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From hackers to luddites, game players to game creators: profiles of adolescent students using technology

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This paper explores a range of responses to computer and video technology as exemplified by a class of Grade 7 and 8 students in a low- to middle-income suburban school in a mid-sized Ontario city. The class was provided with four networked Macintosh LC III computers. The responses, attitudes and behaviours of the students towards technology, both at home and at school, were documented through field notes, observations, concept maps, interviews and journals over the course of a school year. From these observations, classroom 'computer personalities' emerged; students were characterized as hackers, game players, game creators, reluctant users, luddites, eager users and sporadic users of computer technology. Each of the 'personalities' is profiled and patterns of game-playing and game creation are described, classroom uses and home uses of computers are compared, and students' ways of using their free computer time in the classroom context are discussed. Finally, some suggestions for inclusionary practices for schooling with technology are offered.

With the growing emphasis on integrating information technology and curriculum, it is critical to bear in mind that not all students respond in the same ways to the challenges and opportunities presented by these technologies. This paper is an attempt to explore the range of responses to technology as exemplified by a class of Grade 7 and 8 students in a low- to middle-income suburban school in a mid-sized Ontario city. Behaviours and attitudes that were observed over the course of a school year are described as four networked computers were introduced to the classroom. Home use of computer and video-game technology was taken into account as well. This investigation was guided by several key queries: How did home and classroom uses of technology appear to influence each other? What kinds of 'computer personalities' emerged besides the well-known and well-documented 'hacker'? What were some of the patterns of game-playing and game creation? What did students choose to do in their 'free' computer time? How did students use computers for assignment purposes, and did such use differ from free-time use? Finally, what are some of the implications for schooling with technology for including all students? These are important questions because issues dealing with gender and technology, and the interaction between them, are central to any discussion

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of contemporary curriculum (Pinar *et al.* 1995, Rosser 1995, Bendixen-Noe and Hall 1996, Zaher 1996, Slaughter 1997). As Christian-Smith (quoted in Pinar *et al.* 1995: 370) noted, 'while the sociology of curriculum has carefully studied the role of the school in maintaining dominant social arrangements in societies characterized by strong class and racial divisions, it has only lately acknowledged that gender is an equally important dynamic in society'.

Gender, technology, and curriculum

Since the early 1970s, the research literature on the use of computers in school curriculum has burgeoned. Computers have been heralded as tools for thinking (Papert and Solomon 1971, Papert 1980, Mojkowski 1985, Olson 1985, Owen 1990, Papert 1993), as a means for achieving equality on the basis of class, race and gender (Owen 1990), as a means for pursuing authentic, problem-based learning (Papert 1993, Lebow and Wager 1994, Wolk 1994), as a way of enabling children and adults to communicate with one another at a distance through electronic mail (Levin *et al.* 1985, Owen 1990, Upitis 1990), as a way of complementing existing curriculum and teaching practices (Miller and Olson 1994), and as a way of joining children's fascination with aspects of their out-of-school culture (such as toys) with in-school curriculum materials and approaches. An example of this last use is the combination of LEGO with the Logo computing language, used in conjunction with curricula designed to help children learn about ratios, gears, speed, and motion (Rosen 1988, Hall and Hooper 1993). Furthermore, computers have been recognized as powerful tools for mathematical explorations (Battista 1994), and are considered an integral aspect of mathematics curriculum and education (National Council of Teachers of Mathematics 1987, 1989). Numerous articles in professional journals, teacher newsletters, city newspapers, television documentaries, and Internet bulletins promise that the classroom of the future will include more than mere stand-alone computer technology. There will be an increased presence of networked computers, more telecommunications applications, a greater use of the interactive videodisc and CD-ROM technology, more multimedia learning environments, and more computer databases for education (Hedley and Ellsworth 1992).

Yet in all of this promise, there is relatively little literature on the question of inclusion. This is a critical issue from a curriculum perspective (Pinar *et al.* 1995). Further, the issue of desirability of inclusion in terms of technology is rarely addressed. Do we want all learners to use information technology in the same ways? Most researchers appear to assume that with more accessible technology and with computers available for all students, all learners will embrace technological advances and learn with a depth and scope previously unimagined. But what of the learners who are not attracted by technology? Who is marginalized in a classroom filled with technology, and in what ways does such marginalization occur? How can all learners, in some fashion, be included in technology-rich classroom

environments, in ways that honour their own preferences, inclinations, and experiences?

The area that has received the most attention in the literature in terms of inclusion is that of gender differences in the appropriation of computer and other technologies (race and class as they interact with technology are, as yet, seldom explored). Perhaps the best known early work in the area of technology and gender is that of Turkle (1984). Turkle made the important claim that people bring their own styles to technology, and that, contrary to some of the early characterizations of technology, it is the programmer or computer user who imposes a style on the computer, and not the computer that imposes a style – a single style – on programmers or users. Turkle further demonstrated how many girls are 'soft masters' in their appropriation of technology, that is, that they deal with computers as relational objects, not quite alive, but things with which one negotiates relationships although they will never be understood completely. In one portrait of a nine-year-old programmer, Anne, Turkle (1984: 114) described how Anne programmed a computer but '[thought] like a painter, [a style of programming that] requires technical sophistication and ingenuity'. On the other hand, Turkle showed how boys tend to be 'hard masters', treating computers and programming by planning a course of action, and exercising control over the situation through determination and perseverance. In her description of Jeff, a nine-year-old boy, Turkle (1984: 101) described how he approached programming by conceiving his projects globally, and then breaking up the work into 'manageable pieces'. Turkle (1984: 101) contended that this approach 'conforms to our stereotype of a ''computer person'' or an engineer – someone who would be good with machines, good at science, someone organized, who approaches the world of things with confidence and sure intent, with the determination to make it work'.

But not all girls become 'soft masters'; some do not become masters at all. Following Turkle's work in the early 1980s, later research indicated that boys and girls often approach electronic games and computer technology in different ways and further, that girls are often disenfranchized when it comes to computer use, even when they express interest in using computers (Sanders 1985, DuBois and Schubert 1986, Inkpen *et al.* 1994, Lawry *et al.* 1995, Koch and Upitis 1996). Researchers have demonstrated that the gender differences in computer interest and skills begin in the early grades (Becker and Sterling 1987), are reinforced by peers and the home environment, and continue into adulthood (Giacquinta *et al.* 1993).

