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Gender Inclusiveness in Educational Technology and Learning Experiences of Girls and Boys

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Abstract

The use of technology (information and communication technology, ICT) in secondary education is an important aspect of the current curriculum and of teachers' pedagogy. Learning supported by computers is supposed to be motivating for students and is, therefore, assumed to have positive effects on learning experiences and results. However, the question remains whether these motivating effects are equal for all students. Although the gender gap in the use of ICT and knowledge about it has diminished, there are still indications that the use of technology in education affects girls and boys differently. The present empirical study focuses on the relationship between the inclusiveness of educational tools and the learning experiences of girls and boys. The results show that gender scripts are embedded in educational tools, which are reinforced in classroom practice and affect learner experiences. A greater inclusiveness of the tools appears to improve the participation of students, enhances positive attitudes toward learning and technology, and improves the learning effects as reported by girls and boys. Girls especially tend to benefit from the inclusiveness of educational tools. (Keywords: social scripts, inclusiveness, technology, gender, secondary education)

INTRODUCTION

> "I like working with computers at school. It is nice to be active, to determine your own way of working and to not have to listen to the teacher all the time." (boy, age 14)
>
> "It is nicer than the usual lessons, but it depends on the task that has to be done."(girl, age 14)
>
> "In the beginning it was difficult, because I was used to working with schoolbooks. Now it has become normal. It is not especially nicer, or better, to work with computers at school."(boy, age 15)

Students seem to be motivated by working with ICT at school (Becta, 2006; Ruthven, Hennessy, & Brindley, 2004). At the same time, as the quotations above indicate, students' experiences with technology in education vary and, more specifically, may be related to gender. Gender differences in students' appreciation of the educational use of ICT parallels the research that continues

to show gender differences in computer attitudes, although the gender gap in the use of and knowledge about ICT has diminished (Cooper, 2006). Girls' attitudes are particularly found to be less positive when confidence in working with technology and the role of ICT in students' future plans are at stake (Colley & Comber, 2003; Volman, Van Eck, Heemskerk, & Kuiper, 2005).

The term *educational tools* indicates the whole range of software and content that can be used in educational practice, including particular educational programs, simulations and games, e-mail, and the Internet. However, it has become clear over the past few years that we should differentiate between different types of ICT use when making statements about gender differences in the use and appreciation of ICT. For example, boys play computer games more often than girls (Cassell, 2002), and girls take fewer technology classes than boys in high school (Pinkard, 2005), but girls use e-mail at school more often than boys (Volman et al., 2005). Girls tend to respond less positively than boys on items aimed at measuring computer attitude in general, whereas they report enthusiastically about applications for word processing and drawing (Volman & Van Eck, 2001).

Much has been written about the question of what determines the gender inclusiveness of educational technology (Heemskerk, Brink, Volman, & Ten Dam, 2005): In other words, what makes technology attractive and suitable for both boys and girls? Much is also known about the characteristics of computer games and educational software that appeal to girls. Girls seem to prefer games and educational tools facilitating cooperation to more competitive tools. They generally tend to like games appealing to creativity more than tools that ask for dexterity, and appreciate detailed and colourful images in games and educational technological tools (American Association of University Women [AAUW], 2000; Fiore, 1999). In our own research on educational tools, we found that girls tend to appreciate clear instructions and an interesting subject more than boys, whereas boys appreciate pictures and competition more than girls (Heemskerk, Volman, Admiraal, & Ten Dam, submitted 2008a).

The above mentioned differences support the idea that the use of a particular educational tool in class might affect boys and girls differently. In other words, educational tools may be less inclusive to either boys or girls, which in turn might result in different learning experiences and different learning results. However, the relationship between the supposed inclusiveness of particular educational tools and the actual experiences of students with these has yet to be systematically investigated. The aim of this study is to investigate the relationship between the inclusiveness of particular educational tools in classroom practice and the different learning experiences of girls and boys. The research consists of a small-scale qualitative study that comprises the analysis of particular ICT tools, their use in the classroom, and related experiences of students.

Inclusiveness of Educational Technology Tools

To understand the mechanisms of inclusiveness of educational tools, we use the concept of "gender scripts" as introduced by Oudshoorn, Seatnan, and Lie (2002), based on the "script" concept of Woolgar (1992). We start this section

with an elaboration of these concepts, followed by a discussion on how these concepts can be used in research into the gender inclusiveness of educational ICT tools. We draw on the results of an extensive literature study on socio-cultural sensitivity and gender inclusiveness in educational software that resulted in an "index of inclusiveness" (Heemskerk et al., 2005).

Designers and developers of educational technology have specific images of future users and future usage. These "user representations" or "scripts" are unintentionally built into the design of technology, even if equal access to new technology is the aim. *Scripts* can be defined as assumptions about a supposed user that become an integrated part of the entire process of technological development. These scripts may result in a design more suitable for a specific group of users, to the exclusion of other groups (Akrich, 1995; Oudshoorn, Rommes, & Stienstra, 2004). A study of Huff and Cooper (1987, cited in Cooper, 2006), for example, demonstrated that teachers who design educational software often write with boys in mind, leading to gender scripts that make the tools more attractive to boys than to girls. On the other hand, users of technology do not necessarily need to adopt the scripts as constructed by the designers. In processes of "domestication" they can modify the scripts, or they may reject them. Users of technology can also create new meanings and usage of the objects, and they can become nonusers (Oudshoorn et al., 2004). These processes are situated in a cultural context, in which cultural codes are important (i.e., cultural codes in relation to gender).

