information required by the curriculum but instead to act as coaches promoting students' lifelong learning abilities. The in-depth interviews with the teachers as well as the class observations ensured that. Indeed, all the teachers devoted time to class discussions of topics suggested by students and encouraged students to express their opinions and back them with data. Finally, all three teachers had a similar education. Each had a B.A. in history from an Israeli university and a teaching certificate.

## Findings

### Part A

The students' responses to part A reveal that they spend a lot of their after-school time in front of the computer, but mostly for leisure (table 1). These results are similar to those described in the OECD report (OECD, 2005), as well as by the survey on e-readiness in Israel (2005). However, Gidi's students spend less of their computer time on leisure activities than Yaakov's and Serge's students do.

Average time on computers, in hours per day (standard deviation in parentheses)			
Computer use	Teacher		
	<i>Serge</i>	<i>Yaakov</i>	<i>Gidi</i>
In general	3.46 (2.48)	2.58 (2.09)	1.94 (1.57)
For school	0.98 (0.78)	0.81 (0.62)	1.18 (0.65)

Table 1: Students' use of the Internet for schoolwork

Assignment	Teacher		
	<i>Serge</i>	<i>Yaakov</i>	<i>Gidi</i>
Homework	97%	81%	79%
Tests	7%	16%	26%
Projects	38%	42%	37%

The exceptionality of Gidi’s class can be explained by the fact that they live in a boarding school and thus feel less of a need to communicate with their friends electronically as teenagers typically do. Additionally, Gidi’s students have a heavier load of schoolwork than they did in their previous schools and therefore might feel that their computer time should be spent on schoolwork rather than leisure activities. Indeed, three of Gidi’s students commented in the survey that before attending this school they spent much more time on the computer.

Students’ responses regarding their use of technology for schoolwork showed that they only used the computer for word processing (writing papers and lab reports) and occasionally for Internet access. Table 2 shows students’ after-school use of the Internet for three typical school assignments: studying for tests, doing homework, and doing projects; each figure represents the percentage of students who reported using the Internet at least once for that type of assignment. Students’ lists of the subjects for which they had used the Internet were usually limited to one or two, mostly in the social sciences and humanities, such as history and literature.

The students’ descriptions of the work they do on the Internet indicate that they access the Internet for one reason: to obtain information—as they put it, “material”—for projects, papers, and homework assignments in which they have to summarize information about a new concept, person, or event (a type of assignment typical of the social sciences). Few of the students use the Internet to study for tests; those few mainly do so to obtain additional material from the Internet, scan friends’ notes, or look for sample questions to answer. Additionally, 5% use online dictionaries. Only one student used the Internet for science (he asked a question in a forum). The tendency to use the Internet mainly for the social sciences—information-rich subjects—is consistent with the findings of Cuban et al. (2001).

## Part B

The students’ responses regarding the similarity between the procedure they follow when writing a paper and the procedures followed by two imaginary students, Yossi and Miriam, are shown in table 3 and figure 1. Table 3 shows the mean and standard deviation for each class. Figure 1 shows the distribution of each class’s responses; “similar” represents responses of 4 or 5, “somewhat similar” refers to responses of 3, and “different” refers to 1 and 2 on the original scale of 1 to 5.

