

Gender-related effects of computer and information literacy education

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In the school year 1993-94 a new subject, 'Information and computer literacy' (ICL), was introduced in lower secondary education in the Netherlands. This article reports on a study of the effects of the curriculum materials used and of teaching behaviour in ICL lessons on changes in girls' and boys' attitudes towards computers, knowledge about ICL, and future plans. A second question focuses on the gender-linked ideas about the subject developed by pupils during ICL lessons. Students appear to enter the classroom with gender-linked patterns of behaviour and attitudes, but education plays an important role. After the course the differences in knowledge between girls and boys have diminished. However, the course was not able to remove gender differences in attitudes. Moreover, for students who worked with a non-gender-inclusive method, gender differences in attitudes increased. The events and experiences in the classroom contribute to the extension of gender-specific repertoires of pupils.

The introduction of microcomputers in the classrooms of Western countries during the 1980s was accompanied by growing concern about the participation and achievement of girls in computer education (Sutton 1991). When the problem of 'girls and computer education' was first noted, the negative attitudes of girls towards computers were assumed to be the cause of the problem. Currently, the incompatibility of the subject matter with the everyday life and experience of girls, and the fact that girls' learning styles are not acknowledged are often considered to be the problem. In science education a number of teaching techniques have been suggested that may be successful with girls (Rosser 1989) and similar ideas in the field of computer education are gaining in popularity. Ideas on gender-inclusive instruction have been developed for teaching computer education in a way that is both effective and attractive to girls (Sanders and Stone 1986, Brecher 1989).

In the school year 1993-94 a new subject, 'Information and computer literacy' (ICL), was introduced in lower secondary schools in the Netherlands. For many pupils, this subject offers a first encounter with the computer as something to learn about, as opposed to something that assists their learning. The ideas they develop about the subject and about themselves in relation to it will contribute to their decision either to pursue computer activities further in their school careers or to drop out of this field. This paper focuses on gender differences in such ideas and on the role of education in producing gender differences.

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Until 1993 there was little uniformity in the way computer literacy was taught, although most Dutch schools had already introduced some kind of ICL in their curriculum (Ten Brummelhuis et al. 1991). This offered the opportunity to compare different ways of teaching ICL. This paper considers the effects the ICL curriculum materials and teaching behaviour in ICL classes have on changes in girls' and boys' attitudes, knowledge, and future plans. A second question focuses on the gender-linked ideas about the subject and about themselves developed by pupils during ICL lessons. It is assumed that understanding the processes in which such ideas are developed provides insight into the relationship between educational factors and gender differences in educational outcomes.

Methodology

A combination of quantitative and qualitative methods was used in this study. A pre-test/post-test design in a field experiment was chosen to test the relationship between educational factors (curriculum materials and teaching behaviour) and gender differences in the outcomes of the ICL courses. The field experiment was conducted in 19 lower general secondary education classes. An exploratory analysis of the development of gender-linked meanings pertaining to computers and ICL was undertaken by means of an analysis of qualitative material, i.e. interviews with girls and boys, and classroom observations in the 19 participating classes.

First, a literature study was carried out with the aim of reviewing how gender differences in computer education are described and which characteristics of instruction (curriculum and teaching behaviour) allegedly contribute to these differences. The results were used to compile a list of characteristics of 'gender-inclusive' ICL teaching. Gender-inclusive ICL was defined as an educational practice that contributes equally to boys' and girls' knowledge, insight and skills of and in this subject, as well as their experience of the subject as meaningful and of themselves as competent pupils.

Two studies were then carried out with the aim of mapping the independent variables, namely the gender-inclusiveness of teaching materials and of teaching behaviour. For the purpose of these studies, the list of characteristics of gender-inclusive ICL education was adapted for the analysis of ICL teaching materials and for classroom observations during ICL lessons. The resulting instruments were revised on the basis of comments made by a number of experts in the field of gender and computer education with a view to achieving optimal validity.