Van Zoonen (2002) describes how gender codes play an important role in the processes of domestication of the Internet. In the context of educational technology, teachers as well as students are active participants in domestication processes, and they are able to modify gender scripts in various ways. Gender scripts and, in a broader sense, social scripts in educational tools can be traced with help of the literature on gender-inclusiveness and cultural sensitivity in educational software. Heemskerk et al. (2005) distinguishes three aspects of educational software in which such scripts can be found: the content, the visual and audio interface, and the instructional structure of the technological tool.

Most teachers will agree that educational tools should not unintentionally discourage specific groups of students. Therefore, they should offer students optimal possibilities to identify with the subject matter and the way that subject matter is presented, and each student should feel comfortable as well as challenged when working with an educational tool. Therefore, the content and the interface of the educational tools should be attractive for girls and boys. Moreover, the structure of the programme and the kind of learning processes it facilitates should match the ability levels and learning approaches of various groups of students. For the three clusters of scripts mentioned above (content, interface, and structure), Heemskerk et al. (2005) asks questions about whether social scripts are hidden in the tool, possibly causing less inclusiveness for particular social groups (i.e., either boys or girls) and elaborates on these questions to create an index of inclusiveness (see Table 1, Heemskerk, et al., 2005).

Heemskerk et al. (2005) developed the index of inclusiveness on the basis of literature on gender inclusiveness and sociocultural sensitivity of technology. Here we focus on the literature on gender and technology. Regarding the

Table 1. Index of Inclusiveness

1. Content	
1.1 Perspective	
Presence of different groups	Is there a balanced representation of diverse human groups (e.g., male/female, different cultural backgrounds, diversity of ethnicity/race, different social classes, urban/rural, diversity of religions/beliefs)?
Representation of groups	Are the groups presented in ways that are positive, equal, and nonstereotypical (e.g., variety of living situations, variety of occupational tasks and other activities, variety in human responses, aggressive as well as sensitive, active as well as inactive)?
Contributions of groups	Are the groups represented in ways that reflect accurately their potential contributions to the subject of the program? Are issues relating to groups routinely included within the content as opposed to being separated out as "special concerns"? Does the content avoid assuming that all people are operating from the same group, perspective and/or values? Is it clear that decisions made in simulations may have different effects for different groups?
1.2 Respectful of values	Is the content respectful and considerate of the values, manners, and taboos of the different cultural groups? Is the language free of biased terminology?
1.3 Real-life context	Is the subject matter presented in an authentic context (e.g., using the experiences of the students, actively involving the students in problem solving, addressing the usefulness of the subject in daily life, presenting a subject using different disciplines)?
1.4 Addressing different interests	Does the material have the potential to attract the interest of all groups and not just represent a stereotype of the interest of one group?
2. Interface	
2.1 Visual aspects	
Presence and representation of different groups	Is there a balanced representation of diverse human groups (e.g., male/female, different cultural backgrounds, diversity of ethnicity/race, different social classes, urban/rural, diversity of religions/beliefs)? Are the groups presented in ways that are positive, equal, and nonstereotypical (e.g., variety of living situations, variety of occupational tasks and other activities, variety in human responses, aggressive as well as sensitive, active as well as inactive)?

Respectful of values	Is the visual interface respectful and considerate of the values, manners, and taboos of the different cultural groups (e.g., in the use of colour, icons, pictures of animals, and other images)?
Preferences of different groups	Are the preferences of different groups taken into account in the visual interface (e.g., bright vs. dark colours, detailed or not, clarity of images)?
Packaging	Do the packaging and/or advertising show a diversity of groups rather than one group to the exclusion of others?
2.2 Audio aspects	
Voice	Does audio material include narrators from a range of group voices?
Music and sounds	Does the sound track include a variety of styles of music/sounds?
3. Instructional structure	
3.1 Prior knowledge	
Initial level	Is the material designed effectively and explained thoroughly enough so that all users can work with it, regardless of differences in: • ICT skills and knowledge? • Content knowledge and learning capabilities?
Home language	Does the material acknowledge that learners may have a variety of home languages and take that into account (e.g., by using dictionaries, the use of clear language, multilingual)?
3.2 Learning strategies	Does the material acknowledge that learners may have a variety of learning strategies and take that into account?
3.3 Learning activities	
Collaboration	Does the program accommodate learning together as opposed to competition? If working in groups is required, does the program: Accommodate multiple roles and tasks? Provide all students with the opportunity to do different tasks and practice different roles?

Table 1. Index of Inclusiveness (cont. from p. 257)

Communication	Does the program accommodate ways of communication with other people (e.g., experts, students)? If communication is required, does the program: Acknowledge that some students may have difficulty with asking (why) questions, arguing with adults, or formulating their ideas? Acknowledge that differences in communication styles exist between different groups or different languages (e.g., differences may occur in frequency, length, or tone of messages)?
Skills	Are different kinds of skills addressed (e.g., writing, drawing)?
3.4 Help	
Scaffolding	Does the program offer scaffolding support (e.g.., an apprenticeship approach helping the student to develop the necessary skills)?
Feedback	Is the feedback to the student positive and direct?
Self-esteem	Does the program offer support in a way that promotes the self-esteem of the student? Does the program offer ways for students to function as teacher or expert to other students?
3.5 Student input	
Choice	Does the program offer possibilities for students to have choice in how to work (e.g., are there different ways to use the program, different solutions to the assignments)? Is the student treated as an active participant with responsibility for their learning process?
Flexibility	Is the program made in such a flexible manner that students can alter parts to their preference? Can students add their own information and experiences into the material?