Another interpretation of gender differences and technology is provided by those researchers who have attempted to characterize not only the *style* of interaction, as did Turkle (1984), but also describe differences in *purposes* of interaction. For example, Giacquinta *et al.* (1993) found that boys are more likely to use computers for programming and game-playing than are girls. On the other hand, girls have been found to use computers as tools, as an efficient and attractive means to accomplish tasks set before them (Giacquinta *et al.* 1993). Turkle (1995) also described a category called 'users', which is like the 'eager tool users' category used in the present paper. Further, Turkle (1995: 201) identified the 'hacker' personality as one

in which the machine itself becomes the driving force; thus, rather than using computers as a means for other ends, the computers themselves become the end: 'contact with the tool is its own reward'. Turkle noted that 'hackers' are mostly male, and are driven by the goal of 'mastering' the technology. She also observed that the hacker is no longer characterized only as a 'nerd', but can be viewed as something of a cultural icon.[1] These characterizations of technology use that have been identified in the literature – namely game-playing, 'hacking', and using computers as tools – are explored in the present paper and further categories are suggested as a result of the study.

Recognizing these differences in both style and use of technology, one approach has been to redesign computer interfaces and environments to make them more inviting for girls, building on girls' interest in relational situations with the goal to expand girls' interest beyond using computers as tools (Inkpen *et al.* 1994). The research described here contributes to this issue in a slightly different but complementary way. Rather than attempting to design technology, curriculum and classroom situations to make them more attractive to girls, the focus here is to expose the wide variety of ways students react to technology. Thus, the aim is to identify various forms of marginalization, exclusion *and* inclusion, rather than beginning with instructional and hardware modifications to include one group previously identified as marginalized on the basis of gender. An underlying assumption of this study is that learning is a social act, one that happens in community (Prawat 1996). Issues of inclusion are critical, as is the context in which technology is used and learning takes place.

Both home and school computer use are considered in this paper. The presence of a home computer is one way that inequities in classroom situations can occur – students who have computers at home often have better keyboarding skills than those students who meet a computer for the first time at school. The various differences in classroom use of computers are also strongly influenced by other forms of technology used by children. Although it is tempting to concentrate solely on the perceived and demonstrated benefits of computer tools on learning in the classroom in ways often described in the literature, students' views of technology include computers as game machines. These views must be taken into account. As Provenzo (1991, 1992) has forcibly demonstrated, the video-game culture is pervasive in North American homes and schools, and video-games represent 'neither a neutral nor a trivial technology, [but are] redefining the symbolic underpinnings of our culture' (Provenzo 1991: 33). He argued that increasingly sophisticated video-game systems, with more explicit graphics, more violence, and faster movement of characters, are 'all aimed at keeping up with the tastes of the primary target audience – boys, ages eight to eighteen' (Provenzo 1991: 11).

How does the video-game phenomenon interact with the use of computers in schools? In the classroom described here, video-games were not part of the regular school environment. Yet it will be seen that the students' use of video-games outside of school affected their in-school behaviour in pervasive ways. For example, students judged computer software on the basis of the standards they used to judge video-games,

standards that were often inappropriate for the computer software they were examining. Also, in keeping with Provenzo's (1991) observations and predictions, most of the boys in the class were or had been avid video-game players. Did this make them more comfortable with other forms of technology? I agree with Provenzo's (1991: 117) claim that video-games are 'an important entryway into the world of computing'. Is this another way that girls become marginalized from technology?

The study

Research questions

Several related research questions are addressed in the present study. These are:

- In what ways can computer use in the classroom be categorized when students are observed over an extended period, in a variety of contexts, taking home use of technology into account? Do these categories conform to those described in the literature (i.e. hacker, tool user, game player)?
- Is there overlap in categories of use? If so, where does such overlap occur? In what contexts?
- What is the relationship between category of use, gender, and home use of technology?
- What are some of the implications for inclusionary practices with respect to information technology?

Classroom setting

Twenty-nine students in a combined Grade 7 and 8 class took part in the research. Of these 29 students, 12 were girls. The research class was one of three Grade 7 and 8 classrooms in the school. The school student population was approximately 480 students; most students lived in the neighbouring homes and apartments in the suburban area where the school was located. The student and teacher populations were predominantly white, with 5%of the population comprised of visible minorities.

Four Macintosh LCIII computers with CD-ROM drives and two printers were made available to the students and to the classroom teacher, Sharon Saxton (pseudonym), in April of 1994. In this way, Ms Saxton, together with the eight Grade 7 students who would stay with her as Grade 8 students the following year, was able to become familiar with both the technology and some of the available software. There also was an additional Macintosh Plus with a hard drive and printer available. The teacher had no experience with Macintosh computers before April of 1994, although she was familiar with IBM computers and used one regularly.

At the outset, there was only one researcher in the classroom. By February of 1995, four researchers were involved in the research project.

Each of us spent two or three hours per week in the classroom. Rarely were we all present; having four researchers arrive simultaneously and on a regular basis would have been too disruptive to the flow of classroom life.

The classroom atmosphere was vibrant. The walls were covered with students' work, often reflecting the current units of study. In the 1994–95 school year, these units included topics such as monsters, advertising, illusions, and toys. For each of these topics, students were expected to complete a series of interdisciplinary projects. In addition to the broad interdisciplinary topics, Ms Saxton also conducted a number of teacher-directed lessons. These lessons would be followed by individual hands-on experimentation, group work, or by individual pencil-and-paper assignments. There were also times throughout the day when students could choose from a number of activities, including working on the computer, working on homework, or reading a book. These activities were also common at recess and lunch. The times when students had choice in selecting activities were known as 'free-time'. Although the students were 'free' to choose activities for these times in the school day, certain ones were not acceptable to the teacher (e.g. wandering around the room talking with friends). That is, free-time in the classroom remained under the direction of the teacher, who set up expectations for such free-time. It remained part of the teacher's efforts to shape the students' educational experiences. This situation is different from free-time at home, where the teacher does not have the same influence (although many parents would similarly limit free-time at home). A typical day is depicted in table 1, showing the time spent on the various types of activities (i.e. teacher-directed lessons, free-time, before and after school time, etc.).