The instruments aimed at measuring gender-inclusiveness focused on four components: content, context, teaching methods and hidden curriculum. I will summarize the components in terms of the 'ideal' gender-inclusive ICL course. It is generally considered that the content of ICL should be 'broad', i.e. it should not focus exclusively on computer-handling skills, but also on the formation of information processing concepts and on the social aspects of information technology. The context component comprises the subcomponents use (the benefit of computers and ICL

should be made clear) and everyday life (examples and applications should be chosen that are geared to the everyday lives of pupils, including those of girls). The teaching methods component comprises the subcomponents framework and involvement (the lessons should be clearly structured and facilitate identification with the subject matter) and instructional formats (formats should be used that appeal to the qualities of girls and boys). The hidden curriculum component comprises four subcomponents: gender-stereotyped presentation (a masculine image of the subject due to the absence of women in the subject matter should be avoided); associations (the association of ICL with mathematics, science and technology should be avoided); interaction between teacher and pupils (teacher-pupil interaction should not reinforce traditional gender roles); and interaction among pupils (gender-stereotyped ways of interaction among pupils should be prevented or responded to).

The extent to which ICL curriculum materials show these characteristics was examined by means of a questionnaire with accompanying instructions for assessors. Two different books were used in the classes participating in the research, referred to below as method A and method B. These were analyzed by two assessors; the inter-rater reliability was high (0.88).¹

It was decided also to look at teaching behaviour because the formal curriculum and the curriculum students are actually confronted with are not the same (Goodlad 1979). In a second study, three classroom observations were carried out in each of the 19 classes using an approach comparable to that used in the study of curriculum materials, resulting in an analysis of the extent of gender-inclusiveness of the teaching behaviour of the 19 teachers (3 women, 16 men). In order to obtain an indicator of the reliability of the observations, one lesson in every class was observed by two observers and their scores were compared. The interobserver reliability was high (0.85).²

The main study was aimed at assessing the dependent pupil variables and changes therein by means of a questionnaire completed by pupils both before and after the ICL course. Data from 455 12- to 14-year-old pupils were obtained in the 19 lower general secondary education classes. Results of the lessons were broadly defined, with not only achievement (changes in knowledge) being taken into account but also changes in attitudes and appraisal of the subject. A pre-test consisted, first, of a computer attitude scale, an adapted version of the attitude scale used in the IEA-CompEd study (Pelgrum *et al.* 1993). This scale consisted of four subscales: enjoyment of computers (Cronbach's α (α) = 0.85), relevance of computers (α = 0.78), computer anxiety (α = 0.70), estimation of own competence (α = 0.77). Future plans with computers were also looked at (α = 0.65). A selection of five items from the Functional Information Technology Test (FITT) of the IEA-CompEd study (Pelgrum *et al.* 1993) was used to measure prior knowledge of computers (α = 0.42). A number of additional questions concerned prior experience with computers (no scale). The post-test consisted of the same attitude and future plans instruments (attitude subscales α = 0.90; 0.79; 0.71; 0.84; 0.70). The complete FITT (30 items, α = 0.90) was used in the post-test to assess

pupils' knowledge. Questions on the appraisal of the ICL lessons were also asked and were categorized into three scales: enjoyment of the course ($\alpha = 0.84$), relevance of the course ($\alpha = 0.72$); estimation of own competence in ICL ($\alpha = 0.77$).

Analyses of variance were used to investigate differential effects for girls and boys, and the connections between these effects and the extent of gender-inclusiveness of the method used and teaching behaviour.

Qualitative data were collected to answer the second question concerning the processes of gendered meaning-production during the course. These data consisted of interviews with ten boys and ten girls from five classes and written reports of the observations. The observers not only completed questionnaires (with the aim of quantifying the gender-inclusiveness of the lessons) during the observations, but also made detailed reports on teacher and pupil activity. The interviews were analyzed by means of repertoire analysis (Potter and Wetherell 1987), a method focusing on the interpretative repertoires used by respondents when thinking about an issue. This method is based on the assumption that people interpret and give meaning to their environment using the discourses (or repertoires) available. Potter and Wetherell (1987: 138) define an interpretative repertoire as 'a lexicon or register of terms and metaphors drawn upon to characterize and evaluate actions and events'. As these repertoires can be contradictory, the accounts given by respondents of actions and events can vary according to the context in which these accounts are articulated. In this study, it was assumed that different repertoires pertaining to gender, computers and ICL may be articulated when completing a questionnaire, in an interview, or in a classroom situation.

