Gender, ICT-Related Student Skills, and the Role of a School Library in an Icelandic School

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This article focuses on gender and age differences in information and communications (ICT) skills, attitudes, and computer use in an Icelandic school in 1998 (62 students) and 2002 (63 students). Computer culture is described with regard to the school library media center. ICT skills of students increased from 1998 to 2002 for the primary-level group, particularly the girls. Computer use at the primary level tended to increase, whereas the opposite was true for higher grades. Computer classes and improved Internet access may have enhanced ICT skills among students, although computer access and activity in regular classes have declined.

Introduction
Researchers have described an enormous digital divide between and within continents, cultures, and groups (Kuttan & Peters, 2003; Norris, 2001; Servon, 2002; Warschauer, 2003). They emphasize the importance of bridging gaps that have formed between those who have access to technology and have acquired computer and information literacy and those who have not. An important factor to consider in this respect is gender, although in some Western cultures gender-related differences in relation to computer and Internet use appear to be diminishing, for example, in Iceland, according to several yearly public surveys (Forsætisráðuneytindi [Prime Minister’s Office], 1999a, 1999b, 2000, 2001). Computer-related inequity in Icelandic schools was found to be pronounced in a study in Iceland in 1998 on school computer culture with data from 761 students in 10 Icelandic schools. The study revealed a gender gap favoring boys, increasing with age, in self-reported information and communications (ICT) skills, attitudes, especially self-confidence, and home computer use (Jakobsdóttir, 1999). The study revealed limited computer use in the schools involved, with ICT skills for both boys and girls mainly linked to factors in the home (e.g., number of software types used at home and access to computers and the Internet). In 2002 the study was repeated (Jakobsdóttir & Hjartarson, 2003). Two of the schools from 1998
participated again, as well as 12 new schools (1,402 students). This article focuses on findings from a school that participated in both years, Seydisfjordur Public School (SFS). The focus is on the role of the school library media center in the development of ICT-related skills and information literacy.

Background
What do we mean by school computer culture, and how do school library media centers affect such cultures in Icelandic schools? We provide a literature review on these issues before presenting our study questions.

School Computer Culture
Jakobsdottir (1996) described computer culture in terms of internal and external factors that could affect students’ learning, attitudes, and computer use and determine whether gender differences appeared in those areas. Internal factors included computer hardware and software, computer access and implementation, attitudes and beliefs of users, and the social context of computer uses (see Figure 1). External factors included technological development, media influence, economics, and politics. External influence might be seen at a national or international level, but also in homes, communities, districts, and schools.

Jakobsdottir (1996) conducted a study of the computer culture of an elementary school in Minnesota (ages 6-11) and examined gender differences in that culture. Considerable gender differences were especially noticeable in software preference: boys had a much higher preference for games than did girls. The opposite was true for tool use. However, gender equity in computer use appeared high in the school despite no special efforts to promote computer use among girls. Important factors contributing to this finding probably included the young age of the children, high computer access in the school, frequent use of computer tools (word-processing and graphics), frequent use in the language arts, high parental interest and expectations for their children’s computer use, and high computer access and use at home for both sexes. In addition, the media center and library were located in the center of the school, and its staff played a major role in teaching and encouraging students and staff to use various types of technology.

On the other hand, a large gender gap with regard to ICT attitudes and skills was identified in 1998 in Icelandic schools (Jakobsdottir, 1999). According to more recent findings from 2002, however, it appears that girls, at least in grades 7 and 8, were catching up with boys in ICT skills and confidence (Jakobsdottir & Hjartason, 2003). It should be noted that results vary by school and group, but the question arises as to whether computer access, information literacy programs, and computer classes have helped to bridge the significant gender gap. In the following section we look more closely at school library media centers in Iceland and their role in facilitating information literacy among students.
School Libraries in Iceland and ICT