The interactions between Sharon Saxton and her students were warm and firm. She cared deeply for the students' intellectual, emotional, and personal growth and well-being. She had a marvellous sense of humour,

Table 1. The use of computers in the 'typical' day.

8:50	Free time	Computers available on a first-come, first-served basis.
9:00	Math	Teacher-directed lesson: students may be assigned to computers for work-related projects, can use computers on a first-come, first-served basis once work is completed.
9:45	French	Teacher-directed lesson.
10:35	Recess	Students who wish to use computers may stay in and do so.
10:50	Language Arts	Teacher-directed lesson: students may be assigned to computer for work-related projects, may use computers on a first-come, first-served basis once work is completed.
11:45	Lunch	Students may use computers once after lunch on a first-come, first-served basis.
12:45	Self & Society	Teacher-directed lesson: students may be assigned to computer for work-related projects, may use computers on a first-come, first-served basis once work is completed.
1:20	Recess	Students who wish to use computers may stay in and do so.
1:35	Technology Centres	Students are assigned to centres which are rotated each day. Instructions are given on activity cards. Computers are generally used as one of the centres.
3:00	Home Time	Some students use computers until teacher sends them home.

and the students gleefully commented on her 'zaniness'. She was sensitive to patterns of behaviour often exhibited by adolescents and supportive of students as they struggled to define themselves.

We had a closely negotiated relationship with Ms Saxton, in terms of presence in the classroom and the nature of the research that took place. There were regular classroom and out-of-school meetings to determine how the computers might best be integrated into the existing programme while, at the same time, stretching the boundaries of the curriculum through the introduction of the technology. Discussion topics included the critique and selection of software that could support the project-based units and determining how the students might best be able to test software prototypes as they were developed by the Electronic Games for Education in Math and Science (E-GEMS) group to which the researchers belonged. Studies designed throughout the year were timed to coincide with the regular work of the classroom.

All of the computers had word processing, paint programs, and *HyperCard*. The four Macintosh LCIII computers were networked with one another and to the printers. Further, although we provided software prototypes and commercially available software for research purposes (e.g. *Counting on Frank*, a CD-ROM mathematics game), the teacher was also allocated $700.00 (Cdn) to purchase software based on her own needs and interests. Her purchases included software that was closely related to units she had planned (e.g. *SuperStar Science* was related to the science unit on force, work and energy) and games that she thought would be enjoyable and instructive (e.g. *Theme Park*, a simulation game where players design and operate an amusement park). These choices reflected her view that it was important for all students to become comfortable with technology, and that literacy, mathematics and science were important areas of study. Further, because she believed that students found some concepts about mathematics and science more accessible through game formats, some of the instructional software she purchased reflected this view. She encouraged the use of technology not only by the purchases made for the classroom, but by her own use of it, by her sensitivity to those who were unfamiliar or uncomfortable with using computers, and by her curriculum planning, which usually included a technology component.

All of the available software, listed by type, is shown in table 2. Development tools, word processors, graphics tools, puzzles and games, simulations, and CD-ROM books were available.

Table 2. Types of software available in the classroom.

CD–ROM Books	Tools	Games	Simulations	Development tools
3D Atlas	ClarisWorks	Counting on Frank	Mac Theme Park	HyperCard
New Kid on the Block	CreativeWriter	How the West Was One	Morph	LogoWriter
Superstar Science CD	Cypher	Mac Puzzle	Operation Frog	
	Fine Artist		SimAnt	
	Tesselmania		SimCity	
			SimLife	

Table 3. Video game players and computers available in the homes.

Video Game Players

Number of machines	Male	Female
0	0	4
1	8	1
2	1	4
3	6	3
4 or more	2	0

Computers

Number of machines	Male	Female
0	6	1
1	6	6
2	2	2
3	1	2
4	2	1

Twenty-two of the students (76%) had at least one computer at home. Most of these were IBM or IBM-clone computers. Also, most students (83%) had one or more video-game players at home. The distribution of home computers and video-game players by gender is shown in table 3.

Documenting behaviours, attitudes, and experiences

The patterns of computer and video-game use, attitudes towards technology, and classroom and out-of-school experiences were documented and observed in a number of ways throughout the school year. All four researchers engaged in conversations with students each week, and recorded parts of the conversations through field notes. Some conversations were audiotaped and transcribed. A number of the conversations were reflected upon in some detail in journal writing. Journals of the four researchers and the classroom teacher were shared and discussed throughout the year. Students were also encouraged to reflect on their own experiences in journal form, although, with a few exceptions, this rarely happened spontaneously.

The class was surveyed as a whole and students were interviewed individually twice during the year (October and March) on specific issues such as the use of computers and video-games outside of school, out-of-school activities and hobbies, favourite subjects, and various aspects of school life. Because we spent many hours in the classroom and talked to students on a regular basis, we came to know them well; we were not only familiar with their interests and patterns regarding the use of technology, but also came to know the social structures that existed in and out of the classroom. It became apparent that the ways in which students used computers depended not only on the teacher's expectations, the availability of computers in free-time, software choices, and students' inclinations towards the technology, but also on their interactions with one another as

they attempted to define themselves in this particular social context. For example, one young woman was more likely to use the computer when her friends were also using computers. In another case, a young man played a particular game at home (or in the class when his friends were not present) because his choice was not considered acceptable by his peer group. As Turkle (1984: 19) pointed out, during adolescence reflecting on one's identity is key: 'experience is polarized around the question of identity, and the child's relation to the computer . . . [is] not about the machine but about oneself'.

Use of computers in the classroom was documented from early November to the end of May. This included both use of computers for assignments and centres as well as use of computers during free-time. Use of computers for assignments was documented by the classroom teacher and confirmed through our observations. For free-time use, students kept track of the programs and games they used by filling out a form (designed by the students and one of the researchers) stapled to the wall above the computers. Students indicated the software used during free-time by marking an 'F' (female) or 'M' (male) in the space next to the name of the software. These sheets were collected and compiled on a weekly basis. The researchers, the teacher, and the students decided that it would be interesting to watch patterns of free-time use according to gender, but that it would be too complicated to keep track of the amount of time spent on each of the programs, or to record the kind of use made of a particular piece of software (e.g. what a word processing program was used for on a given occasion). The accuracy of these self-reports was periodically checked through observation. On the whole, students were diligent in reporting their use, and the occasional reminder was enough to help them get into the habit of tracking their interests.