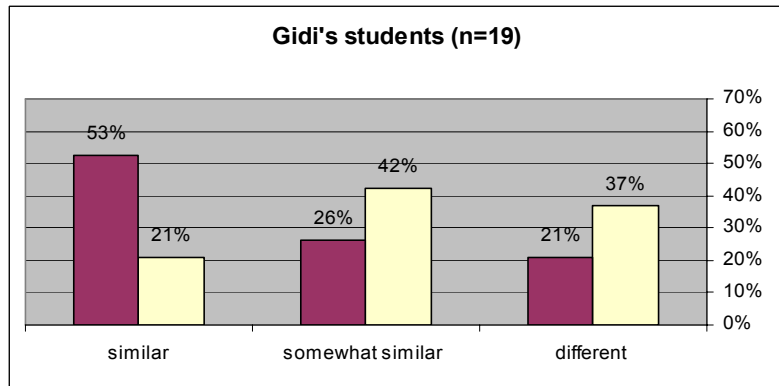
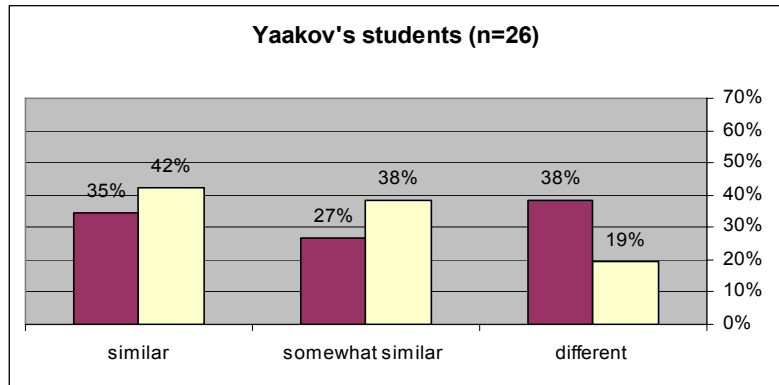
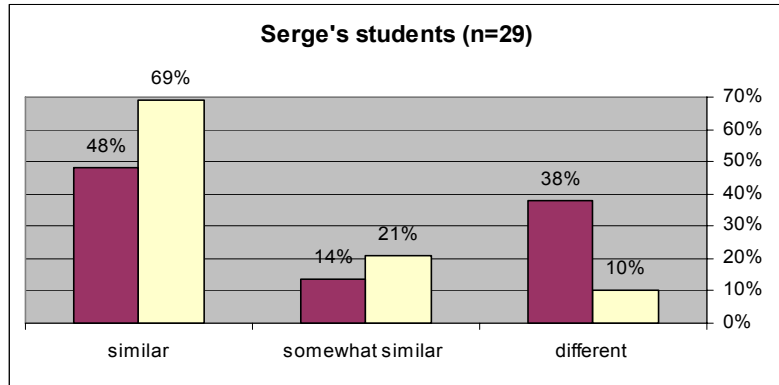
There was a statistically significant negative correlation between students’ responses to the two procedures (Spearman ( $r_s$ )=−0.474\*\*). That is, some students identified more with Yossi and others identified with Miriam. As can be seen in table 3, Serge’s students identified with Yossi’s style (M=3.83\*, sd=1.136) more than with Miriam’s (M=3.07, sd=1.510). Yaakov’s students demonstrated a similar though less strong tendency (M=3.35\*, sd=0.936 for Yossi and M=3.00\*, sd=1.058 for Miriam). In contrast to both public-school classes, Gidi’s students identified with Miriam’s style (M=3.37\*, sd=0.895) more than with Yossi’s (M=2.84\*, sd=0.958).

Table 2: Identification with two approaches to writing history papers

	Teacher					
	<i>Serge</i>		<i>Yaakov</i>		<i>Gidi</i>	
	M	SD	M	SD	M	SD
<b>Yossi</b>	3.83*	1.136	3.35*	0.936	2.84*	0.958
<b>Miriam</b>	3.07	1.510	3.00*	1.058	3.37	0.895

\* A t-test was found significant for  $p < 0.05$ .

A one-way ANOVA test revealed a significant difference among the three classes’ responses to Yossi’s procedure ( $F(2,71)=5.376$ ,  $p < 0.01$ ). A Scheffe post-hoc revealed that Gidi’s class differed from Serge’s. Yaakov’s class was somewhere in the middle. This difference is demonstrated in figure 1. A small proportion of the students in the public-school classes found their procedure different from Yossi’s (Serge, 10%; Yaakov, 19%), compared with 37% of Gidi’s students. Figure 1 demonstrates a difference between the two public-school classes and Gidi’s class with respect to Miriam’s process too. Specifically, only a small proportion of Gidi’s students (21%) thought their procedure differed from Miriam’s, compared with 38% of both public-school classes (almost twice the proportion). However, this difference was not statistically significant.



