Education and Information Technologies 6:1, 43–53, 2001.

Information and Communication Technologies Usage by Students in an Israeli High School: Equity, Gender, and Inside/Outside School Learning Issues

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This study describes and analyses a survey that was conducted with 384 students from grades 7–12 in a typical urban High School in Israel. The students reported on the extent and characteristics of Information and Communication Technology (ICT) usage within and beyond school time and location. Its focus is on (a) equity issues regarding the extent, purposes and scope of ICT usage and students self perception in ICT proficiency; (b) gender and age differences in ICT use; and (c) relationship between inside/outside school learning processes. The findings show that 10% of the students are non-users of ICT, two thirds are common-users and only 25% are skilled users. About half of the students use the Internet to some extent. Major Gender differences were found: in general, more boys used ICT more extensively than girls did. Differences among age groups were found mainly with respect to the use of complex applications, but not regarding Internet usage. These results are discussed in the light of the three focal issues: equity, gender, and integration of learning processes taking place within and outside school.

Keywords: secondary pupils; equity; gender; Internet use; beyond school.

Introduction: The study of ICT usage

The rapid development of Information and Communication Technology (ICT), particularly the Internet, is one of the most fascinating phenomena characterizing the Information Age. ICT powers our access to information, enables new forms of communication, and provides many on-line services in the spheres of commerce, culture, entertainment and education. Tapscott (1998) claimed that for the first time in history, children are more comfortable, knowledgeable, and literate than their parents about an innovation central to society's functioning. These children and youngsters, members of the 'Net-Generation', will use digital media to develop and impose the digital culture on the rest of society. Indeed, the penetration of digital media has been greatest among households with children. Currently, about two out of three households with children in the US have computers, including Internet connectivity. Computers and Internet not only give children powerful intellectual

tools, they also shape their thinking about their own selves and their social environment (e.g., personal identity, interpersonal relationships, sexuality – Turkle, 1995). However, the educational system is not yet prepared to cope with the pace of these transformations (Pelgrum & Anderson, 1999), the majority of which are taking place outside the school (e.g., in the home, informal education settings).

The consequences of the assimilation processes of these technological transformations into education take the form of crucial questions to be addressed at varied levels, e.g., organizational, curricular, or cognitive levels. Among these, in this paper we will focus on three substantial issues: equity in ICT use, gender differences in ICT use, and the challenges faced by the formal educational system as a result of ICT integration into all venues of life.

The usual reference to the 'Net Generation' (Tapscott, 1998) is a too general one, hiding the actual variance among different groups of users. Not all members of this generation are ICT users, and among the users, not all 'keyboard strikers' pertain to the same level of expertise and usage. Some are located at the very-extensive-ICT-usage end of the continuum (e.g., hackers), while others, at the other end, use ICT scarcely and mainly for trivial purposes (e.g., occasional word-processing, games). A better understanding of the structure of this continuum, of the distribution of the learners population along it, and of the reasons for its development, is crucial for coping with matters regarding ICT use.

The interaction between gender and ICT use was examined to a considerable extent in the pre-Web era (e.g., Collis, Kaas & Kieren, 1989; Fetler, 1985; Shashaani, 1994). The results are not conclusive. Several studies report on differential performance by girls and boys concerning the use of applications, programming, or video gaming (Kafai & Sutton, 1999). Others suggest that the difference is mainly cultural (e.g., in motivation to approach the technology and work with it), and when performance is specifically examined gender is not a determinant variable. Within the context of the widespread dissemination of ICT, and its transformation into an everyday resource for most people, the clarification of gender related questions is of highly educational relevance.

The third issue addressed relates to the changing perception of schooling and learning, from the idea of a formally defined and spatially constrained event (namely a formal curriculum to be learnt in the school place), to the idea of life long learning anywhere at anytime (Sinitsa, 2000). Formal education systems have not approached yet this change in perspective, and are not able to offer educational models and configurations allowing harmonic synergism of inside-school and outside-school learning processes (Mayer, Quilici & Moreno, 1999). The close examination of these processes is crucial for devising novel models of integration between formal and emerging ICT-based educational agents. Most research on children's use of ICT primarily describes and examines the potential of the Internet *within* the educational system (Berenfeld, 1996; Mioduser et al., 1999). These research efforts seldom take into account that the real impact of the Internet on children might come from home use rather than from school access. At present, it is widely accepted that much of children's learning takes place in other-than-school settings (e.g., the home, community centers, special interest groups, diverse cultural experiences). Emergence of electronic networks might extend this phenomenon and lead to changes in the role and

character of the school. A necessary conclusion is that new research channels should be opened to study children's learning processes both within and outside school, and to assess the extent to which ICT use is connected with school-based activities and demands.