In February, students were asked to complete a form indicating who they would consult for help if they had trouble with a certain piece of software. Students also filled out software evaluations, again using a form of their own design. These forms were used regularly from February to mid-June, and collected once a week. We discussed the students' evaluations with them, sometimes to clarify what they had written, and to indicate that their views were being into account and that their feedback was valued.

Finally, 15 students were asked to complete concept maps regarding their interest in computer games, a mechanism that helped us discover how students linked ideas and structured the broad topic of computer games (White and Gunstone 1992). Extended interviews were conducted with the six students profiled at length later in the paper (pseudonyms are used throughout).

The categorization of use, which appears in the following section, was based on a compilation of classroom use (both assigned and free-time) and on reported home use, using the methods outlined above. The categories of use began with the research literature and were augmented as more categories became apparent through extended observation. These categories emerged over the course of the school year through discussions among researchers and the classroom teacher. By the end of the year, we reached agreement regarding the categories. Then, each researcher and the

classroom teacher independently assessed the students, based on the data available. In three cases there was some disagreement as to which category best described a particular student. In those cases, it was agreed to use both categories, with an indication of context (e.g. one student was viewed as both a tool user and game player, but the tool user role was primarily with respect to class assignments, whereas game-playing was most often at home and in free-time).

Use of technology in the class as a whole

The information gathered made it possible to analyse the use of technology in the classroom and outside of school. In addition, we were able to document changes that occurred during the year, as several instruments were used more than once; a few were used on a weekly basis.

After analysing the data, it became apparent that most children developed strong and consistent patterns of technology use, and could be characterized as one of seven types of users. There was some overlap between the categories, especially in terms of the students who fell under the categories of 'hacker', 'game player', 'game creator', and 'eager tool user' (see table 4). In other cases, there was no such natural overlap. For example, a 'luddite' never exhibited the characteristics of a 'game creator' or a 'hacker'.

Some types of computer use were more likely to emerge during centre time (associated with assigned work); others were more likely to be observed during free-time. In the home context, video-games were included along with computer use; here again, use of technology differed from one type of user to another. A summary of the contexts of video-game player and computer use, along with the categories of technology users, is presented in table 5. The characterizations of use appear below.

Table 4. Categories of users and the interaction between types of use.

Category	Male	Female
Eager tool users	5	3
Reluctant tool users	1	5
Hackers	6	0
Game creators	7	3
Game players	7	4
Luddites	3	2
Sporadic users	4	3

Notes

1. One of the male tool users was a hacker, one a game creator.
2. Five of the hackers were game creators, one an eager tool user.
3. Five of the seven boys who created games were also hackers. All of the game creators were game players (but not all players were creators).
4. One of the sporadic male users was also a game creator.

Table 5. Typical patterns of use by type, venue, and category of user.

	School		Home			
	Assigned time and task	Free time: assignments	Free time: games	Video games	Computer games	Computer assignments
Eager tool users	✓	✓				✓
Reluctant tool users	✓					✓
Hackers	✓	✓	✓	✓	✓	✓
Game creators	✓		✓	✓	✓	
Game players	✓		✓	✓	✓	
Luddites	✓					
Sporadic users	✓	✓	✓	✓	✓	✓

Eager tool users

Eight of the 29 students could best be characterized as eager users of computers when they could use the computer as a tool – to write and print homework assignments, create illustrations, to communicate with others through e-mail, or to create a particular artifact for a special occasion. Tasks that fell under the last category included making cards and invitations, and designing a graduation programme to display the names, photographs and interests of all of the Grade 8 students. The students who were seen as eager tool users described themselves as skilled, and were equally as likely to use a computer at school as they were to use their home computers. With one exception, the students who used the computer eagerly as a tool did not play computer or video-games. Of the students who fell into this category, three were girls, one of the boys was also categorized as a hacker, and another boy was described as a game creator. The students falling into this category had a well-established group of peers that they looked to for help when needed. They would also seek advice from adults on occasion, but relied mostly on one another to solve problems. This was similar to what one would expect from adults comfortable with technology. Research has documented that when skilled users run into difficulties, they first experiment on their own, then ask another skilled user for advice (Miller *et al.* 1996).

Reluctant tool users

A group of six students used the computer, but only reluctantly. They were capable of using such programs as word processors and graphics programs, but were uninterested in games or in development tools like *HyperCard.* Many of them used computers both at home and at school because they realized that their work 'would look better' or 'might get a better mark' if it was produced on the computer. They chose to use computer tools primarily for these reasons (i.e. assignment-driven uses). Five of the six reluctant users were girls; none was a video-game player. When the reluctant tool users needed help with a particular piece of software, they looked to adults for assistance.

Hackers

The six 'hackers' loved using computers – they explored new software, solved hardware problems, played games, and created programs and games of their own. They were not necessarily interested in using tools such as graphics programs or word processors. They were perceived by peers as the ones who 'knew about computers', and would be asked for help when there was a problem with a particular piece of software or a printer. In fact, if a researcher or the teacher had a problem, one of these students would be approached for help. It is of note that all six of the students who clearly fell into this category were boys: the one girl in the classroom who had comparable computer skills was not considered a 'hacker' by herself or her peers. In every other way, however, she was a 'hacker'. Like all six of the male hackers, she was a game player, and she had created a game as well. However, because computer use, as it has been characterized in the present research, includes a social dimension as well, the fact that she was not accepted by her peers as a 'hacker' determined that she was not included in this category.

One male hacker did not create any games of his own. However, he was what is described in the present study as an eager tool user – he spent many hours exploring every piece of available software and incorporating the software into his classroom assignments. The female 'near hacker' was also an eager explorer of new software. Hackers used computers whenever they could in the classroom context, and also made frequent use of both computers and video-game players at home.

Game creators

Roughly a third of the students created their own games on the classroom computer using *HyperCard*. The students had no direct instruction for using *HyperCard*, and none of them had used it before the 1994–95 school year. One of the students discovered *HyperCard* while browsing through the software on the Macintosh hard drives, and began exploring its possibilities. Initially the students consulted the *HyperCard* manual but then relied on one another's expertise as they learned to create cards and link them, and incorporate increasingly sophisticated graphics. These students rarely sought help from the teacher or the researchers.

