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ABSTRACT

This document focuses on gender differences in information and computer literacy (ICL) and on the role of education in producing such differences. The effects of the curriculum materials used and of teaching behavior in ICL lessons are considered in relation to changes in girls' and boys' attitudes, knowledge, and future plans while following an ICL course; the gender-linked ideas about the subject and about the students themselves which were developed during ICL lessons are also examined. The experiment was conducted in 19 lower general secondary education classes where an ICL course was taught. Results indicate that education was successful in the primary task of diminishing the differences in knowledge between girls and boys; in terms of attitudes, education was not able to remove gender differences. It was also shown that events and experiences in the classroom add to the extension of gender-specific repertoires and pupils' behavior and experiences in the classroom influence their gender identities. It is suggested that 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. Three tables provide study results. (Contains 14 references.) (AEF)

SCO-KOHNSTAMM INSTITUUT

AND GRADUATE SCHOOL OF TEACHING AND LEARNING

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1. Introduction

The introduction of microcomputers in the classroom in Western countries during the eighties was accompanied by growing concern about the participation and achievements of girls in computer education (Sutton, 1991). When the problem of 'girls and computer education' was first taken notice of, 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 in education, 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 & Stone, 1986; Brecher, 1989).

In the schoolyear 1993/94 a new subject, 'information and computer literacy' (ICL), was introduced in lower secondary education 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 to pursue computer activities further in their school careers or 'drop out' of this field. This paper focuses on gender differences in such ideas and on the role of education in producing gender differences.

Until 1993 there was little uniformity in the way the subject was taught, although most schools had already introduced some kind of ICL in their curriculum (Ten Brummelhuis, Pelgrum & Plomp, 1991). This offered the opportunity to compare different ways of teaching ICL. The effects of the curriculum materials used and of teaching behavior in ICL lessons have been considered in relation to changes in girls' and boys' attitudes, knowledge and future plans while following an ICL course. 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 in the relationship between educational factors and gender differences in educational results.

2. Methodology

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

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 behavior) 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 equally contributes 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 behavior. 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 resultant 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 the 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 component Context 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 component Teaching methods 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 component Hidden curriculum 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 interrator reliability was satisfying (.88).[1]

It was decided also to look at teaching behavior 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 one of the methods analyzed in the previous study. An approach comparable to the one used in the study of curriculum materials was used, resulting in an analysis of the extent of gender inclusiveness of the teaching behavior of the 19 teachers (3 women, 16 men). In order to obtain an indication of the reliability of the observations, one lesson was observed by two observers in every class and their scores were compared. The interob-

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[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 interrator reliability see Volman, 1994.

server reliability was high (.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 12-14 year old pupils were obtained in the 19 lower general secondary education classes. Results of the lessons were broadly defined with not only achievements (changes in knowledge) being taken into account, but also changes in attitudes and appraisal of the subject. A pretest consisted firstly of a computer attitude scale, an adapted version of the attitude scale of the IEA-Comped study (Pelgrum, Janssen Reinen & Plomp, 1993). This scale consisted of four subscales: enjoyment of computers (Cronbach's alpha (α) =.85), relevance of computers (α=.78), computer anxiety (α=.70), estimation of own competence (α=.77). Future plans with computers were also looked at (α=.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 with computers (α=.42). A number of additional questions concerned prior experience with computers (no scale). The posttest consisted of the same attitude and future plans instruments (alpha's attitude subscales: .90; .79; .71; .84; .70). The complete FITT (30 items, α=.90) was used in the posttest to assess pupils' knowledge. Questions on the appraisal of the ICL lessons were also asked which were categorized in three scales: enjoyment of the course (α=.84), relevance of the course (α=.72); estimation of own competence in ICL (α=.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 of teaching behavior.

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 & Wetherell, 1987), a method focusing on the interpretative repertoires used by respondents when thinking about an issue. It is based on the assumption that people interpret and give meaning to their environment by using the discourses (or repertoires) available. Potter and Wetherell define an interpretative repertoire as 'a lexicon or register of terms and metaphors drawn upon to characterize and evaluate actions and events' (p.138). 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 classroom situation.