This paper describes and analyses a survey that was conducted with 384 students from grades 7–12 in a typical High School in Israel. The students reported on the extent and characteristics of ICT usage within and beyond school time and location. Specifically, the study's objectives were:

1. To learn about the extent of ICT use within the 12–18-year-old age group.
2. To examine the scope and purposes of ICT usage within this age group (e.g., time spent on the computer, where and when ICT is being used, styles and modalities of usage).
3. To understand the students' scope and purposes for Internet use (e.g., information retrieval, programming, browsing the Web), and to identify factors (e.g., gender, age, Internet accessibility from home, computer experience) that might affect this use.
4. To examine if there is relationship between ICT usage and school related issues, and if so, what is the nature of this relationship.
5. To asses students' perception of their own ICT knowledge.
6. To identify gender and age differences in regard to all previous issues.

The results of the study will be discussed in the last section of the paper addressing the above-presented focal themes, namely, equity, gender, and integration models of learning processes taking place within and outside school.

Method

Research participants

This study was conducted in one six-year comprehensive public high school (grades 7 to 12) in Tel-Aviv, attended by students belonging to middle and upper SES. This school is a typical urban school similar to about 60% of the high schools in Israel (it may not represent the situation in rural and development towns, or orthodox religious schools). Participants were 384 students, 208 girls and 176 boys. The students' distribution among the grade levels was: 67 students in grade seven, 68 students in grade eight, 63 students in grade nine, 59 students in grade ten, 65 students in grade eleven, and 62 students in grade twelve.

Research instrument

The ICT usage questionnaire implemented comprises 87 questions. Table 1 describes the structure and content of the questionnaire.

Table 1. Questionnaire description

Item #	Topic	Questions
1–4	Descriptive information	Gender, grade level, computer ownership at home, and Internet access at home
5–7	Extent of computer usage	From home, school, and other places
8	ICT experience	Years of experience
9	Self-perceptions	ICT proficiency
10–20	ICT usage	Word processor, spreadsheet, database, graphics, audio, programming, games, Internet
21–22	Extent of Internet usage	e.g., how many times a week, for how long
23–30	Purposes for Internet Usage	e.g., information retrieval, communication
31–50	Use of Internet tools	e.g., use of search engines, e-mail, chats, forums
51–58	Resources downloading	e.g., games, utilities, music files, text
59–62	Website creation	e.g., time invested, maintenance, URL
63–74	Internet usage settings	e.g., when, where, with whom
75–87	Relationship between ICT and school	e.g., homework support, access in school, teachers encouragement

Procedure

The school was chosen as a typical urban High School in Israel. Each grade level (7–12) in the school comprises six classes. For each grade level, two classes were randomly selected for this study – a total of twelve classes. The questionnaire was administered to *all* students in the selected classes during school hours. This procedure ensured that all students, even those who are not highly motivated towards ICT-usage, responded to the questionnaire (a 100% response rate).

Data analysis

All variables were analyzed by descriptive statistics (i.e., frequencies, means, and standard deviations). Gender and age differences (by grade level) were analyzed using the chi square test of independence. In addition, a stepwise linear regression was conducted on *Internet usage* as the dependent variable, and gender, age, and varied ICT usage characteristics as independent variables.

Results

The results are presented in the order of the study's objectives, namely, to learn about extent, scope and purposes of ICT use by High School students, and their self-perceptions of ICT knowledge and proficiency.

Table 2. Extent of ICT use by gender and age groups

Population	N	Home use in hours (S.D.)	School use in hours (S.D.)	Other places use in hours (S.D.)	Total use in hours (S.D.)
Boys	176	6.67 (6.14)	1.40 (1.90)	1.38 (2.02)	9.45 (10.06)
Girls	208	3.55 (4.53)	1.32 (1.64)	0.72 (1.31)	5.59 (7.48)
Grade 7	67	4.61 (5.18)	1.42 (0.89)	1.16 (1.55)	7.19 (7.62)
Grade 8	68	7.53 (6.24)	2.07 (1.52)	1.97 (2.42)	10.57 (10.18)
Grade 9	63	4.41 (5.47)	1.02 (1.14)	0.85 (1.17)	6.28 (7.78)
Grade 10	59	3.47 (4.23)	2.34 (2.32)	0.70 (1.18)	6.51 (7.59)
Grade 11	65	5.06 (5.35)	0.62 (1.65)	0.55 (1.08)	6.23 (8.08)
Grade 12	62	4.56 (5.84)	0.70 (2.07)	0.85 (1.98)	6.11 (9.85)
All students	**384**	**4.98 (5.55)**	**1.36 (1.76)**	**1.02 (1.71)**	**7.36 (9.02)**