– identification with Yossi's procedure  
 – identification with Miriam's procedure

Figure 1: Distribution of students' responses on similarity of procedures

Table 3: Most common objections to Miriam's and Yossi's procedures

<i>Students' most common objection</i>	<b>Teacher</b>		
	<i>Serge</i>	<i>Yaakov</i>	<i>Gidi</i>
<i>To Miriam's procedure:</i>			
I prefer Internet resources to books/I wouldn't use only books.	48%	54%	37%
<i>To Yossi's procedure:</i>			
I would use books (or an encyclopaedia) in addition to Internet resources.	24%	27%	47%



The students' most common response regarding the differences between their procedures and those of Miriam and Yossi concerned the resources (books and Internet) used, as indicated in table 4. The table shows that students approve of both resources; yet the public-school classes tend to prefer the Internet, as reflected in the fact that about half of Serge's and Yaakov's students (48% and 54%, respectively) objected to Miriam's decision to use books primarily and only about a quarter (24% and 27%, respectively) objected to Yossi's decision to rely exclusively on the Internet. In contrast, Gidi's class had a more balanced attitude towards the use of books and the Internet, as reflected in the fact that nearly half of the class asserted that unlike Yossi they would use books and 37% objected to Miriam's choice of resources.

### Part C

Table 5 presents students' responses to statements regarding the relationship between computers/Internet and learning as well as the intellectual gains from school and history classes on a scale of 1 to 4, where 1 and 4 represent strong disagreement and strong agreement, respectively. For each statement, the mean (M) and the standard deviation (sd) of each class is shown. An asterisk (\*) was added near the mean to indicate significance according to a t-test ( $p < 0.05$ ). A mean greater than 2.75 is defined as agreement by the class with the statement; a mean smaller than 2.25 is defined as class disagreement with the statement. Means between 2.25 and 2.75 are defined as diverse opinions regarding the statement.

Most of the students agreed that they are capable of independent study (statement 1: Serge,  $M=3.31^*$ ; Yaakov,  $M=3.31^*$ ; Gidi,  $M=3.32^*$ ). No class agreed that living with computers and the Internet had made them independent learners (statement 2: Serge,  $M=2.59$ ; Yaakov,  $M=2.17^*$ ; Gidi,  $M=2.68$ ) and there was also broad disagreement with the statement that their generation, as a whole, know better how to learn than the generation raised without computers (statement 3:  $M=2.45, 2.12, 2.37$ ). Thus, it was commonly agreed that the Internet per se does not make one a better learner.

However, differences were found among the classes with respect to their views on the intellectual gains from school in general and history class in particular, as well as the usability of computers and the Internet for schoolwork.

*Two polar attitudes about gains from school and history class.* Significant differences were found among the classes' responses to all the statements (7–10) concerning intellectual gains from school and history class. The results of a one-way ANOVA test on these statements were as follows: statement 7,  $F(2,71)=3.884^*$ ; statement 8,  $F(2,71)=14.137^{**}$ ; statement 9,  $F(2,71)=4.106^*$ ; and statement 10,  $F(2,71)=10.783^{**}$ , where \* and \*\* indicate  $p < 0.05$  and  $p < 0.01$ , respectively.

As can be seen from table 5, all three classes agreed that they had gained general knowledge from history class (statement 7). Gidi's students did not think the class had improved their cognitive and analytical abilities (statement 8:  $M=1.84^*$ ,  $sd=0.688$ ) or taught them about values (statement 9:  $M=2.26$ ,  $sd=0.806$ ). Additionally, Gidi's students agreed that school as a whole provides them with tools for independent study (statement 10:  $M=3.43^*$ ,  $sd=0.692$ ).