Gender differences in the field experiment

At the start of the ICL course, there were considerable differences between girls and boys in experience with and knowledge about computers. Sixty-three percent of the girls had a computer at home, and 57% actually used a computer. For the boys these figures were 85% (computer at home) and 80% (computer users). Gender differences were significant for the following computer activities out of school: learning about the computer; learning about another subject; programming; games. Word processing and drawing were the only exceptions, although for these activities the scores of boys were also higher than those of girls. Five questions were asked in the pre-test to assess students' prior knowledge of computers and information technology. On average, girls answered 2.6 of these questions correctly, whereas boys gave 3.2 correct answers ($p, 0.01$).

Table 1 presents the gender differences in attitudes, plans with computers, and computer knowledge about computers before and after the ICL course. On average, boys answered questions about enjoying and being interested in computers and about their relevance more positively than girls before the course. Boys were more explicit about the fact that they were not afraid of computers and they were more positive about their

Table 1a. Means and standard deviations of computer enjoyment/interest, relevance of computers, computer anxiety and estimation of own competence of girls and boys, before and after the course (four-point scale, 1= totally disagree, 4= totally agree with positive statements).

	Enjoyment girls <i>n</i> = 216 boys <i>n</i> = 182		Relevance girls <i>n</i> = 217 boys <i>n</i> = 178		Anxiety girls <i>n</i> = 223 boys <i>n</i> = 191		Est. competence girls <i>n</i> = 211 boys <i>n</i> = 187	
	M (SD) pre	M (SD) post	M (SD) pre	M (SD) post	M (SD) pre	M (SD) post	M (SD) pre	M (SD) post
Girls	2.38 (0.45)	2.11 (0.54)	2.82 (0.45)	2.79 (0.46)	2.18 (0.55)	2.13 (0.55)	2.66 (0.52)	2.66 (0.62)
Boys	2.85 (0.63)	2.75 (0.66)	2.96 (0.45)	2.90 (0.43)	1.83 (0.55)	1.84 (0.57)	3.02 (0.62)	2.98 (0.63)
Sign. gender difference	**	**	**	*	**	**	**	**

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

Table 1b. Means and standard deviations of future plans (three point scale, 1= intention to go on with computer activities; 2= do not know; 3= no intention), computer knowledge (scores between 0 and 1)¹ of girls and boys, before and after the course, and increase of knowledge² of girls and boys.

	Plans girls <i>n</i> = 237 boys <i>n</i> = 193		Knowledge girls <i>n</i> = 239 boys <i>n</i> = 190		Increase of knowledge girls <i>n</i> = 239 boys <i>n</i> = 190
	M (SD) pre	M (SD) post	M (SD) pre	M (SD) post	M (SD)
Girls	2.29 (0.34)	2.43 (0.41)	0.51 (0.24)	0.63 (0.13)	0.12 (0.24)
Boys	2.11 (0.43)	2.18 (0.50)	0.63 (0.26)	0.67 (0.16)	0.04 (0.28)
Sign. gender difference	**	**	**	*	**

** = $p < 0.01$; * = $p < 0.05$.

1. The knowledge scores were calculated by converting the scores on the five knowledge items of the pre-test and on the thirty knowledge items of the post-test into scores between 0 and 1.
2. The differences between the knowledge scores in the pre-test and post-test served as a measure for 'increase of knowledge'.

own competence with computers. They also had more plans for future activities with computers.