Of the 10 students who created games throughout the year (seven male), eight created games for the pure enjoyment of it, although two created games only in the context of class assignments. Of these 10 students, five were also classified as hackers. The game creators also were game players; they enjoyed, for example, playing the simulation games available in the classroom, and spent many hours playing video-games outside of school.

Game players

The game players played video and/or computer games every day. Although some of the game-play occurred at school (during recess and lunch hours) much of the game-playing took place after school in the company of siblings and friends. The kinds of games these students played included fast-action, time-critical games, both with and without violent graphics and sound effects; adventure and fantasy games; puzzles and strategy games (such as chess); and simulations. Of the 11 students falling into this category, seven were boys. Game players sought advice and support from peers. On occasion, they sought advice from the classroom teacher for puzzle and strategy games or for simulations, for these were games that the classroom teacher was familiar with, and the students knew she had an interest in playing.

Luddites

A luddite, as defined in *Webster's College Dictionary*, is 'any opponent of new technologies or of technological change'. Accordingly, the students identified as luddites emphatically, repeatedly, and unwaveringly claimed that 'computers [were] stupid and boring' and that they 'hated anything to do with computers'. These students would never voluntarily use computers and tried to avoid using them, even when required to complete an assignment with a computer component. These students were even averse to being interviewed about their views on computers although, in some cases, when they found that the researchers were open to hearing about their dislike of computers, they became more engaged during the interview process. Three boys and two girls fell into this category. One of the girls began the year as a somewhat reluctant computer user, but as the year progressed, she became more disenchanted with anything to do with computers and related forms of technology. Luddites were as unlikely to use a computer at home as they were at school although one of the luddites (a boy) played video-games. Luddites would seek help almost exclusively from adults in the classroom when they were obliged to use a computer to complete an assignment. It is doubtful if the luddites were aware of the particular strengths various students in the classroom had regarding computer use, and it is also possible that they were unwilling to show themselves as unknowledgeable or unskilled in relation to their peers. For example, the profile in the following section of one of the luddites indicated that his lack of typing ability was a hindrance to his computer use. Of course, this begs the question as to whether his lack of typing skill was an effect of having spent little time at the computer keyboard, or the cause.

Sporadic users

This group of seven students used computers intermittently. They also were intermittent game players; many of them played video-games 'on and

off'. When they were interested in a particular piece of software or a game, or were engaged by an activity involving a computer, their interest was high, and they spent a large amount of time with the technology. At other times during the year, they appeared disinterested in the technology, and even averse to some of the computer tools available in the classroom. Of this group, four were boys. One of the boys also was a game creator – during one of the periods when he was captivated by the computer, he was learning to use *HyperCard* so that he could design a game. It is possible that sporadic use of technology was also related to social issues. For example, at times the researchers observed increased use when popular peers invited the sporadic users to play a particular game.

The experiences of six students: Alana, Maren, Gary, Justin, Tyler and Mark

Alana: eager tool user

Alana was a cheerful and engaging young woman, well-liked by both her female and male peers. She was openly enthusiastic about things that she found interesting – and working with computers was something she definitely found interesting. Alana performed well in terms of school curriculum, and completed assignments competently, even when she was not overly taken with a given assignment or unit. Her out-of-school interests included sports and playing the piano.

Alana was keen on the use of computers in the classroom, and also spent considerable time on the computer at home. Like other girls who enjoyed using computers, her use of computers tended to fall into two classes: using the computer as a writing/graphics tool, and using the computer for communicating with others. Alana was not particularly fond of computer games, stating 'we don't have many games on our [home computer], but I don't care'. Also, Alana did not know the names of particular types of software or even the type of computer she had at home – 'I don't know what type it is, really. But it's not like the one we have at school.' This finding was typical of girls; many girls use computers avidly and skilfully, but, nevertheless, take little interest in knowing the names and specifications of the software and hardware they readily employ (Inkpen *et al.* 1994).

Another common finding regarding girls' use of technology is that they are interested in activities that allow them to explore the complexity of relationships and their roles within those relationships (Inkpen *et al.* 1994). Alana was a regular user of e-mail to 'talk' with her friend, Emily, who was in a different class at the same school. She also used e-mail to communicate with a friend who had moved away. She used it after school for anywhere from ten minutes to an hour and a half (a new form of teenagers talking on the phone!). Alana informed the researchers, with glee, that her family was thinking of getting a second line for their modem.

When asked why she enjoyed using the computer as a tool, Alana replied that she found it 'easier to do [the] writing with a computer, and it makes it look neater and does it quicker'. These sentiments were commonly

expressed by girls who liked to complete assignments using the computer and printer. When asked about her lack of interest in games, Alana described one game she enjoyed, *Counting on Frank*. In fact, *Counting on Frank*, a CD-ROM mathematics game designed by Electronic Arts in consultation with the E-GEMS research group, was created with the goal of attracting female players. There are a number of characters in the game who are well developed, there is a clear story line, and the game relies on solving mathematical puzzles and making computations. Unlike other computer and video-games in which time-critical responses are critical to winning, *Counting on Frank* can be played at any pace, and following a number of different paths. Like some of the CD-ROM books (for younger readers), such as *Just Grandma and Me*, *Counting on Frank* also has a number of 'click-on animations'. That is, when a player clicks the mouse on some of the images, a short animated sequence is activated. Alana found these click-ons amusing, and would engage them periodically as she was working her way through the puzzles. It came as no surprise that Alana also liked the CD-ROM books of poetry. Like *Counting on Frank*, one could move through the poetry book in any order, stopping along the way to have different words highlighted or to view the animation embedded in the poems.

Alana claimed that she found some of the other software 'really hard', such as *Morph* (a tool for creating animated sequences by 'morphing' one character's features into another's) and *SimCity* (a simulation where a city is constructed by the player, and where each choice made affects other aspects of the city's operation, e.g. adding a shopping mall would change traffic patterns. Although Alana found these 'games' difficult, she was quick to note that she 'watched Desiree use them', indicating that she was not averse to the games, but simply had not pursued them on her own.