In contrast, the two public-school classes believed they had gained cognitive and analytical abilities from history class (statement 8: Serge,  $M=3.03$ ,  $sd=0.778$ ; Yaakov,  $M=2.81$ ,  $sd=0.849$ ) and had learned values (statement 9: Serge,  $M=2.86$ ,  $sd=0.953$ ; Yaakov,  $M=2.96^*$ ,  $sd=0.774$ ). Additionally, unlike Gidi's students, the public-school classes did not think school was providing them with tools for independent study (statement 10: Serge,  $M=2.75$ ,  $sd=1.005$ ; Yaakov,  $M=2.23$ ,  $sd=0.765$ ).

The Scheffé post-hoc test found that the public-school students differed significantly from Gidi's students with respect to the statement that they had gained cognitive and analytical abilities from history class the previous year (statement 8) and the statement that school gives them tools for independent study (statement 10). A similar pattern was found in the responses to statements 7 and 9, that students had gained general knowledge (statement 7) and values (statement 9) from history class the previous year, but there Gidi's and Yaakov's students differed significantly, whereas Serge's students, though their responses were similar to those of Yaakov's students, did not differ significantly from Gidi's.

Table 4: Students' attitudes

Statement	Teacher						
	<i>Serge</i>		<i>Yaakov</i>		<i>Gidi</i>		
	M	SD	M	SD	M	SD	
<b>The usefulness of the technology for learning<sup>a</sup></b>							
1	I am capable of independent study.	3.31*	0.850	3.31*	0.679	3.32*	0.749
2	Living with computers and the Internet has made me an independent learner.	2.59	0.907	2.17*	0.919	2.68	1.003
3	My generation know better how to learn than the generation that did not have computers.	2.45	0.985	2.12	0.993	2.37	1.165
4	I am more aware of the potential of the Internet for learning than most of my teachers are.	2.86	1.026	2.77	0.863	2.26	0.653
5	It is important to use computers in history courses.	3.07*	1.016	2.62	0.898	2.42	0.838
6	When a topic interests me I would rather learn about it from the Internet than from books.	3.07*	1.100	2.73	0.919	2.37	0.684
<b>Gains from school and history class<sup>b</sup></b>							
7	I gained general knowledge from history class last year.	3.34*	0.814	3.77*	0.430	3.26*	0.733
8	I became better able to think and analyze thanks to my history class last year.	3.03*	0.778	2.81	0.849	1.84*	0.688
9	I was exposed to my people's values and universal values in history class last year.	2.86	0.953	2.96*	0.774	2.26	0.806
10	School gives me tools for independent study.	2.75	1.005	2.23	0.765	3.42*	0.692

a. Cronbach alpha=0.693 b. Cronbach alpha=0.566 (0.691 excluding statement 10)

\* p<0.05

*Two polar attitudes towards the usefulness of digital technology.* The classes' responses to statements 4–6 concerning the usefulness of the digital technology resembled their responses to Yossi's working procedure in part B. As can be seen in table 5, Gidi's students disagreed with statements 4–6, Serge's students agreed, and Yaakov's varied with a slight tendency to agree. A one-way ANOVA test followed by a Scheffé post-hoc test revealed significant differences between Gidi's and Serge's students with respect to statement 6, that when a topic interests them they would rather learn about it from the Internet than from books. The differences between the responses to statements 4 and 5—that students are more aware of the potential of the Internet for learning than their teachers are (statement 4) and that it is important to use computers in history courses (statement 5)—were not found to be statistically significant, but the low p values (p=0.065 and p=0.05, respectively) can point to a similar trend of two polar attitudes towards the usefulness of the technology.