The Icelandic law on schools at the compulsory level (ages 6-15 years) was updated in 1995 and did not include ICT as an integral part of the role assigned to school libraries (Althingi, 1995). A well-equipped library was simply said to be obligatory for all schools to support school activities. However, ICT was rapidly gaining momentum, and the following year the Ministry of Education introduced a groundbreaking policy about the extensive role of ICT in educational and cultural sectors of the new information society (Menntamalaraduneytid [Ministry of Education, Science, and Culture], 1996). Thus the school library was introduced as being central in the implementation of ICT in schools.
In practice, the role of school libraries in Icelandic schools appears to be less clearly defined than official policy documents suggest. This is partly reflected in a great variation in choice of titles or use of terms as to the staff members responsible for the school library, which indicates variations in educational background and job profiles. Terms vary from umsjonarmadur (attendant), bokavordur (librarian or book attendant), safnivordur (librarian or collection attendant), and skolasafnivordur (school librarian or school library attendant), to bokasafnsfraedingur (indicates a degree in library science), skolasafnsfraedingur (indicates a degree in school library science), and upplysingafræðingur (indicates a degree in information science). Terms like kennari (teacher), kennari í upplysingamennt (teacher of information education), safnkennari (library teacher), or skolasafnskennari (school library teacher) may also be used.

The school on which we focus—SFS—is one among 15 small schools in Austurland, the easternmost region of Iceland. In spring 2003, three of them (20%) had a school librarian or school library teacher with a degree in library and information science. A library consultant working part time in a regional school center, however, has provided professional support and taken extensive measures to implement the use of ICT in all libraries in the region.

Although a number of school libraries in Iceland play a central role in their schools and may also be closely tied to efforts to promote ICT at various levels of school activities, this is not always the case (Hjartarson & Jakobsdóttir, 2003). Some school libraries seem to hold a peripheral position in their schools. Opening hours may be limited to a few a week, with the stock of books, journals, and other resources inadequate, computer equipment scarce or outdated, and the library not centrally located. Recent school buildings do, however, include open and relatively large libraries in central locations adjacent to computer labs, which provide most classrooms with good access to ICT and other library resources. A few schools have even provided their teaching staff with laptop computers as well as access to mobile laptop labs with wireless connections. Many schools dedicate weekly class hours for varying periods and for varying age levels to information literacy. These classes often take place in the school library, but emphasis on ICT and collaboration with teachers who are responsible for ICT classes seems to vary greatly from school to school. It also remains to be clarified how far ICT and information literacy are being integrated across disciplines rather than being taught as separate subjects. Collaboration between teacher-librarians and the teacher core about information literacy and the use of ICT seems significant and fruitful in some schools, whereas in many others the school library remains on the periphery of everyday school activities.4

Our article focuses on gender differences in students’ development of information literacy or ICT-related skills in the context of a specific school
computer culture with emphasis on the potential role of the school library media center.

Our study questions are the following:
- Are there gender differences in student computer-related skills and reactions at SFS? Are there changes over time?
- How has school computer culture changed over time?
- What has been the role of the school library media center?

Method

Participants
The participants came from Seydisfjordur Public School (SFS), which is a compulsory school at the primary (grades 1-7) and lower secondary level (grades 8-10). The school is in Seydisfjordur, which is a fishing village on the east coast of Iceland with about 760 inhabitants. In 2002, 63 of 67 students (94%) in grades 5 to 10 participated compared with 62 of 68 students (91%) in grades 6 to 10 in 1998 (see Figure 2).

Two participants in 2002 were of Asian descent. Others were white, but a considerable number were (up to 11%) of mixed nationalities (part Icelandic). Almost all spoke Icelandic as their native language.

One or more staff members completed a survey on behalf of the school: in 1998, the assistant principal; in 2002, the principal, the school library media teacher, and one of the teachers.

Design and Materials
We had two online questionnaires, one for students and another for staff. The data gathered were mainly quantitative, but both questionnaires included open-ended questions. Students indicated sex, grade, and typical grade-point average and answered questions on types and amount of computer

![Graph showing participation by year and school level](image)

*Figure 2. Participants in the study 1998 and 2002 by school level and gender.*
use, peer computer use, and home and school computer access and use. In the 2002 study, students mentioned physical and social problems they associated with computer and Internet use. Other questions were on attitudes and ICT-related skills (14 in 1998; 16 in 2002). The skills can be grouped into four main categories:

- File management (4 skills);
- Internet related (6-7 skills);
- Analytical/programming (2 skills);
- Creative/presentation (2-3 skills).

The questions for staff covered access and location of computers and technology, teaching methods, teacher collaboration, development of ICT-related school policy and curriculum, and use of computers by teachers and in which subjects.