Maren: reluctant tool user

In contrast to Alana, Maren spent little time using computers during the course of the school year. In other ways Alana and Maren were similar – Maren, too, was a cheerful adolescent and took interest in school work and out-of-school activities. She was a sports enthusiast – Maren played hockey and baseball both informally and on organized teams. She identified 'talking on the phone' as one of her most important after school activities. (One wonders if she might be more enthused about using the computer at home if her home computer had a modem and could be used for e-mail.)

In the classroom context, even the students who were not keen on computers were required to use them regularly throughout the year. Thus, Maren had either tried or observed most of the software that was available in the classroom. She used the graphic/paint and word processing software the most, stating that 'they were better than the others'. Like Alana, she preferred games 'where you have to use your mind', stating that she did not like video-games because they were 'boring'. This is in keeping with observations made in other settings (Inkpen *et al.* 1994), in which girls were frequently quoted as saying that they preferred software and games

that required them to think. When asked which games she played, Maren could not name them, but described them in some detail. For instance, she 'played a game at home called ''Mind something'' where you have to find the diamonds. It's like a puzzle game, in an adventure'. Maren also used her home computer for word processing (again, an unnamed computer and unnamed word processing software). When asked about one of the most popular games used in the classroom, *Theme Park*, Maren was adamant in her dislike for it. Although she had tried it two or three times, she stated, 'It goes too fast. You don't know what's happening'.

Perhaps the most important issue about Maren's use of computer was this: although she did not care for computers, she did not feel that she was unable to use computers. In fact, at one point she stated, 'I'm pretty good with them, but I'm not like a whiz. I can use all the stuff, I just don't like to. I'd rather do something that has action, where you don't just press keys. Like baseball.' Maren, like other girls, made an explicit choice to use her time in other ways when given the freedom to do so: her lack of interest in computers was not due to an inability (or perceived inability) to use computers. She was confident in her abilities and made choices based on that confidence.

Gary: hacker and game creator

Gary was a typical hacker in many ways. He explored all kinds of software as it became available, he was called on by peers and adults to help with software and hardware problems, and he created his own games when time allowed. He imagined and understood many uses of technology, far beyond the classroom context. He viewed technology as 'good and bad', offering the following:

> If we did not have computers we would not be able to go to Disneyland roller coasters because they are controlled by computers. [Another] good thing of technology [is that] we can find causes of diseases by using computers. Or police use computers so they can catch bad guys with one push of a button or get their fingerprints. But if we keep inventing things that will do stuff for us, we won't be as active, because instead of going outside to cut your lawn, you will have a machine do it for you while you are inside on your computer or watching TV.

As noted above, one of Gary's uses of computers was game creation. He created games using *HyperCard* stacks; he learned to use the programming tool by reading manuals and collaborating with his peers – the other hackers in the room. The games were usually set in a familiar context; one game involved taking over the school. The characters in the game were teachers and students in the school, and the player could choose which characters would be involved in the game by activating a 'button' such as 'get more friends'. In this game, there were many possible paths, with the result that one of the students in the class would end up taking over the school (Gary didn't tell us what the student would do after 'capturing' the school; perhaps that issue remains for a sequel game). The graphics were

not sophisticated; Gary's emphasis was on character development and story line. He used colour for effect on some of the screens, but most of the graphics were in black and white. The game had implicit violence. Knowing that the researchers and classroom teacher were opposed to violence in games, his opening screen contained a warning: 'This game contains violence and may be disturbing to your views'. The games Gary created were similar to those created by other hackers, with the exception of the female student, Desiree. She created a game in the context of a class assignment, and her game was of the 'choose your own adventure' variety and entirely text-based.

Gary was one of the first students in the class to be identified as a hacker. Although he had no prior experience with Macintosh computers, he had used IBM computers in the past. Like other hackers in the group, he was prepared to plunge in and explore the territory. In Gary's words:

> At the beginning, I didn't know that much about the Macintosh, but I picked it up really quickly. I'd played them once or twice, but that was it.

For the first few months of the year, he enjoyed the attention of what he viewed as privileged status – after all, he could be called away from his

> regular work at any time, just to help on the computers – which I love. Everyone had questions. It was fun – I got to do stuff other people weren't doing. Like when other people were doing math, I was fixing something on the computer. At the beginning I was asked for help a lot. And I didn't mind it.

During these first few months, when a couple of other students joined the ranks of the hackers, it was obvious that Gary was disappointed, and some careful negotiations occurred so that each of the hackers could enjoy their role. For example, Derek, Matt and Scott became the *HyperCard* helpers; Gary would work with systems and printer problems.

By January, a disturbing pattern took hold. Gary started to visibly resent the requests made of him to help with computer-related problems – something we came to call the 'burnt-out hacker syndrome'. At one point, in sheer frustration, he addressed a journal entry to me stating that he 'didn't want to be mean, but [he] just didn't want to help anyone anymore – except you or Ms Saxton'. When asked to reflect about this phenomenon in May, he stated:

> I couldn't get any of my work done, because every second, I'd turn around and someone would say 'Help me, help me, help me'. There were four computers and everyone was talking to me at once. 'Just a sec, just a sec' was all I'd ever say. It was about January, I guess. It was a constant bothering. After that time, I didn't use the computers for about a month. Well, maybe once or twice if I had to do work. I started using them a bit more in March, and helping people a bit again – the odd printer thing. Like the dip switches.

By May balance had been restored. Gary was a frequent computer user and answered questions when they arose. He also had carved time for himself to create games, something he had been wanting to do all year. One reason he was able to do this was that other hackers had emerged, and most students had developed considerable competence using the computers.

> Lots of people don't *need* help anymore either. They're as good as I was in the first month. And now I'm making a game and writing my mystery.

Although Gary was the only hacker who experienced a real aversion to the computer enterprise, it is important to realize that this phenomenon is possible in classroom situations, much as it emerges in other settings where one person is relied on for his or her expertise while attempting to fulfil other obligations.

Justin: game player

Justin was a pleasant person with a ready smile. At the beginning of the school year, it appeared that he would become one of the class 'hackers' as he had considerable experience with technology, primarily in the form of computer and video-games. In fact, to a casual observer visiting the classroom in March, it would have seemed that Justin was not the least bit interested in computer technology. Justin almost never used the computers during free-time, and used them only reluctantly when required to complete an assignment or an activity on the computer.