*The relationship between perceptions of usability and perceptions of school and history.* Statistically significant correlations were found between the reactions to Yossi's working procedure, which relies exclusively on the Internet as a learning resource, and statements 3, 4, 5 and 6 ( $r_s=0.304^{**}$ ,  $0.333^{**}$ ,  $0.266^*$ , and  $0.398^{**}$ , respectively; \* means p<0.05 and \*\* means p<0.01), as well as among these statements, all of which concern the advisability of using the Internet and computers for learning purposes. Thus, students' preferences for using computers and the Internet for learning purposes in or outside of school (statements 5 and 6, and the reactions to Yossi's procedure) are correlated with the belief that computers make people better learners (statement 3) and that they are more aware of the educational potential of the Internet than their teachers are (statement 4).

In contrast, the reactions to Miriam's working procedure were found to have a significant positive correlation with statement 10, that school provides tools for independent study ( $r_s=0.261^*$ ), as well as a significant negative correlation with statement 4, that students are more aware of the educational potential of the Internet than most of their teachers are ( $r_s=-0.290^*$ ). Thus, students' decision to rely on books, as Miriam does, is correlated with legitimation of school learning practices. No other significant correlations were found between the reactions to Miriam's and Yossi's approaches and the statements in part C.

## **Discussion**

### **Two polar perceptions of the usefulness of the technology for history classes**

The findings depict two polar perceptions of the usefulness of computers and the Internet for history classes. At one extreme are students who think computers and Internet technology are more useful than books. These students reported that they would use the Internet to write a paper and objected to giving priority to books. These students also demonstrated a preference for use of the Internet as a learning resource when a topic interests them (statement 6) and thought it would be beneficial to use computers in history class (statement 5). Moreover, the perception of the usability of the Internet was positively correlated with the belief that the students know more about studying than their teachers do, at least with respect to the Internet (statement 4).

At the opposite extreme were students who found books more useful than the Internet for writing history papers (and thus identified more with Miriam's approach than with Yossi's). These students disagreed with statement 4 that the students are more aware of the educational potential of the Internet than their teachers and agreed that school provides tools for independent study (statement 10). In other words, they regarded school as a learning-to-learn venue.

### **Legitimation of school as an anchor for students' perceptions of the technology**

Interestingly, Gidi's class, who are in the elite, learner-centred school, identified with Miriam's approach more than with Yossi's, whereas Serge's and Yaakov's classes, the public middle school and high school classes, respectively, identified more with Yossi's approach than with Miriam's. The difference is interesting because Gidi's students experience learner-centeredness more than the two public-school classes and presumably—given the ready access to digital technology, youngsters' affinity for learning with the technology, and the freedom inherent in learner-centred activities—should have expressed some of the rebelliousness of Papert's assumed army of epistemological change (1996, 1998). Should they not, then, advocate procedures different from Miriam's book-oriented method?

Apparently they do not; although they did not actually reject use of the Internet, they perceived it as ancillary to their method of doing schoolwork. Their responses to part A imply that this preference is not subject-dependent; rather, the computer is not central to any of the subjects in their curriculum. One might argue that Gidi's school advocates the use of books and that Gidi's students go along with the school message, perhaps because they want to belong to the prestigious school. If so, however, why do the students readily admit that they do not think they know better about the educational potential of the Internet than their teachers? Furthermore, no matter what message the school conveys, the fact is that Gidi's students agreed that school provides them with tools for learning and did not consider themselves more knowledgeable with respect to the Internet. Thus, these students' are not compliant; they are simply legitimizing school as a learning-to-learn venue. Living with computers thus has not changed these students' epistemology in any crucial way. Presumably, they appreciate their school's beyond-information agenda and are unaware of the learning potential inherent in partnering with the technology to pursue this agenda.