3. Gender differences in the field experiment

At the start of the ICL course, there are considerable differences between girls and boys in experience with and knowledge about computers. Sixty three percent (63 %) of the girls

[2] A measure similar to the one in the analysis of the methods was used (see note 1, and see Volman 1994).

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 pretest 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 ($p<.01$).

Table 1 shows gender differences in attitudes, plans with computers, and computer knowledge about computers, before and after the ICL course.

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 n=216 boys n=182		relevance girls n=217 boys n=178		anxiety girls n=223 boys n=191		est. competence girls n=211 boys n=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 (.45)	2.11 (.54)	2.82 (.45)	2.79 (.46)	2.18 (.55)	2.13 (.55)	2.66 (.52)	2.66 (.62)
. boys	2.85 (.63)	2.75 (.66)	2.96 (.45)	2.90 (.43)	1.83 (.55)	1.84 (.57)	3.02 (.62)	2.98 (.63)
sign. gender difference	**	**	**	*	**	**	**	**

** = $p<.01$; * = $p<.05$

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)[3] of girls and boys, before and after the course, and increase of knowledge[4] of girls and boys.

	plans girls n=237 boys n=193		knowledge girls n=239 boys n=190		increase of knowledge girls n=239 boys n=190	
	M (Sd) pre	M (Sd) post	M (Sd) pre	M (Sd) post	M (Sd) pre	M (Sd) post
. girls	2.29 (.34)	2.43 (.41)	.51 (.24)	.63 (.13)	.12 (.24)	
. boys	2.11 (.43)	2.18 (.50)	.63 (.26)	.67 (.16)	.04 (.28)	
sign. gender difference	**	**	**	*	**	

** = $p<.01$; * = $p<.05$

[3] The knowledge scores were calculated by converting the scores on the five knowledge items of the pretest and on the thirty knowledge items of the posttest into scores between 0 and 1.

[4] The differences between the knowledge scores in the pretest and posttest served as a measure for 'increase of knowledge'.

On average, boys answer questions before the course about enjoying and being interested in computers and about their relevance more positively than girls. Boys are more explicit about the fact that they are not afraid of computers and they are more positive about their own competence with computers. They also have 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 have caught up with the boys with regard to computer knowledge; gender differences in *knowledge* about computers have on average decreased; girls' increase of knowledge is higher than that of boys (see table 1b). However, the difference between girls and boys in *enjoyment* of computers after the course has increased, even though the average computer enjoyment of both girls and boys has decreased. As to the other aspects of computer attitude - relevance, fear, estimation of one's own competence - the extent of gender differences has changed slightly, but the differences are still considerable (see table 1a).

It appears, moreover, that the boys' estimation of their competence in this subject was higher than the girls'. Gender diffences in enjoyment of the course and in the extent to which the course was found useful are not significant, although the scores of boys are consistently higher. This is illustrated in table 2.

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	relevance course	est. competence in course
	M (Sd)	M (Sd)	M (Sd)
. girls (n=226)	2.79 (.62)	2.50 (.54)	2.76 (.58)
. boys (n=188)	2.90 (.69)	2.58 (.65)	3.03 (.62)
sign. gender difference	n.s.	n.s.	**

** = p<.01; * = p<.05; n.s. = not significant

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).

4. The role of gender inclusiveness of the curriculum and teaching behavior

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

The gender inclusiveness of the ICL *methods* (the teaching materials) was investigated with the help of the instrument introduced in section 2. It appeared that the extent of gender inclusiveness of the methods differed considerably. I will call the less gender-inclusive methods '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 use real-life *contexts* to introduce the subject matter and discuss computer applications, but this is done less systematically in A and not always in a way that is geared to the everyday lives of girls. The biggest differences between the methods, however, lie in the *teaching strategies* suggested. Instructional formats that fit the assumed needs and capacities of girls are well-represented in B. This method does not require pupils to work at the computer for a whole lesson. Various formats, including verbal instructional formats, are used, whereas method A is less varied. As to the *hidden curriculum*, women and men are not represented in stereotyped roles in the text or the pictures in either of the methods. However, both A and B do contain more pictures of men and boys than of women and girls. In A this is also applicable to the text and there is more emphasis on calculation than in B. Neither of the teacher manuals pay attention to the possible occurrence of gender-stereotyped interaction among pupils, and between teachers and pupils.