content of educational tools, many authors have argued that there should not be any obstacle to students giving personal meaning to the subject matter. Taking a nonsexist and nonstereotypical perspective is assumed to contribute to this (Adler, 1999; Gillani, 2000; Larson, 1999). This implies, for example, that the content of educational tools avoids sexist language. The literature on gender-inclusive education has also pointed out the importance of presenting the subject matter in a real-life context, which appeals to girls (Agosto, 2001; Volman, 1997). A final issue regarding the content of educational tools is the importance of creating applications that address students' different interests. Girls' learning results were found to improve when the educational tool addressed their interests, whereas this effect was not found with boys (Joiner, Messer, Littleton, & Light, 1996).

Discussions on the characteristics of an inclusive visual interface in educational technology largely address issues similar to those concerning the content. Questions that can be asked are: "Do the illustrations and graphics of the program represent male and female persons, and are they represented in a nonstereotypical way?", "Are the preferences of girls and boys taken into account in the visual interface?", etc. Regarding the audio aspects of educational technology, it is important to include narrators from different sexes and a variety of styles of music and sounds (Fiore, 1999; Gillani, 2000; Royer, Greene, & Anzalone, 1994). Using a variety of visual and audio features in educational tools can make these tools more attractive to both boys and girls.

The inclusiveness of the instructional structure of an application refers to whether the way the learning process is structured or supported by the tool matches the ability levels and learning approaches of different students. Several issues can be addressed. First, to be inclusive, the instructional structure of an educational tool should be based on the prior knowledge of students. This concerns both the skills of students necessary for using ICT and their knowledge of the particular subject matter. Generally, girls report fewer ICT skills and less ICT knowledge than boys do (Volman & Van Eck, 2001). The second issue concerns differences in learning strategies. Programmes should accommodate students' learning strategies (Adler, 1999), which can be related to gender. For example, boys are found to like programmes with lots of choices, and they like to try out things, whereas girls like to have an explanation first about what they are supposed to do (Volman et al., 2005). The third issue regarding the instructional structure of educational tools refers to the kind of learning activities a software program or tool addresses. The issue of social interaction is considered to be particularly relevant. Preferences for collaboration or competition in general, and for applications facilitating communication in particular, have been found to be related to gender. For instance, research on gender reveals that girls prefer collaboration to competition (Agosto, 2001; DeJean, Upitis, Koch, & Young, 1999; Fiore, 1999, Heemskerk et al., submitted 2008 a). The fourth aspect of the instructional structure of educational tools that is relevant to inclusiveness is the opportunity for students to receive help. Many authors mention the importance of clear and immediate feedback and scaffolds (Gillani, 2000; Selby & Ryba, 1994), which appear to be particularly important for girls, who

tend to be less self-assured in ICT matters (Agosto, 2001). The fifth issue that impacts the inclusiveness of educational tools is the extent to which students are allowed to have their own input or to take responsibilities when working with the educational tool (e.g., DeVoogd, 1998; Maurer & Davidson, 1999). Girls have been found to prefer programmes that allow multiple paths and many possible answers (Agosto, 2001).

The present study aims to improve our understanding of the functioning and effects of gender inclusiveness in educational software. Although a few empirical studies have been carried out thus far, the literature on this issue is mainly of a theoretical and reflective nature. For an analysis of the gender inclusiveness of educational technology, the distinction between manifestations of the curriculum described by Van den Akker (2003) is relevant. In this study we investigate three levels of the curriculum: the formal, the operational, and the experiential curriculum. The analysis of the formal curriculum concerns the inclusiveness of the design of the tools. However, curricula are not just delivered by teachers, and educational tools are not just used in a neutral way. In the literature on educational technology it has been shown that teachers tend to adopt technology in ways that are consistent with their personal perspectives on curriculum and instructional practice (Niederhauser & Stoddart, 2001). This might also apply to the way they handle the inclusiveness of educational tools in the classroom. Therefore, the analysis of the operational curriculum focuses on how teachers enact the inclusiveness of the tools in the classroom: How do they use the tools in their class? Inclusiveness at the level of the experiential curriculum is analysed by focusing on students' learning experiences, particularly differences between girls and boys, while using particular educational tools in class.

In this study we focus on the relationship between the inclusiveness of educational tools at the formal and operational curriculum level on the one hand, and the inclusiveness in terms of different learning experiences of girls and boys on the other hand. The main research question is: In what way is the inclusiveness of educational tools as enacted in classes related to the learning experiences of boys and of girls?

METHODS

Participants

The participants of this study are 81 ninth grade students (age 14–15) in four schools for general secondary education. The aim was to select schools that are forerunners in ICT use and to observe one ninth grade class at each school, in two courses (a language and a social course). The teachers and students had to be experienced ICT users. We searched the Internet for the Web sites of schools in our region that advertised their use of ICT by laptop classes or e-learning, and/or the use of a virtual learning environment. We approached the ICT coordinators of these schools and asked for the actual ICT use in ninth grade classes and which teachers were most experienced with their subject and with the use of ICT in these classes. We agreed which social course and which language course to observe during the planned observational period. The selected schools are in two large cities and a small town in the Netherlands and vary in size and

Table 2. Students in Participating Schools and Observed Courses

School		School A N=13	School B N=21	School C N=27	School D N=20
Courses		History	English, Geography	Geography	French, History
Gender	Girls (%)	53.8	54.5	63.0	60.0
	Boys (%)	46.2	45.5	37.0	40.0

denomination. The study reports about seven educational tools that have been examined at the formal curriculum level, and six educational tools that have been investigated by means of observations and interviews at the operational and experiential curriculum level. The choice of these six tools is explained in section 3.3. Table 2 shows the distribution of students over schools and observed courses in which the six educational tools were used, as well as student characteristics.

