

**INFORMATION AND COMMUNICATION TECHNOLOGIES USAGE BY
STUDENTS IN AN ISRAELI HIGH SCHOOL**

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ABSTRACT

This study examines the extent and characteristics of ICT usage among 384 junior high and high school students in Israel. Its focus is on (a) the purpose and patterns of ICT usage, with focus on the Internet, by 12-18-year-old youngsters; (b) gender and age differences in ICT use; (c) the linkage between ICT usage and school activities; and (d) the students' perception of their own ICT level of knowledge. The findings show that ICT is being used by 90% of the research population, and the Internet by about 50% of the students. The main purpose for ICT use is for computer games and word processing, and far behind spreadsheet, programming and information retrieval. Minor linkage was found between the Internet usage and school related tasks. The results showed significant gender differences in most aspects. 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 Internet use proper. Self reported perception of ICT knowledge revealed that one tenth of the students are computer illiterate, two thirds are basic users, and only about 25% are skilled users.

INTRODUCTION

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 serves 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 are using computers and about 40% have 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, the majority of which are taking place outside the school (e.g., in the home, informal education settings).

The characteristics of these children's involvement and interaction with novel communication technologies are the subject of the present research. The purpose of this study is to understand of how ICT is used by high school students, and to what extent their work with ICT is related to formal academic or school objectives.

THE STUDY OF ICT USAGE

The number of studies regarding Web use by children under 18, the genuine representatives of the new Net Generation, is still limited. A recent Israeli survey among 2,000 12-18-year-old youngsters revealed that 37% are Web users (*Maariv*, 2/12/98). Another study, conducted at Carnegie Mellon University, focused on home-computer usage by 48 families. In about 85% of the families, the major users were children, and in most families, youngsters were the main Internet users (Tapscott, 1998). According to the same source, in 1996, one out of ten Internet users was under 16 years of age.

Research on children's use of ICT primarily describes and examines the potential of the Internet within the educational system (Berenfeld, 1998; Mioduser, Nachmias, Oren & Lahav, 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.

Additional relevant questions raised by the crescent impact of ICT on youngsters' learning and social life relate to equity issues in general, and those involving gender in particular (Shashaani, 1997). When first introduced as a personal tool in the late 1970's the PC was accepted and used differentially by boys and girls. This issue has been widely studied in the last 20 years (e.g., Collis, Kaas & Kieren, 1989; Fetler, 1985). The

emergence of the Internet and the new tools it provides further complicates this concern regarding equal access to information and updated knowledge resources.

The present study examined the extent and characteristics of ICT usage among 12-18-year-old students in Israel, focusing on the following objectives:

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 in particular 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 relationship between ICT usage and the school 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 concerning all previous issues.

METHOD

Subjects and procedure

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.

All the students were administered a questionnaire containing 87 open-ended and closed questions. The participants were interviewed to obtain a more detailed description of the students' attitude, motivation and patterns of ICT use.

Research instrument

The ICT usage questionnaire implemented contains descriptive information (i.e. gender, grade level); items assessing access to a computer and the Internet at home and at school; items focusing on the extent and character of computer usage; and items examining the subject's computer literacy. The last question of the questionnaire centered on Internet use per se. Data collected was self-reported.

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 will be presented in the order of the study's objectives, namely, to learn about extent of ICT use, factors affecting usage, variety of ICT tools use, Internet usage, and school access.