Table 3 presents data on the results of girls and boys who worked with one of the two methods.

Table 3. Means and standard deviations of enjoyment of the course, relevance of the course, estimation of own competence, changes in enjoyment of computers[5] 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) A	M (Sd) B	M (Sd) A	M (Sd) B	M (Sd) A	M (Sd) B	M (Sd) A	M (Sd) B	A	B
. girls nA=114; nB=112	2.67 (.59)	2.92 (.63)	2.48 (.52)	2.53 (.56)	2.64 (.61)	2.87 (.53)	-.34 (.47)	-.20 (.61)	.14 (.24)	.11 (.25)
. boys nA=95; nB=93	2.94 (.67)	2.88 (.71)	2.66 (.70)	2.50 (.58)	2.98 (.66)	3.09 (.57)	-.13 (.49)	-.07 (.54)	.02 (.26)	.01 (.31)
sign. gender difference	**	n.s.	*	n.s	**	**	**	n.s.	**	*

** = p<.01; * = p<.05; n.s. = not significant

It was found that girls and boys equally enjoy the more gender-inclusive method B and find it equally useful, whereas the less gender-inclusive method A shows gender differences in favour of the boys. The girls in method B assess their competence in ICL to be higher than the other girls (p<.05), although the difference between the boys is also significant. The changes in the enjoyment of computers of these girls are less negative than those of the other girls. As to the other elements of computer attitude (relevance, anxiety and estimation of own competence) there are 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.

[5] The differences between the enjoyment scores in the pretest and posttest served as a measure for 'changes in enjoyment'.

The classroom observations showed that only a very small number of the components of gender inclusiveness was manifested in *teaching behavior.* 'Classic' mistakes were made, like taking over at the computer more often with girls, giving girls less turns in class, and addressing boys as experts more often than girls (see e.g. Sanders & Stone, 1986). Gender inclusiveness varies considerably between the teachers, but this is 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 behavior is, 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 behavior, 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 differ greatly, though, in terms of students' results. The changes during the course in almost all the variables vary from class to class, and the gender differences in relation to enjoyment of the lessons and to changes in the enjoyment of computers also vary 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 are produced.

5. 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 occur 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 show mainly similarities between girls and boys; almost all of them like computer games, they all find computers useful, they are not afraid of computers, and they can 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 '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 uses 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.

6. 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 computerlab. 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 loudly let the teacher know 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 behavior of boys. In their 'present' behavior, 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 out of the ordinary 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' behavior. '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; Wajman, 1991) - without actually mastering the skills and knowledge presupposed in the repertoires they use. For girls it is not communication about computer expertise they 'practice' in the classroom, but about their inexpertise.

Although pupils enter the classroom with a wide range of gender-linked behavior, the types of girls' and boys' behavior and 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 behavior (for example 'not getting it', making noise and taking space), they extend their repertoires of gender-linked behavior at school.

More generally, girls and boys at the age of twelve to fourteen are preoccupied with gender and becoming women and men. They are actively constructing their gender identities (cf. Davies, 1989); they interpret situations, objects and themselves in terms of gender. Girls and boys seem to use the subject 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' behavior. 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.

Secondly, teachers sometimes have their own gender-linked patterns of behavior, 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' repertoire 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 method 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 suggest 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 educational characteristics and results, as well as for processes of constructing meaning in the classroom. The findings on the one hand suggest that the role of education regarding gender differences can only be moderate. Students enter the classroom with gender-linked patterns of behavior and attitudes, and at the age of 12-14 seem to go through a phase in which many things acquire a gendered meaning. On the other hand, education does play a very important role. It appeared to succeed in its primary task: diminishing the differences in knowledge between girls and boys. As to attitudes, however, education was not able to remove gender differences. 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' behavior 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.

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