Extent of ICT use by high school students

Table 2 presents the average amount of time invested by gender and age groups using ICT in three locations: home, school and other sites. The average number of hours per week students spend using the computer is 7.36 h, or about one hour a day. Most of this time (about 5 hours a week) was spent at home. A significant difference was found in the extent of weekly ICT use among the grade levels by location, whether from school ($\chi^2(55) = 275.15$; $p < 0.001$) or from other places ($\chi^2(65) = 99.24$; $p < 0.0$l). A significant difference in total time usage was found between genders: from home ($\chi^2(28) = 53.25$; $p < 0.0$l), from school ($\chi^2(11) = 23.24$; $p < 0.05$), and other places ($\chi^2(13) = 27.20$; $p < 0.05$). Boys spend more time (an average of 9.45 hours per week) than do girls (an average of 5.59 h).

Figure 1 presents the distribution of the students' weekly use of ICT. From this figure we see that 28 students (7.3%) reported that they do not use ICT at all. Eighty students (20.8%) reported that they seldom use ICT, 153 students (39.8%) use it between four to ten hours a week, 85 students (22.1%) between ten and twenty hours a week, and 38 students (9.9%) use it over 20 hours a week.

Scope and purposes of ICT usage

Table 3 presents the subjects' purposes for using the computer via different tools and software. The Table shows that the most frequent uses of ICT are for playing computer games (about 88% of the students) and word processing (about 82%). Graphic processing, information retrieval and Internet usage comprised the next-frequent group of uses (about 60–70% of the students). Use of database and spreadsheet software, audio/video processing or programming was rather infrequent (about 30–40% of the students).

No significant difference between genders and age levels was found regarding word processing. In contrast, in all other uses significant differences were found between genders (excluding graphic processing) and between age levels (excluding Internet usage).

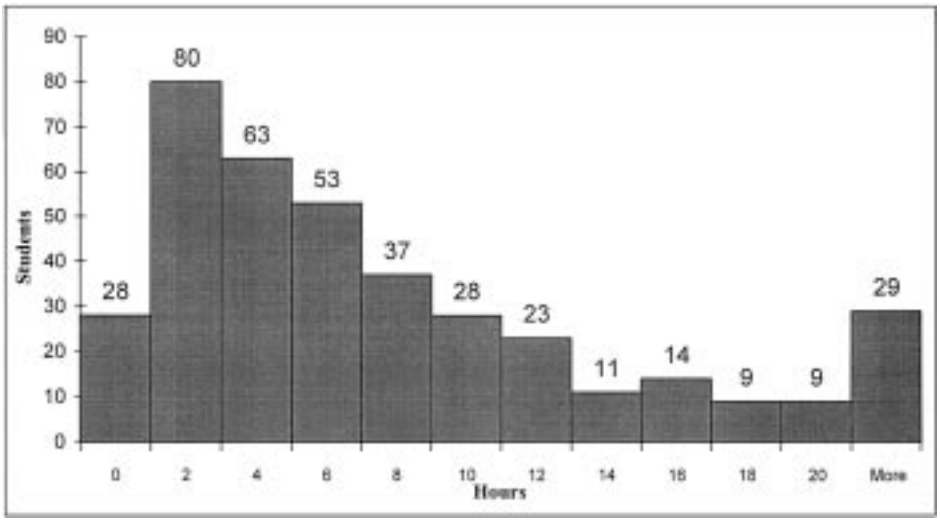

Figure 1. Distribution of time spent on ICT use.