Procedure

In both years, permission for the study was obtained from the principal of the school and passive consent was obtained from the parents of the students. Data were gathered toward the end of the fall semester. Students answered the online questionnaire in the school computer lab during ICT or word-processing classes. The staff members completed the questionnaire for their school shortly afterward.

Data Analysis

ANOVAs (Analysis of variance, 2x2x2) with factors gender (female, male), school level (primary, secondary), and year (1998, 2002) were performed on total number of ICT skills, attitude questions, types of computer use, number of software types used at home and school, peer use, and number of subjects. Chi-square tests by level were performed to identify gender differences in other questions. Independent sample t-tests were done to identify gender differences in number of skills and differences between years.

Results

In this section we report results on students’ ICT skills, attitudes, computer use, and computer-related problems. We then describe the computer culture at SFS and the role of the library media center.

Students’ ICT Skills and Attitudes

The results from 1998 and 2002 are presented in Table 1 broken down by sex, school level, and year. ANOVA revealed a considerable gain in the mean number of skills reported by students from 1998 to 2002. The respective means were 7.6 and 9.5, $F(1,115)=26.94, p<0.001$. The increase was mostly due to students in the primary grades, whose means doubled from 4.9 in 1998 to 9.3 in 2002, whereas in the higher grades the respective means were 9.0 and
<table>
<thead>
<tr>
<th>Skills</th>
<th>Boys</th>
<th>Girls</th>
<th>Lower secondary level (grades 8-10)</th>
<th>Primary level (grades 5-6)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic skills—% of students</td>
<td>46 to 67</td>
<td>39 to 61</td>
<td>56 to 67</td>
<td>39 to 67</td>
</tr>
<tr>
<td>Install programs</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Suffix files</td>
<td>59 to 88</td>
<td>53 to 67</td>
<td>57 to 74</td>
<td>53 to 67</td>
</tr>
<tr>
<td>Delete files</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Print</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Nervous skills—% of students</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Connect to the Internet</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Search for information</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Create Web page</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>E-mail</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Chat</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Use Web conferences</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Blog**</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Analyzing/programming—% of students</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Calculate with spreadsheet</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Program</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Creating/images—% of students</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Create images/pictures</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Create slides</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
<tr>
<td>Write with word processor***</td>
<td>61 to 74</td>
<td>54 to 67</td>
<td>57 to 74</td>
<td>54 to 67</td>
</tr>
</tbody>
</table>

*In 2002, Grade 5 participated but not in 1998. **Blog was not included on skills list in 1998 (commonly not available as communication method). ***Not included on skills list in 1998 due to an error. ****Two skills added (blogging and writing with word processor) in 2002.
9.7. The interaction of year and school level was significant, $F(1,115)=10.24$, $p<0.005$.

Boys reported more skills than did girls (9.5 vs. 7.8, $F(1,115)=16.38$, $p<0.001$). However, the gain made by girls at the primary level from 1998 to 2002 was particularly striking (see Figure 3). They claimed 5.6 more skills than girls in 1998, a significant difference ($t(21)=5.6$, $p<0.001$). In 1998, the mean for these girls was only 3.0 skills; the most commonly claimed skills were saving and printing files and creating images (word-processing skills were not on the 1998 list due to an error). In 2002, however, the mean had jumped to 9.3 skills, with the largest increase in Internet-related skills. The boys at the primary level in 2002 also claimed a significantly higher number of skills (10.2) than boys in 1998 (6.4), $t(20)=2.66$, $p<0.05$, but about two skills fewer than the group of girls had gained over their predecessors. The gain in the number of skills did not increase as much in the higher grades. However, the average skill increase from 1998 to 2002 was 1.8 for the girls, which approached significance.

A highly correlated attitude with skills was a measure of self-confidence or agreement with the statement “I am very good at using computers” (Jakobsdóttir, 1999). In 1998, there was a large gender gap in most of the participating schools in this attitude; boys agreed with the statement, whereas girls disagreed. In 2002 boys also agreed with the statement, but girls tended to be neutral rather than disagreeing (Jakobsdóttir & Hjartarson, 2003). A similar trend also occurred at SFS, where the girls tended to be neutral in 2002, but disagreed in 1998 (see Figure 4).