Data

To define the gender inclusiveness of particular educational tools, the authors independently coded the design of the tools (the formal curriculum level), then checked how the teachers' behaviour affected the inclusiveness of the tools. This level (the operational curriculum) was investigated by means of observations of teaching and classroom interaction during the use of ICT in class. The authors observed 2 lessons of each educational tool, for 12 lessons total. We supplemented video and audio records with field notes (Adler & Adler, 1994). We investigated the reported learning activities and learning effects (the experiential curriculum level) through student interviews, class observations, and learner reports. In each class the teacher selected four students (two boys and two girls with different learning achievements) for observations and interviews. An author and another researcher transcribed the 24 interviews and observations into verbal protocols and analyzed them with code-and-retrieve software. We obtained learner reports from all students of the participating classes in each observed course (n=122).

Instruments

In Table 3 (page 262), we summarize the variables, data, and instruments. We distinguish between three levels of curriculum: the formal, the operational, and the experiential. For each level we indicate the investigated research materials/actors (research objectives), the relation to inclusiveness, the research instruments, the variables, and whether the variables are independent or dependent in the present study.

In this section, we first describe the way we have determined the inclusiveness of the educational tools. After scoring the gender inclusiveness of the educational tools at the formal curriculum level, we have examined whether or not teachers modified the inclusiveness of the tool at the operational level. As teachers' actions hardly appeared to modify the scripts in the tools, we have used the score of gender inclusiveness at the formal curriculum level to investigate the relationship

Table 3. Summary of Research Data and Instruments

	Formal curriculum level	Operational curriculum level	Experiential curriculum level
Research objectives	Design of tools	Teacher behaviour	Students' experiences
Relation to inclusiveness	Inclusiveness of social scripts	Enacted inclusiveness	Effects of inclusiveness on learning experiences
Variables	Items of the index of inclusiveness (Independent variable)	Teaching behaviour in terms of the index of inclusiveness (Independent variable)	Learning experiences Attitude Participation Learning results (Dependent variables)
Instruments	Operationalization of the Index of Inclusiveness	Teacher/class observational instrument	Learner reports Student interviews Student observational instrument

between the inclusiveness of educational tools and the learning experiences of girls and boys.

Inclusiveness at the formal curriculum level. In this study we selected seven applications to examine gender inclusiveness at the formal curriculum level; three applications for a language course (English, German, and French) and four for social studies (history and geography, each two applications). The German and French applications belong to schoolbooks that are used in the course. A publishing firm designed the programmes, which are available on the internet and/or CD-ROM. These applications have the same look and feel as the textbook and correspond with the contents of the regular lessons, which in general are repeated and exercised in the educational tool. The teachers themselves designed the other applications, which generally consist of the use of the Internet for assignments and searching for information.

We measured the social scripts in these tools using an operationalization of the index of inclusiveness (see Table 1). Two researchers scored each subheading (1.1, 1.2, 1.3, etc.) with the help of questions focusing on whether attention was paid in the tool to that particular theme (i.e., "Are men and women presented in ways that are positive, equal, and non-stereotypical?" The scores include 0 (no or little attention) and 1 (clear attention). We summed the scores of the four subheadings of Content (leading to a range of 0–4), the two subheadings of Interface (range 0–2), and the five subheadings of Instruction (range 0–5), for a total range of 0–11. The interobserver agreement between the two observers in terms of Cohen's κ is 0.91. In Table 4, we separately summarized the inclusiveness of the gender scripts of the educational tools at the formal curriculum level, for the three clusters of the index of inclusiveness (content, interface, and instruction). We distinguish two types of tools for further analyses: the less inclusive educational tools (tools 1, 2, and 3), and the more inclusive tools (tool 4, 5, and 6).

Table 4. Inclusiveness of the Gender Scripts of the Educational Tools

Application	Content (range 0–4)	Interface (range 0–2)	Instruction (range 0–5)	Total (range 0–11)
Tool 1 Geography (B)	1	0	0	1
Tool 2 Geography (C)	1	0	0	1
Tool 3 English (B)	1	1	0	2
Tool 4 History (A)	4	1	2	7
Tool 5 History (D)	3	1	4	8
Tool 6 French (D)	3	2	5	10

Compared to the three tools with low scores on inclusiveness, the three tools with high scores generally include assignments in a real-life context, address students' different interests, and present both textual and visual materials. The instructions of these tools match with students' prior knowledge and skills, address various skills, accommodate cooperation, and offer support by, for example, a glossary or help function (for more details, see Heemskerk, Volman, Ten Dam, & Admiraal, submitted 2008b).

Inclusiveness at the operational curriculum level. At the operational curriculum level, we checked whether teacher behaviour changes the inclusiveness of the educational tools. We transcribed the video tapes and researchers' notes of the observations into written protocols. From these protocols, we selected assertions and descriptions that were related to the index of inclusiveness. This process resulted in summaries and reflections on actions and behaviours that diminish or reinforce the inclusiveness of the educational tools. We ordered these text selections for each combination of class and tool. Four researchers (one of whom was familiar with the observations) analyzed these data from scratch and negotiated disagreements until the outcomes were agreed upon or disagreements were understood and reflected as such (cf. Marble, 1997).