Table 3. Purposes for ICT use

Aims for ICT use	N	Not at all (%)	Seldom (%)	Frequent (%)	Mean	S.D.	Gender difference (χ^2)	Age group difference (χ^2)
Word processor	384	18.0	33.0	49.0	2.23	1.37	1.06	28.51
Spreadsheet	384	57.6	31.7	10.7	0.82	1.12	10.07*	54.88**
Database	384	66.9	24.2	8.9	0.67	1.09	26.66**	54.41**
Information retrieval	384	38.5	37.2	24.3	1.42	1.36	22.91**	42.04**
Graphic processor	384	30.5	42.2	27.3	1.60	1.35	4.51	48.60**
Audio/Video processor	384	58.6	24.2	17.2	0.92	1.31	35.20**	35.84*
Programming	384	65.4	23.5	11.1	0.70	1.12	22.67**	33.11*
Games	384	11.7	25.3	63.0	2.70	1.36	29.98**	63.29**
Internet (all purposes)	384	42.2	25.5	32.3	1.49	1.54	19.29**	10.67

** $p < 0.01$; * $p < 0.05$

In general, boys use these tools more than do girls, and middle school students use more ICT than do high-school students.

Purpose for Internet usage

The Internet, as a rapidly evolving technology, received particular focus in this study. Figure 2 presents the percentage of Internet usage of the 384 students who participated in this study. About half of the students (177 students, 46.4%) in all grade levels use Internet

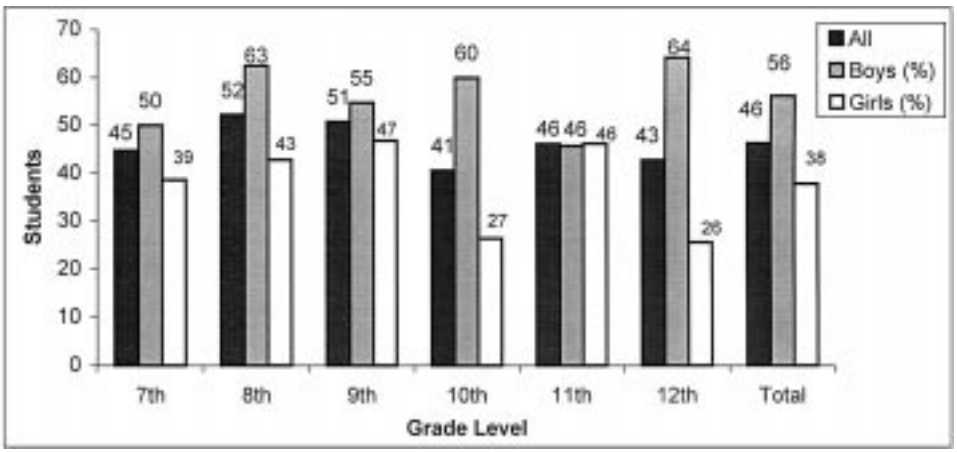

Figure 2. Distribution of Internet usage among the students (n = 384).

to some extent. More boys use the Internet than do girls: an average of 56% of the boys, and only 38% of the girls reported using Internet ($\chi^2(1) = 12.8$; $p < 0.0$l). Surprisingly, the percentage of users at the different grade levels (from sixth grade to twelfth grade) was similar ($\chi^2(5) = 2.6$; $p > 0.05$).

Table 4 shows the results for Internet usage by high school students, according to six main areas: information gathering, communication, creating an Internet site, distance learning, downloading resources and school work. The Table shows that among the 177 students reported that they are Internet users, the most frequent reported use is for communication purposes (about 88% of the Internet users). Gathering information, downloading resources, and doing schoolwork appear at a reasonable frequency among these students as well (about 70–80%). Creating Websites and distance learning are of less frequent use.

Among the Internet users reporting that they use the technology for school related work (70%), 60% indicated that they use Internet to enrich and expand their knowledge about

Table 4. Main uses of Internet by high school students

Use of Internet for	N	Not at all (%)	Seldom (%)	Frequent (%)	Mean	S.D.	Gender difference (χ^2)	Age group difference (χ^2)
Information gathering	177	17.5	48.6	33.9	1.95	1.27	2.1	30.6
Download resources	177	24.3	33.9	41.8	1.98	1.46	15.6**	24.0
Communication	177	12.4	35.0	52.6	2.42	1.38	1.2	29.1
Website creation	177	91.5	0.0	8.5	0.34	1.12	3.8	16.9**
Distant learning	177	77.4	16.9	5.7	0.41	0.89	3.8	26.17
School work	175	30.3	33.1	36.6	1.83	1.51	5.3	28.9

**$p < 0.01$

topics learned, 17% to prepare exams, and only 13% to participate in collaborative tasks or discussion groups related to school activities. Only 20% of the Internet users indicated that the Internet is regularly accessible from school, 60% that is fairly accessible, and 21% that it is not accessible at all from school. Further details about Internet usage by high school students can be found in Nachmias, Mioduser & Shemla (2000).