Figure 3. Mean number of skills of girls and boys at different school levels in 1998 vs. 2002.
In the 12 attitude questions, students tended to agree with positively worded statements and disagree with negative statements. There were few significant gender differences in attitudes, although boys at the primary level agreed more than girls in both years that computers were important for their future ($M_{02}=3.21$, $SD=1.19$, $M_{00}=4.40$, $SD=1.08$, $F(1,22)=6.27$, $p<0.05$); $M_{02}=3.9$, $SD=0.84$, $M_{00}=4.9$, $SD=0.32$, $F(1,16)=12.94$, $p<0.005$). In 1998, boys at the primary level also agreed more than girls that computers were necessary at work and play and that it was fun to try new things.

**Computer and Internet Use at Home and School**

*Last computer use.* Students were asked to describe their last (or typical) use of computers. The average student had used a computer at home less than a week before for more than 30 minutes, by themselves and mainly for play, with the exception of the girls at the primary level in 1998 when 43% had used computers less than a week before and only 20% for more than 30 minutes. Also, fewer girls than boys at the secondary level reported using computers for more than 30 minutes in 1998 (58% vs. 93%, $\chi^2(0.95)=4.34$, $df=1$, $p<0.05$). The primary level girls in 2002 appeared more social than the other groups. Only 20% indicated their last use had been by themselves, but 60% said they had used the computer in a group of two and 20% in a group of more than two (significant difference, $\chi^2(0.95)=11.6$, $df=2$, $p<0.005$). Also, gender difference in 1998 at the secondary level was significant in the purpose of computer use ($\chi^2(0.95)=12.9$, $df=4$, $p<0.05$), and approached significance at the primary level in both years. The vast majority of boys at both school levels and in both years indicated play as their main last computer-related activity, but the activity of the girls tended to involve more variety (see Figure 5) including learning and communication. Boys named a large range

![Figure 4. Agreement with the statement “I am very good at using computers” (3=neutral) by year, school level, and gender.](image-url)
of games (most with sports or violent themes), but many girls made reference to less violent or competition-related software (including solitaire, Team hospital, Sims, Word, communications software/Internet).

**Amount and type of use.** Students indicated their amount of computer use, Web, e-mail, chat, conferences, and computer or videogames. Computer use at home was more frequent than in school. In 1998 no student at the primary level indicated more than two hours of computer use per week in school, whereas 38% of the girls and 64% of the boys indicated at least that amount at home. A considerable proportion of students indicated at 2+ hours of computer use at school (15% of girls and 38% of boys at the primary level in 2002; 39% of girls and 32% of boys at the lower-secondary level in 1998; and 32% of girls and 42% of boys at the lower-secondary level in 2002). However, in each group twice as many indicated 2+ hours per week of use at home (31% of girls and 67% of boys at the primary level in 2002; 76% of girls and 78% of boys at the lower-secondary level in 1998; and 72% of girls and 85% of boys at the lower-secondary level in 2002).

ANOVAs were performed for each type of computer use; results are presented in Table 2. Trends for home use included boys claiming more computer and Web use than girls, older grades more computer use than younger, and more use overall in 2002 than 1998. Furthermore, girls claimed to use chat rooms more than boys, and older students more than younger. The relationship between chat and gender and year was significant; boys’ means stayed about the same, but girls’ use rose from 1998 to 2002. For e-mail, the relationship between school level and gender was significant; girls’ use, but not boys’, tended to increase at the lower-secondary level. Furthermore, for e-mail, the relationship between gender, year, and school

![Figure 5. Purpose of last computer use by gender, year, and school level.](image)
Table 2: Various Types of Computer Use at Home and School: Significant Differences by Gender, School Level, and Year
(Arrows indicate trends whether scores are going up or down or staying similar)