We found that teachers generally reinforce the inclusiveness of the more inclusive tools and they do not affect the inclusiveness of the less inclusive tools. Table 5 (page 264) presents the counts of inclusiveness diminishing and inclusiveness reinforcing teacher behaviour for the less inclusive tools and the more inclusive tools separately. The differences between the tools are most prominent in teacher behaviour with regard to prior knowledge, students learning activities, and providing help (for more details, see Heemskerk et al., submitted 2008b). We could not define whether teacher behaviour was influenced by the gender of the teachers, as only one female teacher participated in the research.

Our analyses show that the categorization of the educational tools at the formal curriculum level in terms of gender inclusiveness needs no readjustment with regard to the operational curriculum level. For investigating the experiential curriculum level, we therefore, decided to maintain the categorization into three less inclusive tools and three more inclusive tools.

Inclusiveness at the experiential level. The analysis of students' learning experiences uses the data from the student interviews and the learner reports, partly

Table 5. Scores on Teacher Behaviour in Relation to the Index of Inclusiveness

Item of the index		Less inclusive tools		More inclusive tools	
		Further diminishing inclusiveness	Reinforcing inclusiveness	Diminishing inclusiveness	Further reinforcing inclusiveness
Content	Perspective				
	Respectful of values				+1
	Real-life context		+1		+1
	Addressing different interests				+2
Interface	Visual aspects			-1	
	Audio aspects				
Instruction	Prior knowledge				
	• ICT		+3	-1	+1
	• Content	-2	+1		+3
	Learning strategies	-2			+2
	Learning activities				
	• Cooperation				+2
	• Communication	-1	+1		+3
	• Skills				+2
	Help				
	• Scaffolding		+2		
	• Feedback	-1	+1	-1	+2
	• Self-esteem	-2	+1	-1	+2
	Students' input; choice & flexibility				+2
Total		-8	+10	-4	+23

Note: Range 0–3, indicating the number of teachers showing the specified type of behaviour.

supplemented by class and student observations. The observational instrument focuses on student behaviour, in terms of how and to what extent students participate in learning activities. We looked at students' concentration, involvement, and effort. We considered how much time students were working concentrated and actively involved during the observation intervals, and the duration and amount of times of distraction from their work. We also observed whether students were working on task, or whether they were chatting or using Google off task. This information provided insight into the extent of students' participation. Students were interviewed separately as soon as possible after the observations about particular events from the previous lesson. Questions in the interviews dealt with students' participation, their attitudes toward technology in education, how they experienced working with the particular tool, and how they perceived what they learned. Moreover, during the final 10 minutes of the second observed lesson of each course, all students completed a learner report about the educational tools with which they worked. We asked students to write down their learning experiences by completing a sentence ("I have learned from the programme that…"), which they could fill in three times. The learner report also included closed questions such as "Did you like to work with the tool?", "Was the tool easy to work with?", and "Did you learn much by working with the tool?" with a 4-point scale ranging from 1 (not nice at all/very difficult/learned very little) to 4 (very nice/very easy/learned very much).

Analysis

The analysis of the student observations and interviews followed the process of content analysis according to Huberman and Miles (2002). We transcribed the video, audio tapes, and researchers' notes of the observations and interviews into written protocols. From these protocols, we selected assertions and descriptions related to students' learning experiences. After the process of data reduction, we sorted the relevant fragments into categories based on appearance related to gender and to whether less inclusive or more inclusive tools were used (data matrix). In the third phase, which was the conclusion-drawing and verification phase, we drew conclusions about whether student behaviour and student articulations were meaningful in terms of learning experiences. Another researcher who analysed the data again while looking for counterexamples verified these conclusions. These researchers negotiated disagreements until they agreed upon outcomes or understood disagreements and reflected them as such (cf. Marble, 1997).

We analysed the quantitative data of the learner reports using *t*-tests of independent samples. We analysed differences between the less inclusive tools and the more inclusive tools, as categorized at the formal and operational curriculum levels, as well as gender differences. In the first round of analysis of students' completed sentences, one researcher developed categories and scored the answers, while a second researcher scored the answers independently. The categories of what students reported that they learned were "related to exercise and repeating only," "related to the content of the course," "related to learning in general," "related to ICT skills," and "other." The interobserver agreement

Table 6. Differences Between Tools in Learner Reports (Range 0–4)

	Less inclusive tools Mean (SD)	More inclusive tools Mean (SD)
Did you learn much by working with the tool?		
Girls (n=65)	2.09 (0.668)	2.61 (0.558)*
Boys (n=46)	2.00 (0.849)	2.35 (0.745)
All students (n=111)	2.05 (0.746)	2.51 (0.644)*
Was the tool easy to work with?		
Girls (n=66)	2.97 (0.747)**	3.32 (0.475)*
Boys (n=48)	3.41 (0.628)	3.47 (0.513)
All students (n=114)	3.17 (0.725)	3.38 (0.490)
Did you like to work with the tool?		
Girls (n=62)	2.78 (0.591)	2.92 (0.392)
Boys (n=49)	2.66 (0.814)	2.95 (0.686)
All students (n=111)	2.72 (0.696)	2.93 (0.533)

Note: T-test of independent samples.