In order to identify the major factors that might affect the use of Internet by high school students, a Stepwise Linear Regression was conducted on *Internet usage* as dependent variable, and *gender*, *grade level*, *home accessibility to computer*, *home accessibility to Internet*, and *computer experience* as independent variables. The only two factors that entered the linear regression and affected the dependent variable were *home accessibility to Internet* ($R = 0.66$, SE $= 0.38$) and *computer experience* ($R = 0.71$, SE $= 0.35$ for both predictors). These two variables explain 49.8% of the variance of the dependent variable ($F(2,383) = 188$; $p < 0.01$).

Students' perception of their ICT knowledge

Table 5 presents the students' perception of their own ICT knowledge.

The data suggests that about 90% of the students see themselves as ICT proficient to some extent. Significant difference was found in the students perception of their own ICT knowledge among grade levels ($\chi^2(20) = 45.65$; $p < 0.001$). Surprisingly 13.4% of the older students (grades 10–12) indicated that they have no ICT knowledge, whereas only 6.1% of the junior-high school students (grades 7–9) indicated the same. Significant difference in the students perception of their own ICT knowledge was found between genders ($\chi^2(4) = 47.58$; $p < 0.01$). Boys saw themselves more ICT proficient than did girls (40.9% and 15.9% respectively). In addition, 14.2% of the boys considered their ICT competence as very high, while none of the girls did so.

Table 5. Students' perception of their ICT knowledge

		Self reported level of knowledge						
	N	0	1	2	3	4	Average	S.D.
Boys	176	6.3	15.9	36.9	26.7	14.2	2.27	1.09
Girls	208	12.5	30.3	41.3	15.9	0.0	1.61	0.90
Grade 7	67	7.5	10.4	58.2	22.4	1.5	2.00	0.83
Grade 8	68	1.5	20.9	38.8	29.8	9.0	2.24	0.94
Grade 9	63	9.5	20.6	42.9	22.2	4.8	1.92	1.00
Grade 10	59	11.9	37.2	32.2	10.2	8.5	1.66	1.09
Grade 11	65	9.2	21.5	38.5	23.1	7.7	1.98	1.07
Grade 12	62	19.0	33.4	23.8	15.9	7.9	1.60	1.20
All students	**384**	**9.6**	**23.7**	**39.9**	**20.8**	**6.6**	**1.91**	**1.04**

Self reported level of knowledge: 0 = Not at all; 1 = very little; 2 = little; 3 = knowledgeable; 4 = very knowledgeable

Discussion

The purpose of this study was to characterize high school students' use of ICT, regarding three focal issues: equity, gender, and integration of learning processes taking place within and outside school.

Critical equity issues are unveiled when we consider the variables examined in this study namely, extent, scope, and self-perception of proficiency in using ICT. Among the research population, three distinctive groups of users were distinguished. First is the *non-users group*, comprising about 10% of the students. Within a generation of students born into an ICT saturated culture (Katz, 1997), still about a tenth of them are computer-illiterate, and do not use computers at all (even not for gaming or leisure). Over 70% of the non-users group are girls. The second group are the *common-users*, comprising about two thirds of the study's population. Students in this group focus mainly on the use of basic tools (mostly word processing) and gaming, spending 2–6 weekly hours using ICT. The third group are the *skilled-users* (about 25%), which deal with sophisticated tasks such as graphic processing, spreadsheet and mindful use of the Internet. Within this group are highly skilled students (about 7% of the whole population), able to cope with complex data manipulation, programming tasks, and Website creation. In light of these results, it is hard to claim that *all* children growing up in the digital era are active members of the net generation. Actually, three out of four youngsters are still not there.

Another key variable for which we did expect differences among the subjects was age level. However, differences among age groups followed an interesting pattern. Although it could be expected that as students mature their use of ICT would become more sophisticated, the use of complex software packages (e.g., spreadsheets, graphic processing, programming) was more extensive among the younger groups. A reasonable explanation for this could be based on the fact that learning how to use varied ICT tools has been explicitly included in the curriculum for junior high grades. Equally surprising was the finding that regarding Internet use, no difference was found among the age groups. We assume that given the fact that all youngsters entered the 'Internet era' at the same time (only recently), an even distribution of those who were 'trapped in the Web' among age levels is still observable.