<table>
<thead>
<tr>
<th>Place</th>
<th>Type of Use</th>
<th>Gender</th>
<th>School level</th>
<th>Year</th>
<th>Gender</th>
<th>Level</th>
<th>Gender</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>Computers</td>
<td>B&gt;G₄</td>
<td>2&gt;1₁₅</td>
<td>6</td>
<td>02&gt;₉₈</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Web</td>
<td>B&gt;G₇</td>
<td>2&gt;1₈</td>
<td>02&gt;₉₈</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chat</td>
<td>G&gt;B₁₀</td>
<td>2&gt;1₁₁</td>
<td>98-02</td>
<td>G¹ →₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E-mail</td>
<td></td>
<td></td>
<td>1-2 G¹</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1-2 B→</td>
<td></td>
<td></td>
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<tr>
<td>Conferences</td>
<td>No use</td>
<td></td>
<td></td>
<td>G¹ →₁①</td>
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<tr>
<td></td>
<td>Blog 02</td>
<td>No use except very limited by two girls at the primary level</td>
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<td></td>
<td>Net-games 02</td>
<td>B&gt;G₁₅</td>
<td></td>
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<tr>
<td></td>
<td>Video games</td>
<td>B&gt;G₁₆</td>
<td>02&gt;₉₁₁₀</td>
<td>98-02</td>
<td>G→; 98-02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School</td>
<td>Computers</td>
<td>2&gt;1₁₉</td>
<td></td>
<td>98-02</td>
<td>G (1: 98-02; 02: ← 2;)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Chat</td>
<td>Very limited use</td>
<td>B&gt;G₂₂</td>
<td>02&gt;₉₂₃</td>
<td>1: 98-02; 02: ↑; 2: 98-02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E-mail</td>
<td></td>
<td></td>
<td>02&gt;₉₂₅</td>
<td>1: 98-02; 02: ↑; 2: 98-02</td>
<td></td>
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</tbody>
</table>

1) G=girls, B=boys; 2) 1=primary level (grades 5/6-7), 2=lower secondary (grades 8 to 10); 3) 98=1998, 02=2002
4) Mm=3.54, SDm=1.32, Mg=2.86, SDg=1.46, F(1,111)=14.23, p<0.001; 5) M2=3.41, SD2=1.20,
M1=2.73, SD1=1.32, F(1,111)=9.73, p<0.005
level was significant; girls’ use of e-mail at the primary level and boys’ use at the lower-secondary level tended to be similar from 1998 to 2002, whereas girls’ use at the lower-secondary and boys’ at the primary level tended to increase. On the other hand, boys tended to use Net-based games (in 2002) and computer/video games (both years) much more than did girls. Video game use rose from 1998 to 2002, but only for the boys (interaction significant, \( F(1,105)=4.95, p<0.05 \)).

As perhaps expected, considering shared class activities, fewer gender differences were evident in school than in home computer use. However, girls reported similar school use in 1998 and 2002, but boys reported a little more in 2002 (interaction of year and gender was significant). Also, boys reported more Web use than did girls. In the light of the particular gains in skills (especially Internet-related) made by the girls at the primary level in
2002 over other groups, it was interesting to note that for computer use, the relationship between year and school level approached significance ($F=3.89$, $p=0.051$); computer use at the primary level tended to increase, but stay the same or go down at the secondary level. Similarly, the relationship with Web and e-mail was significant; use tended to increase at the primary level, but stay similar or even decrease at the lower-secondary level from 1998 to 2002.

**Number and types of software.** Students indicated which types of computer software they used at home and school (word-processor, paint/draw, presentation software, spreadsheet, e-mail, chat, Web browser, Web editor, educational software, and games). In 1998 the number of types of software used at home was the factor most highly correlated with the number of skills for both boys and girls, whereas the number of software types used in school was not linked to the number of skills. ANOVAs for the data at SFS revealed that the number of types of software students said they had used at home declined with year ($M_{02}=3.75$, $M_{98}=5.02$, $F(1,116)=5.00$, $p<0.05$). However, this was true only for the boys (relationship between gender and year was significant, $F(1,116)=9.51$, $p<0.005$). The girls’ mean was about the same in 1998 and 2002 (4.1 vs. 4.2), but the boys’ mean declined from 5.8 to 3.0. For the number of types of computer software at school, there was a significant relationship between school level and year. The number rose at the primary level from 3.5 to 4.9 from 1998 to 2002, whereas it declined at the lower-secondary level from 6.0 to 3.7 ($F(1,116)=14.66$, $p<0.001$).

**Problems**

Students in 2002 indicated whether they associated any physical, social, or other problems with computer use. Students at the lower-secondary level complained mostly about headaches or eye strain (60% of girls and 46% of boys). Also, 36% of the boys, but none of the girls, complained about pain in arms and elbows (significant difference). Other commonly reported problems (20-24% of boys and girls) were pains in the shoulder or neck, back pain, and an opinion that too much computer use might affect learning negatively. At the primary level, there were also gender differences in elbow/arm problems: 45% of the boys, but none of the girls, complained. A relatively large percentage of girls (14-36%), but especially boys (27%-36%) also complained about other physical problems. Gender differences approached significance in reporting of online teasing or bullying and the opinion that they were taking too much time for computer/Internet games and found it difficult to quit; 36% of boys, but only 7% of the girls, complained about both problems.