** Significant difference between less inclusive and more inclusive tools ($p<0.05$).*

*** Significant difference between boys and girls ($p<0.05$).*

between the two observers in terms of Cohen's κ is 0.95. For each of the categories, we analysed the learner reports using Pearson's Chi-Square, with a view on gender-specific elements: which differences in learning experiences between girls and boys emerge?

EXPERIENTIAL CURRICULUM LEVEL: STUDENTS' LEARNING EXPERIENCES

The analysis of students' learning experiences is based on four types of data: completed sentences and answers to closed questions from the learner reports, student interviews, and observations at the class and student levels. Table 6 presents the results of the closed questions in the learner reports. Students generally reported more positively about their learning experiences when they worked with the more inclusive tools. This is especially the case for girls.

Below we will discuss students' learning experiences in more detail on the basis of the qualitative data. We organize the analysis under three themes: students' perceived learning effects, their attitudes toward the tools, and student participation in class.

Reported Learning Effects

All students reported that they learned significantly more from inclusive tools than from noninclusive tools (see Table 6) (t= -3.44; F=0.33; df= 109; $p\leq$ 0.001). A similar result, with a larger effect size, was found when girls were selected (t= -3.42; F=0.43; df= 63; $p\leq$ 0.001). In the sentences in which students

answered what they had learned from the programme, 60% of the reported learning effects concern the more inclusive tools. Girls more often mentioned general learning effects such as learning to listen carefully in order to be able to answer questions, to have different ways of working, to search for information, and to learn more from drawings. Boys more often mentioned specific learning effects that relate to the content of the course in which the tool was used, such as to write sentences, to learn grammar, to translate, and to learn about the Second World War (Chi^2=21.21; df=4; $p \leq 0.001$).

In the interviews, girls reported learning effects with regard to the technical use of the computer and handling the tool more often than boys. This was the case for both the less inclusive tools and the more inclusive tools. For example, one girl stated that she learned how to do searches on the computer and that this is something one needs to know. Another girl said she learned how to search for information, which she calls "important knowledge for the future." A final example of learning effects pertaining to computer skills concerns a girl who mentioned in the interview that she learned how to handle computers to look for a word in a dictionary. Some girls also reported that they knew the necessary computer skills already and that the same features are used all the time. It is striking, however, that almost all boys stated that the tools were easy to work with, so they did not learn much about computers. Only one boy mentioned that he learned a little about how to use a computer. He thought the use of the tool was a good way to learn this. Another boy mentioned that he learned to make a PowerPoint presentation. These two boys were exceptions to the rule that boys reported learning little about computer use.

With regard to the subject matter of the content of the tools, most students were positive about what subject matter and skills they had learned. For example, from working with the English language tool they learned to read and understand English texts, and from the history tools they learned about the Second World War and European history. In the interviews, we detected only one gender difference: Girls gave more positive descriptions of what they learned than boys did for the more gender-inclusive tools. For example, regarding the history tools, girls reported that they remember important terms better because they had to search for answers, that the tool helped them to understand the content, and that it helped them to get a better picture of how people lived during the Second World War.

In the interviews we also asked the students to compare "learning with the help of educational tools" with "learning with the help of schoolbooks." Pertaining to this issue we found no gender differences with respect to the less inclusive tools. Both boys and girls mentioned that the English language tool provides authentic English, in contrast to the schoolbooks that offers English for students. They remember better what they have learned with the tool.

With respect to the more inclusive tools, however, we did find differences between girls and boys in learning experiences. Girls reported more, and produced more different, positive learning effects than boys (and compared to the girls who worked with the less inclusive tools). Girls mentioned that they understood

the content better, and that they noticed whether they understood the content in the right way. Girls also mentioned that they learned better because the tasks were different from the regular schoolwork, and that they knew better whether they performed the tasks in the right way. One of the girls was really enthusiastic and mentioned that she saw only advantages in working with the tools. The fact that particularly girls reported more positive learning effects than boys does not mean, however, that boys did not mention positive effects of learning with educational tools. Boys also mentioned that they remember the information better because they had to actively search for information, and that they had more options to choose from than in regular lessons. However, boys and girls also remarked several less positive aspects while working with educational tools; for example, they mentioned that reading and learning texts from the screen is more difficult, and computers are in their opinion more suitable for the performance of specific tasks.

To summarize, it appeared that girls' experiences were more positive when they worked with the more gender-inclusive educational tools. They showed more enthusiasm about what they learned and about the advantages of the tools, not only compared to boys but compared to the girls who worked with the less gender-inclusive tools, as well.

Attitude

In this section, we will discuss two aspects of students' attitudes toward educational technology, their attitudes toward working with the particular educational tools in class and their attitudes toward ICT as an educational tool at school.

Girls reported that they work more easily with the more gender-inclusive tools compared to the less gender-inclusive tools (see Table 6) (t= -2.25; F=0.28; df= 64; p= 0.03), whereas boys worked equally easily with both types of tools. Another result (Table 6) is that we found a significant difference between boys and girls in reported ease of working with the less inclusive tools (t= -2.53; F=0.32; df= 62; p= 0.01), which is not found in the more inclusive tools. These results suggest that less inclusive tools trouble girls more than boys. In contrast to the results from the learner reports, we did not find differences between boys and girls in the interviews. In general, most students found it quite easy to work with the specific tools whether they were gender inclusive or not. At the same time, they also mentioned some difficulties. For example, with regard to the less inclusive tools, both boys and girls had difficulty finding the answers to the questions if much text is used (in assignments, instructions, questions, etc.). Some boys reported that they found it difficult and annoying to have to work with several screens at a time (a Word document for the answers, the Internet source, a separate document with questions). Students who worked with the French language tool (one of the more inclusive tools) mentioned that they had difficulties with content such as tests on grammar.