But Justin was by no means averse to technology. To say that Justin was an avid game player would be a gross understatement of his commitment to video-games. He reported spending many hours playing video-games after school, and conversations with his friends and peers confirmed this report. Like the boys described in an earlier E-GEMS paper (Lawry *et al.* 1995), Justin had a large network of male friends and siblings who shared games and strategies. Justin could effortlessly rhyme off the names of the games he was currently playing, as well as the names of games he once played but no longer found interesting. In May of the school year, he was playing *DOOM*, *Warcraft* and *Heretic*. In describing these games, he noted that he liked violent games, an understatement given the titles. He was aware that violent games were not acceptable in his classroom, stating 'in the classroom, like the school board doesn't allow violent games, like *DOOM* would offend some people. Like that's what I play at home all the time'. Justin took delight in describing how much he enjoyed the violence in games, stating:

> Violence is great 'cause you get to see all these guts fly out of people's heads and stuff. It's good. Like you can get *DOOM* add-ons and kill the Simpsons and Barney the Dinosaur. He's fun to kill. He starts singing and you give him a shot to the head. It's fun.

During the conversations and interviews where Justin offered such observations as the one above, one could hardly help but wonder if his descriptions were not partly for effect. Justin was aware of the conventions and mores of school life, and, for the most part, respected them. When given an opportunity to describe something that was of interest to him, and to describe his interest to us in a school environment, it appeared that he took advantage of this unexpected audience and tried to use shocking

details for effect. In fact, in other conversations between Justin and his male peers, the substance was not violence but strategy.

Justin also used the home computer for 'writing reports for school'. Like Maren, he was skilled at using the software, but chose not to do so unless he perceived a school-based need. When asked what software he used most at school, he noted that he enjoyed *SimCity* and *Morph* – the two programs that Alana noted she liked the least. Justin's interest in *SimCity* was understandable, given his love for learning and developing strategies for game play. However, when asked why he liked *SimCity* (a program with no apparent violence) he gleefully responded:

> Oh yes, there's violence. Yes there is, the dinosaurs come and stomp on your city. And you can trash other people's cities. You're like in control of a whole town. You can destroy it or build new stuff or whatever you want.

Similarly, he claimed that his interest in *Morph* was based on violence: 'I like *Morph* 'cause you can wreck the guy's face'. Again, one wonders if his sustained interest also was not based on the dynamic nature of the software.

Tyler: luddite

Tyler was accepted by most peers, but had few close friends. His dislike of computers was palpable in his words, actions and demeanour. His avoidance of computers was so great that he avoided the physical space of the classroom where the computers were located. His views, indicated by both verbal and written comments, were infused with thoughts like these:

> I just don't like computers, I despise them. There's no point to them. They're dumb. I don't like them at all, they're dumb, boring, there's nothing good about them. I hate them, their existence.

Tyler only used computers in the classroom if he was asked to by the teacher. When asked if he ever used computers during 'free-time', he emphatically replied, '*Never*'. Interestingly, when asked who he would consult for help, he named the teacher and researchers. This was a common pattern for students who were reluctant tool users or luddites – they seemed unaware that the true expertise lay with the students. Those who were skilled at computer use could name which people would be most likely to give them assistance, and their answers varied according to the specific type of assistance needed (e.g. a hardware problem vs learning to use *HyperCard*). In fact, his first response to the question asking what he would do when he encountered a problem was 'Turn it off'.

Part of his dislike may have been due to his minimal keyboarding skills. In an interview in June, he stated:

> It takes more time because I don't know the keys – typing takes a long time. I'd [rather use] the control instead of the keyboard, like Sega, yeah, not the keyboard. But I wouldn't play [games] so I haven't much to tell.

Tyler also did not have a computer at home (nor did three of the other luddites). He did not play video-games, and generally worked on his own

when 'forced' to use the computer. One wonders if Tyler would have been more engaged had he found ways to work with peers, was able to play with computers at home, knew where to find the pockets of expertise among his classmates, or could have worked with software that did not require advanced keyboarding skills.

Mark: sporadic user

Mark exhibited many of the same patterns as the other students already described. At times he was a keen and insistent game player, at times he would avoid using the computer for weeks. For some applications, Mark 'could hardly keep away'. This was certainly the case with the CD-ROM poetry books. Mark found them engaging and would 'have the computer read them for [him]' repeatedly. One of the reasons Mark enjoyed the CD-ROM poetry books was that he found reading difficult. As Sharon Saxton observed at several points during the school year, when the software required a higher skill level of reading and problem-solving than Mark had achieved, he would find the computers unattractive and even aversive. On the other hand, when the software was suited to his level, Mark was keen.

Mark's interest also was dependent on whether he was working alone or working with peers or younger students. Mark worked well on his own when the software level was suitable. However, he rarely worked with peers. He was often an observer of his peers, though, and would gladly work with others when the situation suited him. One of the times when Mark was a keen computer user, collaborator and tutor, was during a 'math buddy' unit in the late fall. For several weeks, students from Grades 2 and 3 came to the Grade 7/8 classroom to learn how to use *Counting on Frank*. During that time, Mark volunteered to be the 'math buddy' for the younger students, stating, 'I like working with the little kids. It's fun showing them things and watching their faces'. It also was apparent that with *Counting on Frank*, as with the CD-ROM books, Mark preferred software that was entertaining; he would almost always choose something with animated graphics and sound over the blank screen of a word processing document.

Although the patterns of the sporadic users were unique, their use of computers could be explained by several key factors, as exemplified by Mark: the level of difficulty of the software; the possibility of accommodating their interests in working alone or with others; and the entertainment value of the software.

Implications for inclusion

After closely observing this class of adolescents for a full school year, it would appear that the most pressing issue is to find ways to include all students in the technological revolution which is now taking shape, in ways that honour the *many* possibilities for involvement. As indicated at the outset, some of the questions guiding the observations and analysis were

based on issues of inclusion. Who, if anyone, was being left out of the circle of technology? How could they be included? To what extent should they be included? How might teachers and other educators make provisions for certain types of student experiences, such as the 'burnt-out hacker' syndrome? How can teachers and others work with students who do not like using computers?