The course seems to have succeeded in its primary task. Although there is still a difference between girls and boys after the course, the girls caught up with the boys with regard to computer knowledge; gender differences in knowledge about computers on average decreased; girls' increase of knowledge was higher than that of boys (table 1b). However, the difference between girls and boys in enjoyment of computers after the course increased, even though the average computer enjoyment of both girls and boys decreased. As to the other aspects of computer attitude – relevance,

Table 2. Means and standard deviations of enjoyment of the lessons, relevance of the lessons and estimation of their competence in ICL of girls and boys (1= totally agree; 4= totally disagree with positive statements; knowledge after lessons (1= all answers correct; 0= no correct answers) and means of increase of knowledge of girls and boys.

	Enjoyment course M (SD)	Relevance course M (SD)	Est. competence in course M (SD)
Girls (<i>n</i> = 226)	2.79 (0.62)	2.50 (0.54)	2.76 (0.58)
Boys (<i>n</i> = 188)	2.90 (0.69)	2.58 (0.65)	3.03 (0.62)
Sign. gender difference	n.s.	n.s.	**

** = $p < 0.01$; n.s. = not significant

fear, estimation of one's own competence – the extent of gender differences changed slightly, but the differences were still considerable (table 1a).

It appeared, moreover, that the boys' estimation of their competence in this subject was higher than the girls'. Gender differences in enjoyment of the course and in the extent to which the course was found useful were not significant, although the scores of boys were consistently higher (table 2).

It may be concluded from these results that although the ICL lessons had a positive effect at the cognitive level, at the affective level they either scarcely compensated for existing gender differences or contributed to an increase in the differences. This is a problem. Pupils' ideas about a subject and about their own ability in that subject are important determining factors in the decision to pursue the subject in the future (Eccles 1987).

The role of gender-inclusiveness of the curriculum and teaching behaviour

The findings discussed above concern average results. In this section I will first discuss the gender-inclusiveness of the methods and its relationship to the pupils' results. This is followed by a discussion of the gender-inclusiveness of teacher behaviour and its relationship to the pupils' results.

The gender-inclusiveness of the ICL methods (the teaching materials) was investigated with the help of the instrument discussed above. It appeared that the extent of gender-inclusiveness of the methods differed considerably. I will call the less gender-inclusive method 'A', and the more gender-inclusive, 'B'. Nine classes worked with method A, ten with method B.

Method B appeared to be the broader of the two with regard to the content of ICL. Both methods used real-life contexts to introduce the subject matter and discuss computer applications, but this was done less systematically in A – and not always in a way that was geared to the everyday lives of girls. The biggest differences between the methods,

Table 3. Means and standard deviations of enjoyment of the course, relevance of the course, estimation of own competence, changes in enjoyment of computers¹ and increase in knowledge of girls and boys who used method A (less gender-inclusive) and girls and boys who used method B (more gender-inclusive).

	Enjoyment course		Relevance course		Est. competence course		Changes in enjoyment computers		Increase of knowledge	
	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	A	B
	A	B	A	B	A	B	A	B		
Girls	2.67	2.92	2.48	2.53	2.64	2.87	- 0.34	- 0.20	0.14	0.11
<i>n</i> _A = 114; <i>n</i> _B = 112	(0.59)	(0.63)	(0.52)	(0.56)	(0.61)	(0.53)	(0.47)	(0.61)	(0.24)	(0.25)
Boys	2.94	2.88	2.66	2.50	2.98	3.09	- 0.13	- 0.07	0.02	0.01
<i>n</i> _A = 95; <i>n</i> _B = 93	(0.67)	(0.71)	(0.70)	(0.58)	(0.66)	(0.57)	(0.49)	(0.54)	(0.26)	(0.31)
Sign. gender difference	**	n.s.	*	n.s.	**	**	**	n.s.	**	*

** = *p* < 0.01; * = *p* < 0.05; n.s. = not significant.

1. The differences between the enjoyment scores in the pre-test and post-test served as a measure for 'changes in enjoyment'.

however, lay in the teaching strategies suggested. Instructional formats that fit the assumed needs and capacities of girls were well-represented in B. This method did not require pupils to work at the computer for a whole lesson. Various formats, including verbal instructional formats, were used, whereas method A was less varied. As to the hidden curriculum, women and men were not represented in stereotyped roles in the text or the pictures in either of the methods. However, both A and B did contain more pictures of men and boys than of women and girls. In A this was also applicable to the text and there was more emphasis on calculation than in B. Neither of the teacher manuals gave attention to the possible occurrence of gender-stereotyped interaction among pupils, and between teachers and pupils.