Extent of ICT use by high school students

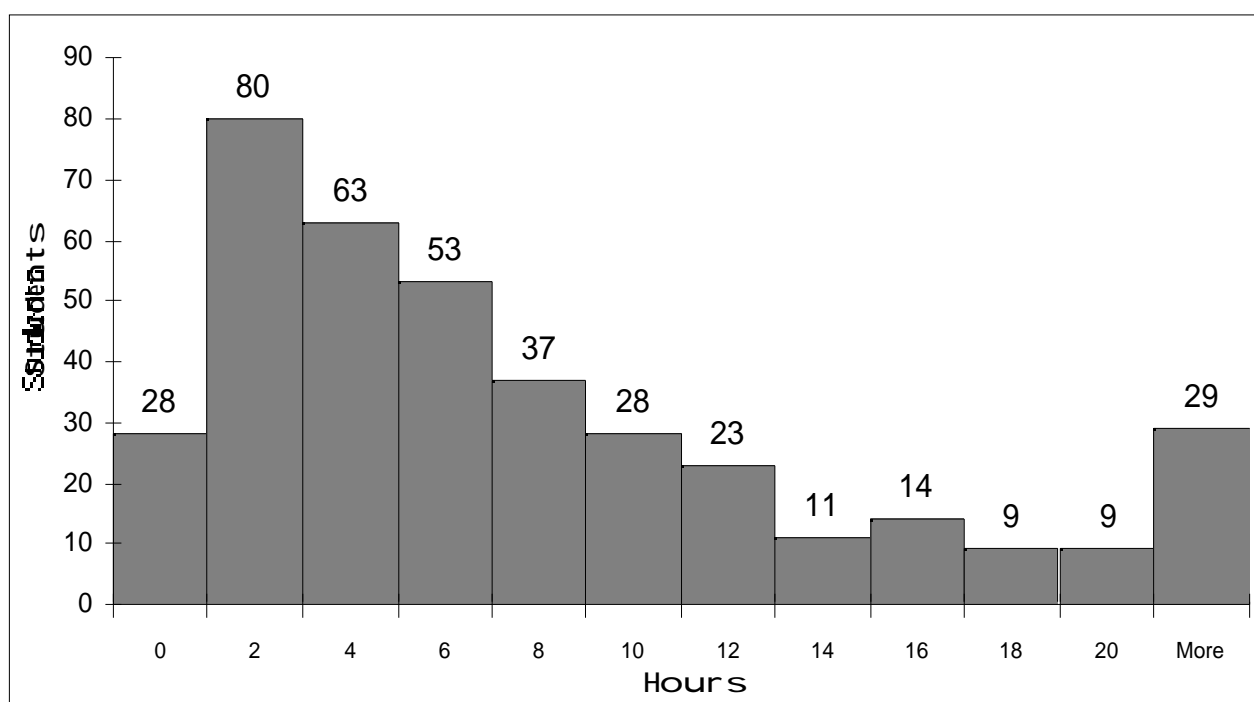
Table 1 presents the average amount of time invested by gender and age groups using ICT in three locations: home, school and other sites. The average number of hours per week students spend using the computer is 7.36 hrs, or about one hour a day. Most of this time (about 5 hours a week) was spent at 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 ($\chi^2(65)=99.24$; $p<0.01$). A significant difference in total time usage was found between genders: from home ($\chi^2(28)=53.25$; $p<0.01$), 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 hours).

Table 1: 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)

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.

Figure 1: Distribution of Time spent on ICT use



Scope and Purposes of ICT usage

Table 2 presents the subjects' aims for using the computer via different tools and software. Students ranked the extent of their usage on a scale of five (0-4) specifically, *not at all*(0), *very seldom*(1), *seldom*(2), *frequent*(3), and *very frequent*(4). In Table 2 (as well as in Tables 3) the students' answers are presented in two ways: the distribution of answers

recorded into a three-level scale (columns 3 to 5), and the mean score and standard deviation calculated according to the original five-level scale (columns 6-7).

Table 2: 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**
Data Base	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

** $p < 0.01$

* $p < 0.05$

The data presented in Table 2 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 unfrequent (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). 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 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 ($\chi^2(1)=12.8$; $p<0.01$). Surprisingly, the percentage of users at the different grade levels (from sixth grade to twelfth grade) was similar ($\chi^2(5)=2.6$; $p>0.05$).