**Computer Culture External Factors: Homes and Peers**

**Home computer access.** Computer access at home increased mainly for girls at the primary level from 1998 to 2002. Other groups involved had relatively high computer and Internet access at home. In 1998, only 57% of the primary school girls reported at least one computer in the house, and 29% reported
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Internet access. On the other hand, 89% of the primary school boys that year had at least one computer, and 44% had Internet access in the home. Furthermore, all the primary school students in 2002 had at least one computer in the home; 100% of girls and 70% of boys had Internet access. Comparable figures at the lower-secondary level for girls and boys (with percentage with Internet access in parentheses) were 81(75) and 82(64) in 1998 and 87(87) and 92(77) in 2002. However, more boys than girls indicated that they had a computer of their own—a question asked only in 2002—8% of girls at the primary level versus 73% of the boys (significant difference), and 36% of the girls at the lower-secondary level versus 54% of the boys (difference nonsignificant). The majority (78-100%) of boys and girls tended to identify themselves as the main computer user in their home with the exception of primary-level girls in 1998 (44%).

Peer group use. Students were asked to indicate how much their peers used computers and video games. ANOVAs revealed significant gender differences. Boys reported their peers using computers and video games more than the girls reported their peers doing so; $M_b=3.5$, $M_g=4.0$, $F(1,110)=7.44$, $p<0.01$ regarding computer use; $M_b=2.60$, $M_g=3.07$, $F(1,112)=12.96$, $p<0.001$ regarding video game use. Also, there was an increase by year in the use of video games, but only among the boys, $F(1,112)=35.84$, $p<0.001$. The girls' mean went down from 2.83 to 2.46 from 1998 to 2002 whereas the boys' mean rose from 2.18 to 4.29.

Internal Factors of Computer Culture

Computer access and environment. SFS has two main buildings, with classrooms for grades 1-5/6 in the newer one and grades 6/7-10 in the older. The school library media center and computer lab are located in the older building, both in a room known as the Town Council Hall from years past. The center and lab are mainly used for computer classes, occasional research tasks, and training in information literacy. The local public library is across the street, and students usually go there to obtain material to read in their spare time, the girls being in the majority. At the center, the students have Internet access through the lab with 12 computers and a single computer provided at the library.

Computer access here in 1998 was the best among the participating schools, with new computers and older equipment still in use. The computer-to-student ratio was 1:4.2 (71% computers connected to the Internet), whereas the average for all the participating schools was 1:13.3 (60% connected to the Internet), with more rural schools than capital-area schools having good access. In 2002, however, the older computers were no longer in use, and the ratio had dropped to 1:5.8 (all connected to the Internet), which was similar to an improved average of 1:6.7 for all participating schools (almost all connected to the Internet). Although it is now planned to replace
the lab computers from 1998 in 2004, they may be used for a few more years together with new ones to increase access.

The lab is closed during the lunch hour because in small villages everybody goes home for lunch. But after school, students have free access to the lab which, according to the school librarian in 2002, was most used by students from grades 5 to 7. Girls seemed to visit the center more often when Internet and e-mail access were offered. An Internet-connected computer at the public library has been available for the past four years, which girls in particular have been using.

The principal computers used were in the computer lab. Free access to computers (outside regular classes) was reported as available and used by 28% of students at the primary level in 1998, but by 54% of students in 2002. At the secondary level, the respective percentages were 47 and 78. Only at the secondary level in 2002 were gender differences significant; more girls at this level used computers in school out of class (88% vs. 58%, $df=1$, chi-square=3.94, $df=1$, $p<0.059$). The free-access use tended to increase with year and school level, especially for the girls.

**Social context.** Usually, one or two adults were present during computer use (most often the teacher). Most students at both school levels and in both years reported individual computer use in school (rather than with one or more students), although a considerable number of boys in 1998 reported use with one or more students (gender differences significant). Students preferred individual access, but with friends nearby (especially the girls). Keyboarding classes at the primary level in 2002 were segregated, and it was interesting that the girls in 2002 at that level tended to be even more socially oriented than other groups, with 36% preferring to use a computer with a friend.