Table 3 presents data on the results for the girls and boys who worked with one of the two methods. Both equally enjoyed the more gender-inclusive method B and found it equally useful, whereas the less gender-inclusive method A showed gender differences in favour of the boys. The girls in method B assessed their competence in ICL to be higher than the other girls (*p* < 0.5), although the difference between the boys was also significant. The changes in the enjoyment of computers on the part of these girls were less negative than those of the other girls. As to the other elements of computer attitude (relevance, anxiety and estimation of own competence) there were no differences between girls and boys in the A and B courses. However, the increase in knowledge of the B girls was slightly smaller than of the A girls, although the difference was not significant.

The classroom observations showed that only a very small number of the components of gender-inclusiveness was manifested in teaching behaviour. 'Classic' mistakes were made, like taking over at the computer more often with girls, giving girls fewer turns in class, and addressing boys as experts more often than girls (Sanders and Stone 1986). Gender-inclusiveness varied considerably between the teachers, but this was not related to the method used. These differences confirm the importance of

the teacher. Some teachers make use of the gender-inclusive elements of the method, others do not.

However, the hypothesis that the more gender-inclusive the teaching behaviour, the smaller the gender differences at the end of the course, cannot be confirmed. One of the reasons that no connection was found between gender differences in educational results and gender-inclusiveness of teaching behaviour may be the fact that little differentiation occurred in gender-inclusiveness. Most of the teachers got fairly low scores on the basis of the observations.

The classes differed greatly, though, in terms of students' results. The changes during the course in almost all the variables varied from class to class, and the gender differences in relation to enjoyment of the lessons and to changes in the enjoyment of computers also varied from class to class. Thus, although it remains unclear what factors these differences can be attributed to, it is clear that in different classes, different gender results were produced.

The meanings of computers for girls and boys

The aim of the qualitative part of the study was to explore the processes of gendered meaning-production that occurred in ICL lessons. Interviews with pupils and reports of the observed classes were analyzed in order to investigate these processes.

At first sight, the interviews showed mainly similarities between girls and boys – almost all of them liked computer games, they all found computers useful, they were not afraid of computers, and they could name several kinds of computer applications. While research on computer attitudes usually treats the computer as an unequivocal object, the interviews suggest a more differentiated approach towards the concept of 'computer attitude'. *The* computer does not exist for the present generation of pupils. They become acquainted with several kinds of computer applications with various meanings in their everyday lives: computer games, word processing, library systems. The interviews show that the low scores on computer enjoyment after the course do not reflect a decrease of enjoyment but a shift of meaning in which the primary association of computers with 'play' is replaced by an association with 'learning'.

Apart from a number of gender-neutral repertoires pertaining to particular computer applications, elements of gender-related repertoires also emerge. These I call the 'expert' repertoire and the 'outsider' repertoire. Boys more often than girls use an expert repertoire. During the interviews they talked more and with more enthusiasm and imagination; they boasted more about computers and technological developments, using computer jargon and explaining to me what computers can do. One of the boys, for example, talked about his computer friend admiringly:

He has a SVGA just for him, ridiculously fast, he's got it in his own room. He can do everything with it – one point five and five point one, or something.

Boys seem to feel good about knowing a lot about computers and about being skillful players of computer games. Most boys are convinced about their competence in using computers. They do not easily attribute a problem to their own mistakes. One of them told me that everything on the hard disk of his father's computer was deleted after he had used the computer.

I think there was something wrong with the disk, maybe there was a virus on it, but nobody knows.