Figure2: Distribution of Internet usage among the students (n=384)

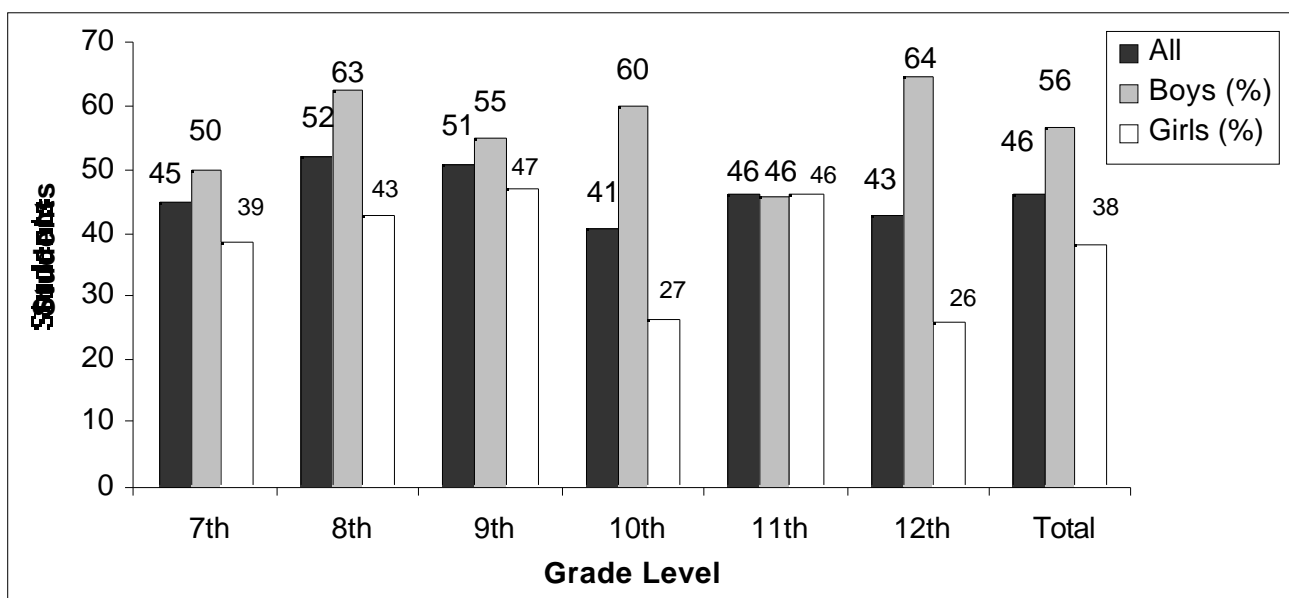


Table 3 shows the results for Internet usage by high school students, according to six main areas: information gathering, communication, creation an Internet site, distance learning, downloading resources and school work. The Table shows that among the 177 students reported that they are Internet users, 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 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 (in press).

Table 3: 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

** $p < 0.01$

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 4 presents the students' perception of their own ICT knowledge

Table 4: Students perception of their ICT knowledge

	N	Self reported level of knowledge					Average	S.D.
		0	1	2	3	4		
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 Studets	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)

The data suggests that about 90% of the students see themselves as ICT knowledgeable 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 knowledgeable than did girls (40.9% and 15.9% respectively). In addition, 14.2% of the boys considered their ICT knowledge as very high, while none of the girls did so.

DISCUSSION

The purpose of this study was to characterize high school students' use of ICT, regarding their accessibility to computers and Internet, time spent on ICT-based activities, kinds of activities, and factors affecting ICT use by the students.

Among the study's research population, three main groups of users were distinguished. First, 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 (e.g., 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 Internet usage. Within this group are highly skilled students (about 7% of the whole population), able to cope with data manipulation or programming tasks.

An interesting figure is that related to computer accessibility. 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. 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. Most significantly, students reported that the average overall time spent with computers is above seven hours per week, most of it out of school. It is evident that 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). 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, 1997).

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 knowledgeable about ICT than girls do. Out of the subgroup of Internet users among the students, about 60% are boys and 40% are girls. A key question to be addressed by educators is whether ICT's image as a male occupation is so culturally rooted that it cannot be modified, or perhaps, that the rapid and continuous integration of the

technology into more and varied areas of our life will eventually generate a more balanced involvement of both boys and girls with ICT.

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., for data manipulation, 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 is 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.

A final remark concerns the pivotal question to be addressed regarding the integration process of ICT into education. 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. Among all possible factors affecting the youngsters' use of ICT, the most significant was accessibility from home. One possible explanation for this finding 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). 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. According to both scenarios, we can expect major changes in educational processes, resources and configurations as ICT technology reshapes the ways we learn, work, and communicate.

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