The discussion that follows begins with a summary of how students are both included and excluded from using technology, referring to the categories of use as described in the literature and in the present study. This is followed by a description of how these categories can be useful in guiding teachers to create a more inclusionary classroom environment. The section closes with a summary and future directions.

Inclusion and exclusion: different sides of the same coin

The profiles offered in the present paper indicate that there are various ways that students appropriate technology, given a classroom environment that includes both structured, mandatory and free-time computer use, and home environments that are relatively rich in computer and video resources. It has been shown that both boys and girls feel included in some ways, but even those who are included are not necessarily included at all times and for all purposes. Also, although it was expected that girls would primarily use computers as tools, and boys would be the game players and creators, this study found that a third of the girls who were game players and/or creators, and conversely, that a number of the boys were eager tool users. The one category that was reflected as expected from the literature was that of the 'hacker': all hackers were male and exhibited many of the characteristics described by Turkle (1984, 1995). It is clear that one cannot simply ask the questions 'Who is excluded?' or 'Who is included?' for, in fact, all of the students were both excluded and included in some way, regardless of gender. For each of the students profiled, and indeed for the other students not described in detail, their computer and video-game use, in and out-of-school, involved both inclusion and exclusion.

Alana (eager tool user) was included by her use of computer tools and e-mail, but excluded in terms of game-playing and creation. Maren (reluctant tool user) was included in that she felt skilled at computer use, but excluded in that she rarely used computers. Gary (hacker/game creator) was included when his expertise was required or when he was creating a game of his own, but excluded when the demands placed on him became too onerous. Justin (game player) was excluded from playing violent games at school, but was included in a strong male video-game sub-culture. Tyler (luddite) was included in that he was required to complete some assignments on the computer, but excluded in every other way. Mark (sporadic user) was included when the software appealed to him or when he was included by his peers, but excluded when the application did not match his ways of making meaning and learning.

Inclusionary practices for a classroom environment

In the effort to establish inclusionary practices, it is important to help students find ways to appropriate technology to explore ideas and create artefacts in ways that sustain their interest. The uses students make of technology need not necessarily be uniform; it is doubtful whether a luddite would ever become a game creator. In fact, it can be argued that uses should not be uniform: it would be ethically questionable to require all students to use computers and video-game players in all the various ways described in this paper. For example, it would not be appropriate to 'force' a girl to play video-games any more than it would be appropriate to 'force' a boy to become a hacker (assuming that such things could be forced). On the other hand, inclusionary practices might include attention to issues such as how the reluctant tool users and luddites could feel more included in the classroom context and how software choices could enhance the possibilities for inclusion.

How, then, might the reluctant tool users and luddites come to regard computers as potentially useful tools? It would appear that some possible directions are revealed in the patterns of use themselves. One of the most striking differences between the reluctant users and luddites in relation to the other class members is that these students did not seek assistance from peers or were unaware of the assistance that peers might offer. One of the roles that the teacher could take would be to help these students become aware of the skills of their peers, and to help establish ways of seeking support from those who would best be able to offer it. Finding ways to help luddites become more proficient with keyboarding also might have a positive effect.

Another important role for the teacher is to make a variety of software available. For example, the game creators and game players were unlikely to use computers for curriculum assignments during free-time. Would there have been some types of tools that might have been attractive to the game creators – word processors that were more game-like? Would video-games in the school setting have encouraged the sporadic users to make use of other forms of technology as well? Or would reluctant tool users have become eager tool users with different tools? There is little doubt that a greater variety of possible types of software would form a wider circle for inclusion, along with appropriate support on the part of the teacher and appropriate integration of the technology with the curriculum. But it is important to stress that endless variety is not necessarily the answer either: the teacher should always have a role in determining what resources are best suited for the classroom context (Miller and Olson 1994). In that vein, it is important for teachers to recognize how their own preferences might affect such choices, and thereby limit inclusion. In the present study, the classroom teacher's interest in mathematics, science and games were reflected in her software purchases. Were there music software choices that might have included some of the reluctant users, or other forms of software relating to other parts of the curriculum?

Teachers also must be aware of the kinds of tools and games that girls might find attractive. Although this study provides evidence of both boys

and girls making use of technology in a variety of ways, it is clear from prior research that girls, on the whole, tend to be excluded more often than boys, particularly with respect to electronic games. Over the past couple of years, there has been a flurry of activity involving the design of 'girl-friendly' games, and many of these are now described and accessible through specific 'female-friendly' sites on the Internet, such as 'Net Chick',[2] 'geekgirl',[3] and 'FeMiNa'.[4] This interest in designing games and tools that are attractive to non-users is likely to grow. As the present research has suggested, patterns of use are not predictable solely on the basis of gender, but are the result of complex interactions between the classroom setting, the students and their teacher, and home influences in terms of technology. This complexity of use is likely to increase substantially; we are only beginning to understand the enormous influence of the Internet on people's construction of reality, sense of self and others, and ways of living (Turkle 1995). This brings to bear on another issue relevant to teachers and technology: teachers must be vigilant in terms of attempting to understand how certain patterns become normalized and therefore run the risk of no longer being questioned. For example, why is it that boys tend to be hackers? Would the girl who exhibited all of the characteristics of a hacker have been considered one if that was part of the 'normal' culture of this classroom? Was such normalization inadvertently supported because of the teacher's view that 'there's always a boy in every class who seems to know about how to work the computers and run the printers'?

Summary and future directions

It would seem that one challenge for teachers is to identify patterns of use, taking into account gender and other factors such as the interaction of home use of technology and the school curriculum. Thinking about categories of non-use (i.e. reluctant tool user, sporadic user, luddite) is perhaps as important as thinking about categories of use (i.e. hacker, game player, game creator, eager tool user). It is then incumbent on teachers and researchers to find ways to stretch students' explorations by opening new channels through cooperative work, suitable software, and teacher and peer support. Further research must include an examination of whether these categories, operationalized by other teachers, can lead to more inclusionary classroom practices based on the discussion above.

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Notes

1. Similarly, the students in this study did not mind being called 'hackers'; indeed, they delighted in the characterization.
2. http://www.cyborganic.com/People/carla/book.html
3. http://www.next.com.au/spyfood/geekgirl
4. http://www.femina.com

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