Most girls on the other hand, use an outsider repertoire. They talk in a 'down to earth' way about the importance and possibilities of computers, and they think computers are 'just handy things', just tools (cf. Turkle 1988) that you will probably need to know about in a future job. But they also have clear reservations about their competence, attribute problems with the computer to their own failure, and certainly avoid showing any signs of expertise about computers. One of the girls had a computer of her own, which she used for games, writing stories and drawing. But when asked what kind of computer this is, she answered: 'Um, I don't know, oh yes, it does have a keyboard'.

While boys talk enthusiastically about computers and their possibilities, some girls only open up when they talk about disasters they have experienced with computers. Two friends got a fit of giggles when they told a story about a lesson in which they thought they had lost a file.

We didn't understand. We had pushed the wrong key and ... 'Oh help, I've lost it'. We were sitting in front of this computer and 'Oh, has everything gone now?'.

The greater knowledge and experience of boys is not the only explanation for these differences. Girls often present themselves as less expert than they are, e.g. by avoiding the use of computer terms ('the other day we had almost taken something off the ... er ... thing') and boys' stories are not always based on knowledge. One of the boys, for example, explained to me all the things you can do with computers.

You can do complicated mathematical calculations much faster, like involution of roots from back to front.

I asked how he knew this.

Well, just by putting it in the computer and then you press on enter and then you wait.

When I asked him if he knew what happened while he was waiting, his answer was a very self-confident,

Of course I do! The computer, that's all digital, all ones and zeros.

The interviews suggest that girls and boys identify with computer use in different ways. For pupils, however, the meaning of computers is not unequivocally masculine. Pupils are aware of the diversity of computer applications. However, they associate different uses of computers with men and women. When I asked pupils about their images of men and women

using computers, they drew upon what I call the 'computer freak and secretary' repertoire. Girls and boys describe men who work a lot with computers as computer freaks and women in jobs involving a great deal of computer work as secretaries. The computer freak is to be pitied, he never goes out, has no friends. He is ugly, wears a tie and glasses, parts his hair, and carries a brief-case. The feminine image associated with the computer is that of the 'dumb secretary' with high heels and varnished nails, which girls in particular can describe in considerable detail.

Both girls and boys use this repertoire, but it offers them different positions and possibilities for identification. Pupils neither identify themselves with the image of the nerd or freak nor with the secretary. But there is an acceptable alternative to the computer freak. Although the computer cannot simply be used as a sign of masculinity, popularity can be won by being skilled at computer games and knowledge of computers earns respect. Such a competent and expert position in relation to the computer is, however, not gender-neutral; it is a position that only boys can occupy as a matter of course. A similar alternative, which could be more accessible to girls, does not exist for the secretary.

Ambivalence and contradictions in meanings of gender and computers become particularly evident when gender differences are the explicit subject of conversation. Pupils draw a sharp distinction between their generation, in which gender inequality and discrimination no longer exist, and 'days gone by' when 'old-fashioned people' still thought that women were worth less than men. They will only discuss gender differences in individual and liberal terms.

There are no differences between boys and girls. Girls who are interested can do it as well as boys, but I think they are just less interested in computers.

Pupils do not seem to have access to repertoires in which gender inequality can be denoted. I called the way in which pupils talk, when explicitly asked about gender differences, the 'free choice' repertoire. Like the computer freak and secretary repertoire, it is used by both girls and boys, but the positions it offers are not gender-neutral. For boys the free choice repertoire means that they do not discriminate against girls. For girls – unlike women of previous generations – it means that they are not victims of gender inequality. At the same time, the 'outsider' repertoire of girls also implies that they contribute to their own exclusion from the technological developments that are becoming increasingly important in society.

Processes of gender construction in the classroom

How are these repertoires expressed in the classroom and how do ICL courses affect them? Classroom observations show that pupils usually sit in twos in the computer lab. Girls chose the computers on one side of the classroom and boys those on the other side. If there are different kinds of computers, the boys usually have the better ones (e.g. the faster ones, or those with a colour screen). Girls and boys do not take much notice of each other, but they are very preoccupied with gender; it is an important

category in their experience. One of the chapters in method B involves working with a file with data on the pupils in the class. 'Gender' is one of the variables. In several classes, this raised responses like 'Yuck, I'm in the file as a girl', or 'Boys are better than girls because they have code 1'.