**Subjects.** In 2002, students reported use mainly in special ICT or keyboarding classes, but use in other subjects was more common in 1998. ANOVAs revealed a significant difference by year, as well as a relationship between year and school level ($F(1,116)=20.04$, $p<0.01$): Use was in fewer subjects in 2002 than in 1998 (mainly true for the lower secondary level). The mean for the primary level changed from 2.6 (Icelandic, math, and Danish most common) in 1998 to 2.1 subjects on average in 2002 (computer/ICT, and other/mostly keyboarding); whereas at the secondary level the respective means were 3.2 (Danish by 50%, Icelandic by 40%, and social studies by 33%) and 1.0 (mainly computer/ICT). The trend at both school levels was to use computers less in regular subjects, but to concentrate use in special classes in ICT and/or keyboarding, which was also evident in students' replies to open-ended questions. Students in 1998 appeared, with exceptions, fairly happy. They mentioned that computers had recently been put into the school and expressed hope that they would then be used more. Students with no computer access at home appreciated access in school. On the other hand, several students, especially girls, expressed negative views in 2002, com-
plaining that computers were only being used for typing (keyboarding skills) and ICT classes and that the focus was more on developing basic skills rather than on more creative applications. Examples of answers included: "Not fun—we don’t learn anything and are just in typing and why should you learn typing if you cannot get to write?" "Computers are not introduced well enough for us—the possibilities they have for us ..."

Role of the School Library
The school library media center at SFS is primarily used for teaching information literacy and for student research work. In 1998, the library media center had recently been reorganized, and a new information literacy program that emphasized ICT was about to be launched. This program, based on the national curriculum from 1999 (Manntamalaraduneytid, 1999), has been taught by the library media specialist mainly in grades 4–6 in the media center and computer lab. Other students have scheduled information technology classes in the lab with a computer technology teacher. Unfortunately, collaboration with classroom teachers has been poor, although teachers at SFS have shown considerable ICT literacy compared with other schools in Iceland (Lemke, 2001).

Summary and Discussion
This study examined gender differences in ICT skills and the attitudes of students at two school levels in an Icelandic school in 1998 and 2002 in the context of a school computer culture. Students in 2002 reported a higher number of computer-related skills (especially Internet-related) than their predecessors four years earlier, especially in the primary grades and especially the girls at that level. Although boys still reported slightly more skills in 2002 than did the girls, as well as a higher level of confidence, more computer use at home and more Web use at home and in school, the gender gap that existed in the school in 1998 appeared to be diminishing. There were fewer gender differences in attitude questions. Girls’ use of chat and e-mail had risen from 1998, whereas boys’ use had stayed similar, in the latter case especially at the secondary level.

What could have contributed to such changes? Looking at other data, it is striking that girls at the primary level in 1998 were in some ways at a disadvantage compared with other groups. They used computers little and had less access to computers and the Internet at home. On the other hand, a peer culture appears to have developed among the girls at the primary level in 2002, part of which was sharing and using computers together to study and play. Also, more girls than boys at the secondary level in 2002 reported taking advantage of free computer access in school. Meanwhile, boys started using video games more, and their computer use became more concentrated on playing games, with the use of other types of software less commonly reported. Girls’ interest and use appeared more varied and to be increasing.
in online communications. The intensive computer and video game use of the boys at home may be why they tended to report more physical and social problems (including elbow problems) than did girls at the primary level. It is especially interesting to note the high percentage of boys at the primary level (36%) who felt they were spending too much time on computer games and had difficulty stopping when they wanted. Although boys might be gaining skills playing games, including navigational skills, English, and an attitude of exploration, more is not necessarily better if they wish to stay in school and do well on traditional tests. On the other hand, the tool-toy divide might indicate that girls tend to be stuck as skilled end users, whereas boys may be more likely to play with the computer, applying concepts and capabilities in addition to skills (Gilley, 2002).