We did not find a significant difference between the more inclusive tools and the less inclusive tools in the extent that students liked to work with the specific tool (see Table 6). In the interviews most students reported that they liked the

specific tool they had used. However, girls who worked with the less inclusive tools were less explicit about their feelings about the tools they used, compared to girls who worked with the more gender-inclusive tools. For example, a girl working with one of the less inclusive tools reported that the tool was nice "for a change." In contrast, the girls working with the more inclusive tools reported these tools to be interesting and attractive. They reported that they liked the pictures and that they liked the tools even more than the games they play at home. The boys commented on both type of tools with equal enthusiasm. They said that the tool was relaxed and that it was nice to work with. They reported that they liked all parts of the tool and liked it for a change. One of the boys reported that a tool was "state of the art."

With respect to whether students prefer educational tools or schoolbooks, we see a difference between the less inclusive tools and the more inclusive tools. For the less inclusive tools, boys were more explicit in their preference of educational tools above schoolbooks than girls were. Boys reported that they liked to work with the tools and that it was easier than working with schoolbooks. In contrast, both boys and girls preferred working with the more inclusive tools to schoolbooks. For example, girls mentioned that these tools were nicer to work with, were more attractive and captivating, were more interesting, and offered more variation than schoolbooks.

Finally, when it comes to working with technology at school in general, most students reported that they like it. Boys and girls agreed in their opinions. One student mentioned that she likes working with technology because it is something other than regular classes, where she has to listen to the teacher all the time. Another student mentioned that it is important that the tools are related to the schoolbooks and are not superfluous. Neither boys nor girls reported difficulties with working with technology in school, although they did differ in the way they reported this to the researcher. Generally boys said straight away that they are good at working with computers, whereas the girls seemed to be a bit shy at first.

In conclusion, there are indications that girls' attitudes are less positive than the attitudes of boys with respect to the less inclusive tools. It seems that girls like these tools less than boys and find these tools less easy to work with than boys. The girls' attitudes are more positive toward the more inclusive tools, compared to the less inclusive tools.

Participation

Based on the observations and interviews, we analysed students' participation in class. The overall classroom observations showed that students working with less inclusive tools are less involved and actively participating compared to students working with more inclusive tools. For example, some of the students using less inclusive tools were chatting online (using MSN), talking louder, or asking irrelevant questions, although students generally concentrated and worked seriously with the applications. Student observations and interviews confirmed these general class observations: Students' participation was better in the classes with the more inclusive tools. Moreover, differences

between boys and girls appeared. Girls' participation was better in lessons in which more gender-inclusive tools were used, compared to lessons in which less inclusive tools were used. Boys' participation was about the same in both types of tools.

Student observations of the less inclusive tools showed only one of the girls working well and being concentrated. The other girls were not really concentrating and not very actively involved in working with the tools. These girls seemed to be busy with other off-task matters such as writing e-mails or chatting with other students, looking away, working on another course, or talking with their peers. In the interviews, these girls indeed were not very positive about the specific contribution of the educational tool to their participation. For example, two girls said they can concentrate well because they never have problems with concentration and that this has nothing to do with the tool they are working with. Two other girls argued that their concentration is influenced by more or less "buzz" and noise in the classroom, which distracts them from their work. One of them said she is able to concentrate better in regular lessons. Only one of the girls was more positive about the contribution of the educational tool to her participation.

In contrast, most boys working with the less inclusive tools were observed to be on task and sometimes collaborated with their peers. Only one of the boys clearly had problems concentrating and working well; he walked away from the computer to look at what other students were doing, talked loudly and made fun, interfered with other matters, and used Google, which was not part of the task.

The better participation of boys was reflected in the interviews. Boys were more positive about their concentration and involvement with the tool than girls were. Most of the boys said they can concentrate well while working with the tools. They preferred working independently, searching for answers on the Internet, and working with concentration to finish the task faster and avoid homework. Only one boy was a bit less positive, reporting that he starts to talk with peers and loses concentration when it becomes boring.

The results concerning the more inclusive tools show remarkable differences compared to the results concerning the less inclusive tools. The participation of girls was about the same as the participation of boys. Most boys worked hard and concentrated on the task, and girls were also working actively and appeared to be concentrating and involved. Some girls collaborated with their peers, others worked individually with only some minor interruptions from their neighbours.

Again, the class observations are confirmed by the student interview data. The girls reported that their concentration was better while working with the tools than while working with the instruction and exercise books. Girls said they liked and were captivated by working with the tools, as they could work independently and search for information actively. The opinions of boys varied a bit depending on the subject. Overall they said they could concentrate well while working with the tools. While some boys were not captivated, others were interested.

To summarize, we found differences in student participation. More specifically, girls who worked with the more inclusive tools participated more actively in class and were able to concentrate more than girls who worked with the less inclusive tools. The results do not show differences between the tools in boys' participation.