Of course there are differences among girls and among boys. Some girls and some boys work seriously and quietly, others do not. However, there are obvious differences between boys in general and girls in general. Boys are usually much more noticeably 'present' in the classroom. They let the teacher know loudly how much they want to start working with the computer, and are often actively involved in conversations about new technologies. Getting up and walking around the classroom, using more space and making more noise by commenting on what others have on their screens, as well as punching friends are all typical behaviour of boys. In their 'present' behaviour, they also use the computer. They shout comments about 'supersonic PCs' across the classroom, and try to attract each other's attention by letting their computer beep, turning each other's computer off, or loading a computer game brought from home.

Girls who behave in out of the ordinary ways and who want to attract the teacher's and each other's attention, also use the computer. However, they use it in a different way. Girls more often attract attention with an anti-technical attitude or a kind of 'helpless' behaviour. 'Help, it's got a virus!' While we saw boys trying to get the teacher's attention with what they know, can do and dare, girls strive for attention with what they do not know and cannot do. 'We don't get it'. 'Sir, we can't do this'. Girls who get the right results on the screen still often ask the teacher to be sure. 'Did we do this right?' In contrast, two boys who had loaded the wrong file, first called the teacher saying that the file was wrong, and then started to blame each other for doing something wrong.

It is plausible to assume that the gender-linked repertoires described in the previous section provide the framework within which pupils interpret their experiences in the classroom. This is manifested, for example, in the fact that girls seem to be more sensitive to negative signals about their capacities, whereas boys are more sensitive to positive signals during the course. Compare a girl's, 'I don't think I'm any good at it – I think you've just got to understand computers, and I don't think I do', with a boy's, 'I didn't get a good mark for my test, but I still think I can handle computers okay'.

On the basis of the qualitative material of the observations and of the interviews held after the ICL course, it can also be argued that students use their experience in school to extend these repertoires. The expert repertoires of the boys are extended with stories about the new computer applications that they have learned, the outsider repertoire of the girls with new 'Oh help' stories. Boys seem to use the classroom environment to practice a typical masculine form of communication – exchanging information on technology and on their technical skills (Cockburn 1985, Wajcman 1991) – without actually mastering the skills and knowledge presupposed in the repertoires they use. For girls it is communication not about the computer expertise they 'practice' in the classroom, but about their lack of expertise.

Although pupils enter the classroom with a wide range of gender-linked behaviour, the types of girls' and boys' behaviour and the repertoires they show in the ICL lessons are new. These are also a product of education, as the pupils were not taught about computers and ICL before. By integrating the computer and ICL in existing patterns of behaviour (for example 'not getting it', making noise and taking space), they extend their repertoires of gender-linked behaviour at school.

More generally, girls and boys at the age of 12 to 14 are preoccupied with gender and becoming women and men. They are actively constructing their gender identities (Davies 1989); they interpret situations, objects and themselves in terms of gender. Girls and boys seem to use ICL and the computer to shape their gender identities. The computer is, on the one hand, a suitable object to use in the construction of one's gender identity because of its association with masculinity. On the other hand, the computer acquires new gendered meanings in this process, and girls and boys attach different meanings to ICL. Enjoyment of and especially abilities in this subject become gendered phenomena.

The observations also yielded examples of how elements to extend gender-linked repertoires are offered to pupils in their interaction with the teacher. Firstly, teachers respond to pupils' behaviour. For example, a boy's 'turn' in the class frequently starts with a disciplinary remark. As drawing attention to themselves and pestering by boys are often expressed by 'experimenting' with the computer, the responses of the teacher are both disapproving and interested.