The pattern of school computer use changed dramatically in the school during the period involved, which may have contributed to the diminishing gender gap in students’ skills and attitudes. Like children in a study by Muntaz (2001), students at SFS, especially the boys, reported much more computer use at home than in school. Computer and Internet use in school nevertheless increased substantially from 1998 to 2002. This, however, was true only for the primary grades. It should be noted that as a result of an effort to foster ICT skills in students, computers were used almost exclusively in special ICT classes. Even if teachers’ ICT skills were good (Lemke, 2001) and student computer access high compared with that in other schools, use in various subjects dropped from 1998 to 2002. The computer was highly subscribed, with ICT classes for all students and keyboarding classes from the grade 5 on. It became difficult for teachers to access the lab if they wished to integrate ICT into their teaching, and computers were not available in the classrooms.

Most gender equity strategies in technology stress usefulness (tools over toys), meaningful projects, and contexts (Jakobsdóttir, 1998; Sanders & Stone, 1986; Volman, 1995). Other strategies include social elements, communication, and creativity; as well as guaranteeing good computer access, sometimes in single-sex classes (Aamot ungdomsskole, 1999; Jakobsdóttir; Sanders & Stone; Treyvaud et al., 2004). In the case of SFS, the school did well in the latter elements. SFS had a low student-to-computer ratio, provided regular use of computers through a special subject, and provided individual access, but with friends or other peers working nearby, sometimes in segregated groups (keyboarding at the primary level in 2002). However, several girls complained that using computers in school was not very interesting, meaningful, or creative.

It certainly appears that more could be done to implement the use of computers across the curriculum at SFS and to provide better opportunities for teachers to develop and implement computer use with students on a more creative level (as described, e.g., by Hooper & Rieber, 1995; Russell,
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1996; Twining, 2002). Also, more attention needs to be paid to the role of the school library media center.

Sanders and Stone (1986) tested and recommended some 100 successful equity strategies at various levels (schools, homes, district, community) to increase the use of computers among girls. This involved the participation of four groups—teachers, administrators, parents, and students—but paid little attention to school librarians. Today’s school library media specialists must ask themselves what they can do to increase gender equity where it is needed in their school. When the world of electronic information invaded the library media center, it became “an onramp to the information superhighway” (Turock, 1998), and students had to be taught how effectively to retrieve information in new environments (Branch, 2002). The Ministry of Education, Science, and Culture in Iceland has clearly defined library media centers in schools as centers for ICT activities and promoters of development toward ICT-based learning (Menntamalaramaduneytid, 1996, 1999). With technological competence, library media specialists can become key advocates for change in their schools, promoting the use of ICT while paying careful attention to possible gender gaps in skills, attitudes, and problems.

It should be library media specialists’ mission to create an atmosphere of gender equity and to promote gender-fair behavior that emphasizes equally affective and assertive skills. Their libraries need to be supplied with multi-culturally accurate and gender-balanced resources. Careful criticism of disciplinary and regulatory practices in library and computer facilities may serve to identify necessary changes with regard to boys and girls and the use of ICT. Satisfaction surveys have been particularly helpful in this respect as they draw attention to the negative effects of certain access restrictions (Coupal, 2002).

A more integrated role for school libraries seems to be required, both with regard to ICT and gender issues. Good collaborative relationships between classroom teachers and library media specialists as curriculum consultants appear to lead to more authentic assignments and increased student success (Russell, 2000). Careful planning, ample time, and flexible schedules are needed if collaborative efforts are to succeed. They also require leadership and good access to technological resources.

Teacher-librarians or library media specialists need to become credible advocates for information literacy by gaining ICT skills, maintaining technological proficiency, and being knowledgeable about the latest information technologies. They need to acquire authority and take firm initiatives toward collaboration by offering teamwork, services, and collaboration to teachers and their students. And we agree with Turock (1998) that, from a feminist perspective, the urgency for library specialists to find an authoritative voice in this regard becomes important.
Notes

1 One school at the upper secondary level (grades 11 to 13, ages ca. 15/16-20) and nine at the primary to lower secondary level (participating grades 5 to 10, ages ca. 10 to 15/16).

2 One school at the upper secondary level and 13 at the primary to lower secondary level (participating grades 5 to 10, ages ca. 10 to 15/16).

3 These findings are derived from interviews and study visits to 18 primary schools in spring 2003 and are based on a forthcoming report of a research team within the LearnICT research project (http://namust.khi.is) including Thorsteinn Hjartarson, Torfi Hjartarson, Thrudur Johannsdottir, Audur Kristinsdottir, Allyson Macdonald and Sigurjon Myrdal.

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