CONCLUSIONS AND DISCUSSION

In the present study, we used the concept of gender scripts, which refers to the gendered user representations that are unintentionally built in the design of technology, to understand mechanisms on gender inclusiveness at the experiential curriculum level. Although learning supported by computers is supposed to be motivating for students (Becta, 2006; Ruthven et al., 2004) and is, therefore, assumed to have positive effects on learning experiences and results, there are indications that the use of technology in education still affects girls and boys differently. In this study we investigated the relationship between the inclusiveness of particular educational tools in classroom practice and different learning experiences of girls and boys.

The results showed some gender differences in learning experiences when boys and girls use educational tools in class. Both boys and girls seemed to benefit more from more inclusive tools than from less inclusive tools, but for girls the difference between the tools was more prominent. In our study we found gender differences in the attitudes of boys and girl towards educational tools and toward learning in relation to the inclusiveness of the tools. Girls working with the less inclusive tools were the least enthusiastic about the tools, compared to the other girls and to the boys. Moreover, girls worked more easily with the more inclusive tools.

These gender differences in attitudes might have larger consequences, as girls' learning performances have been found to improve when educational tools address their interests (Joiner et al., 1996). Ease of use is particularly important for girls, as they report less ICT knowledge than boys (Volman & Van Eck, 2001) and generally show a lack of self-confidence in ICT matters (Agosto, 2001).

Furthermore, our study showed that girls concentrated more and were actively involved in working with more inclusive tools, compared to girls working with the less inclusive tools. It is striking that the inclusiveness of the tool does not seem to affect boys in this respect; they do not show much difference in participation between more inclusive and less inclusive tools.

The final result from our study is that girls who worked with the more inclusive tools reported that they learned more and showed more enthusiasm about what they learned compared to girls who worked with the less inclusive tools and to boys. In general, girls seemed to value more inclusive tools because of the feedback and support of self-esteem these tools provide. These results show similar patterns as those pointed out by Joiner et al. (1996) in the learning performances of boys and girls in relation to interesting subjects in educational tools. Learning performances of boys are not different whether they are interested in the subject or not, whereas girls' learning performances improve when an interesting subject is provided.

We would like to point out that our study is small scale, with data from six teachers working with six tools in four classes with 81 students. The sample size limits the generalizability of the results. Moreover, we selected our schools for this study on the basis of some criteria, one of which was the experience with the use of educational tools. It might be that the gender differences we found cannot be replicated in a study with a larger, more representative data set. The idea behind the selection has been that the subjects need some experience at school with educational tools in order for their gender differences in the use of educational tools to be studied. Having a larger data set provides the possibility to study gender differences in schools that use technology less extensively. For the time being, we do not have reason to believe that our results are valid only for schools that are forerunners of ICT. A study of more schools and more differences in ICT use between selected schools, however, would allow the opportunity to look closer and more precisely at differences between students. Gender is just one axis that students differ from each other.

Second, we would suggest focusing future studies on the explanation of design principles or elements of the educational tools that cause gender differences. For example, a study design or experiment design of various educational tools might give us more possibilities to explain (minor) changes in the formal and/or operational curriculum level responsible for differences in learning and learning experiences between boys and girls. In an earlier study (Heemskerk, et al., submitted 2008a), we explored appreciations of students in relation to technology in education showing that girls value an interesting subject more than boys and appreciate tools that are easy to work with and that include clear, step-by-step instructions and clear help functions. Boys, more than girls, appreciate pictures in the tool and the possibility to compete. However, more research is needed to understand the nature of the relationship between the inclusiveness of the educational tools and learner experiences. Moreover, the relationship between the inclusiveness of educational tools and learning results remains unknown.

Finally, we limited our study to the investigation of educational tools in language and social courses to avoid obvious differences between boys and girls related to more technical courses. Because inequalities between boys and girls are still more prominent in mathematics and science courses, such a comparison might reinforce differences in relation to the use of educational technology. Research on inclusiveness of educational tools in these courses, however, may be interesting and relevant in relation to differences between boys and girls in their choices of courses or studies.

We would like to finish with the conclusion that students' learning experiences can be improved by the use of more inclusive educational tools. The results of our study indicate that the extent of inclusiveness of the tools does not matter much to boys, whereas girls' learning experiences are positively affected by the use of more inclusive tools. This is remarkable, because gender inclusiveness of educational tools is supposed to imply that the tools are attractive and challenging to both girls and boys. In the index of inclusiveness, we distinguish between the inclusiveness of the content, the visual and audio interface, and

the instructional structure of educational technology. Generally, we considered educational tools to be more inclusive if they provided more ways for students to identify with the subject matter and different ways of working and learning. The results support the idea that less inclusive tools trouble girls and might address mainly the needs of boys. Some authors indeed argue that computers and software are predominantly male artefacts (Li & Kirkup, 2007) and that educational software is often unintentionally tailored to the interest of boys (Huff & Cooper, 1987, cited in Cooper, 2006). The more inclusive tools, in contrast, might address both boys and girls, leading to optimal learning experiences for all students. Inclusiveness of educational tools can be improved by changing the gender scripts in the design and/or by modifying the inclusiveness of the tools in educational practice. As it is common practice in Dutch secondary education that teachers design or at least choose the educational tools that they use in class, teachers should be aware of gender scripts in these tools. The index of inclusiveness might help teachers increase their awareness and, consequently, adjust their teaching. The differences between the tools in our research show that it is possible to improve the inclusiveness of the use of educational tools in schools to such an extent that it affects whether students learn positively. Future research should systematically investigate the effects of inclusiveness of (the use of) educational tools on students' learning outcomes.

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