Second, teachers sometimes have their own gender-linked patterns of behaviour, as was also apparent in the quantitative results of the observations. Some teachers address boys easily on the basis of an assumed common interest in computers. When teaching the whole class, boys often receive more attention and are given more turns, whereas when teachers are helping individual pupils or pairs, girls receive as much attention as boys. However, the content of the interaction between teachers and pupils often differs, depending on the gender of the pupils. Some teachers ask boys more often about their own experiences, others give boys more opportunities to come up with a solution, whereas they easily take over the work from girls. Sometimes boys are asked to help when the teacher himself has a problem.

An analysis of classes with conspicuously favourable or conspicuously unfavourable results for girls indicates a number of positive classroom characteristics that have also been identified in research on effective instruction, namely taking the prior knowledge and skills of pupils into account, a well-structured course, and a quiet, open atmosphere during lessons. In ICL courses these characteristics of 'good educational practice', however, do not appear to be gender-neutral; they are related to how much influence the outsider and the expert repertoires are allowed to have in the classroom. For example, when the level and pace of lessons is determined by the expert repertoire of the boys, the existing knowledge and skills of the girls are disregarded. The expert repertoire easily becomes dominant when there is a turbulent atmosphere in the classroom while pupils are working on the computers. Dominance of the outsider repertoire occurred, for

instance, in a class with more girls than boys. The approach of the (female) teacher was strict, she demanded silence and the pupils' constant attention. The girls responded to this approach by challenging the teacher with an overt outsider repertoire.

In these terms the differences between methods A and B can also be explained. The broad range of real-life contexts that are used in method B, and the instructional formats that are suggested in this method, address the expertise of girls more explicitly than the approach of method A.

Discussion

The combination of quantitative and qualitative methods in this study offered an opportunity to look for relationships between curricular characteristics and outcomes as well as for processes of constructing meaning in the classroom. The findings suggest, on the one hand, that the role of education in the area of gender differences can only be moderate. Students enter the classroom with gender-linked patterns of behaviour and attitudes, and at the age of 12 to 14 seem to go through a phase in which many things acquire a gendered meaning. On the other hand, curriculum does play a very important role. It appeared to succeed in its primary task: diminishing the differences in knowledge between girls and boys. However, curriculum was not able to remove gender differences in attitudes. For the students who worked with the less gender-inclusive method, gender differences in attitudes even increased, which presumably will be expressed in future educational choices. It was also shown that events and experiences in the classroom contribute to the extension of gender-specific repertoires. Pupils' behaviour and experiences in the classroom contribute to their gender identities. Classes appeared to differ in the extent of gender differences and in the prevailing repertoires.

The findings suggest that ways of teaching ICL should be found that are favourable for girls both in terms of gaining knowledge and changes in attitudes. In such models of gender-inclusive ICL teaching, 'dealing with gender-related repertoires and identities' should be explicitly integrated. Teachers should try to prevent an unintentional contribution to processes which exclude girls, or make girls exclude themselves, from certain areas of knowledge and skills. This demands an awareness of the importance of gender identity for pupils, as well as an alertness to the repertoires concerning computers and information technology that prevail in the classroom.

In conclusion, I would like to emphasize that my aim is not to promote an expert repertoire for everyone. The expert repertoire and the outsider repertoire are both problematic in their own way. The former suggests knowledge and skills that the pupil does not really possess, the latter denies knowledge and skills that the pupil does possess. Both repertoires can hamper learning processes. ICL education should contribute to a new kind of repertoire for pupils, which might be called a user repertoire. This repertoire transforms and combines the outsider and the expert. It combines the matter-of-fact approach towards the diversity of computer

applications of the outsider repertoire, with the awareness of the expert repertoire that these applications all require their own kind of expertise. However, it does emphasize the idea that such kinds of expertise can be acquired by learning and experience.

Notes

1. A *kappa*-like measure was calculated for all the items together using the formula (number of corresponding scores - expected number of corresponding scores)/(total number of scores - expected number of corresponding scores). For a justification of the questionnaire, the procedure of data collection and calculation of the interrater reliability, see Volman (1994).
2. A measure similar to the one in the analysis of the methods was used (see note 1, and Volman 1994).

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