Following these results, an evident conclusion is the need to supply ample support to the large group of students that remain illiterate or interact shallowly with the new technologies. We can define this as the need for a concentrated effort to support the majority of the students' transition from (ICT) illiteracy to e-literacy. An obvious but important consequence of this effort should be the disruption (if not elimination) of the actual process in which differences generated in the schooling stage are perpetuated and even amplified in the 'real-life' stage, when the students enter the technology-based work market of today. To repair actual inequities, but more important to diminish the prospect of future ones, a mindful process of priorities definition, planning, allocation of resources, and implementation steps is required.

Gender, although an equity issue by itself, deserved particular consideration in this study. Gender differences were evident regarding most of the aspects of the study's results. Boys use more ICT for more time than girls do, and perceive themselves as more proficient

about ICT than girls do. Regarding Internet usage, about 56% of the boys and only 38% of the girls belong to the users group.

There is no conclusive data in the research literature on gender related questions across ICT areas or age levels, and no consistent explanation about causal factors behind the reported disparate results. It is evident that a great deal of research is still needed. One of the key questions to be addressed is whether ICT's image as a male occupation is so culturally rooted that it cannot be modified. In the past, the biased identification of technology as male dominated area was probably rooted in the perceived nature of the technologies of the industrial era. But for present post-industrial and knowledge-society technologies, even this cultural bias lost its relevance as explanatory argument for gender-related differences. Therefore, educators are challenged to devise appropriate educational means that together with the dynamics of the rapid and continuous integration of the technology into more and varied areas of our life, would eventually generate a more balanced involvement of both boys and girls with ICT.

A third issue concerns the pivotal question regarding the integration process of ICT into formal education settings. Becker (1994) indicated that according to existing data regarding schools infrastructure, it could be expected that each student would spend about two hours a week doing computer-based work. Notwithstanding this expectation, the figure reported by the students as weekly time actually spent on computer work at school was about 40 minutes a week. In this study, we observed that the center of gravity of this cultural and social process is not in the school, but in out-of-school settings, mainly the home. In this study we have found that among all possible factors affecting the youngsters' use of ICT, the most significant was accessibility from home. About 87% of the students have computers at home, half of them connected to the Internet. The majority of the students indicated that they prefer to use computers at home or in other settings, rather than at school. Students reported that the average overall time spent with computers is above seven hours per week, most of it out of school.

One possible explanation for the findings could rely in the gap between the (limited) technological capability and support which most schools offer, and the complex demands of work with the new communication technologies (i.e., hardware, software, knowledge, skills). It is evident that the school is not perceived yet as an environment in which ICT has been assimilated as efficiently as within other arenas of our culture (e.g., the workplace, commerce). But this is too simplistic an explanation. An alternative perspective should try to unveil the deeper cultural issues raising the potential conflicts between the school and ICT-based cultures in general, and the Internet in particular. Among other characteristics, school culture can be characterized as mainly non-democratic (as an organization), highly structured, pursuing a strictly defined set of objectives, and fostering social equity. On the other hand, ICT/Internet culture is perceived as overly democratic, open-ended, non-structured, and highly individualized, with no commitment to social equity. One can think of two possible outcomes of this conflict between the two different cultures. The first could be that significant changes in the school's set of values and structure will transpire as key components of the Internet culture are assimilated. In an alternative scenario, the Internet will remain outside the school world, but as a central activity for youngsters in non-school

settings. This implies the redefinition of the school's function as society's main knowledge provider and communication facilitator.

By both scenarios, we can expect major changes in educational processes, resources and configurations as ICT technology reshapes the ways we learn, work, and communicate. Ensuring accessibility (that is, integrating work stations throughout the school to respond to differing needs in different spaces and courses) and offering continuous pedagogical support is essential for the creation of an ICT culture *within* today's schools (Berenfeld, 1996). School is still, and it will continue to be in the foreseeable future, a strong socialization agent. As such it should be ensured that the within-school processes keep strong linkage with outside-school processes, in particular with these varied forms of learning emerging at outside school settings with heavy support of ICT. Moreover, a crucial challenge for today's school is to participate (and even lead?) in the creation of novel models of integration of the varied formal and informal, beyond the constraints of time and space, ICT based learning processes.

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