In contrast, a majority of students in the two public-school classes favoured Yossi's procedure and believed they knew more about the educational potential of the Internet than their teachers. Given that the focus of school, and specifically history classes, is on information (e.g., Resnick, 2002; Salomon, 2000; Scardamalia & Berriter, 2003), the students will presumably find the Internet a useful learning resource. Furthermore, students would quite likely attribute the school's decision to pursue its information-oriented agenda through books rather than through the Internet (or any digital medium) to ignorance of the potential of the Internet. Thus, keeping the school agenda focused on information leads students to propose the Internet as a better way to pursue this agenda, thus acting somewhat like Papert's army of change. This claim is consistent with the fact that a majority of Serge's and Yaakov's students did not think school provided them with tools for independent study and it implies that the Internet influences students' perceptions of school.

However, these students agreed that they had gained cognitive and analytical abilities from their history class in the same school. If history is focused on information, what are these abilities? Probably students believe that dealing with masses of information requires the ability to think and analyze; alternatively, perhaps they regard their teachers' explicit instruction as teaching them how to deal with masses of information. Gidi's students gave the opposite response, probably because of their impression of their school's emphasis on beyond-information learner-centred

activities. Specifically, the history classes they had experienced before coming to this school had resulted from an information-focused agenda and were thus less highly regarded.

### **The intellectual partnership between humans and computers as developed in history class**

I claim that all the classes have failed to develop a fertile intellectual partnership with the computer. Gidi's students do not have an intellectual partner; they carry their intellectual load by themselves. They could benefit from the technology. For example, authoring tools might help them organize and re-organize their thoughts while they are engaged in their projects. They could also use the Internet to give feedback to their peers, to get feedback from them, and to communicate with experts outside school. The fact that these tools were not mentioned strengthen Cuban's argument that students' exposure to technology is limited if the teacher does not advocate its use.

Serge's and Yaakov's students do share their intellectual tasks with digital technology; however, they merely use the technology for word processing and information searches and do not spontaneously form an intellectual partnership that would broaden their intellectual abilities. Furthermore, in an information-centred school, the technology might diminish students' intellectual efforts. For example, an assignment to write summaries used to be an opportunity to develop the intellectual abilities required for dealing with the main knowledge resource back then—books. Due to the linear presentation of information in the books, the students invested mental effort in distinguishing the essence from the ancillary or their hand would have hurt from writing. These days this assignment can be accomplished without the need to invest such cognitive efforts because with the Internet one can rapidly retrieve the exact information needed from a vast number of sources. Furthermore, living in a world with easy access to information, students might get the impression that these homework assignments are all about information rather than learning to learn. (Of course, teachers can insist that students manually copy the material they find on the Internet into notebooks, as some of the interviewees in the preliminary research reported, thereby forcing them to summarize. This, however, is artificial; obviously students could simply find a shorter explanation of the material on the Internet. It would not prevent the students from perceiving schooling as merely creating a copy of someone else's knowledge in their heads.)

Given that students used computers and the Internet very little and that history was one of the most commonly mentioned subjects for which the Internet is used, it may very well be that their responses would have been dramatically different for other subjects in the sense that they would believe that the Internet is more useful for the other subject. Further work is required, however, to explore students' perception of the school's general attitude towards computers and the Internet.

### **Conclusions**

To some extent, the results of this study are reminiscent of the culture clash found in computer science education (Ben-David Kolikant, 2004; Ben-David Kolikant & Ben-Ari, 2008). In both cases, students' informal experience with the technology led the students to believe that they knew more than their teachers. In computer science education, this belief led students to delegitimize what their teachers had to offer. For this reason, the results of this study, especially the belief among a significant number of public-school students that they know more about the educational potential of the Internet than their teachers, should alert the system. It may be losing its legitimacy as a learning-to-learn institution. However, more work is required to explore students' attitudes towards school learning. Additionally, further work is needed to shed light on teachers' attitudes towards students' use of the Internet at home and its impact on students' beliefs and schooling practices.

The results show that the Internet enters school through the back door. Specifically, it was evident that a significant number of students prefer using the Internet when they have a choice. Ignoring this fact could bring about a culture clash. Therefore, schools should rethink how to encourage students to engage in a fertile intellectual partnership with the technology to enhance their learning.

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