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Author	I.M.C.C. Heemskerk
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Chapter 1

INTRODUCTION

The use of technology (Information and Communication Technology, ICT) in education is inevitable in current society. From an economical and social point of view, it is argued that the labour market requires ICT-skills and students should be prepared for the information society. Schools nowadays are usually well equipped for implementing ICT in education and learning. Schools for primary and secondary education in the Netherlands have one computer available for seven students, access to the Internet is about 100 per cent for schools in secondary education and 87 per cent in primary education (Vier in Balans Monitor, 2007). The way in which technology is used has largely shifted from learning about ICT to learning with ICT. Although many teachers still experience the need for more useful digital learning materials and content, the potential of educational software for improving the quality of education is tremendous and promising. In addition to particular educational software, such as programs for drill and practice, instructional programs, simulations and games, a number of general programs are being used as educational tools (e.g., word processing programs, databases, spreadsheets and power point). Finally, e-mail and the Internet, in particular, have become important learning tools. However, as recently reported by Balanskat, Blamire and Kefala (2006), the lack of suitable educational software is still considered an important hindrance for the further development of technology in education.

Educational tools can be used to substitute traditional learning, but it is claimed they can also be used to promote a new kind of learning in which teachers support and coach students' learning processes instead of mere transmittion of knowledge (e.g. Bransford, Brown, & Cocking, 1999; De Corte, Verschaffel, & Lowyck, 1996; Volman, 2003). Simulations and multimedia programs, for example, offer opportunities to engage students in solving authentic problems encountered in daily life. The Internet makes it possible to provide problems and assignments that are authentic and up-to-date, and facilitates communication with the world outside school.

Educational technology has the potential to facilitate differentiation and individualization in education: it makes it possible to tailor both the content and the presentation of the subject matter to the individual backgrounds, experiences and

needs of students (e.g., DeVoogd, 1998; Gillani, 2000; Volman, 2003). Students seem to be motivated to learn, to learn faster, and to learn more when educational technology is used at school (Becta, 2006; Ruthven, Hennessy, & Brindley, 2004; Vier in Balans Monitor 2007). However, there are indications that not all students equally benefit from the advantages of ICT in education. Since technology has been introduced in education, differences between students are related to gender and the socio-cultural background of students. From the viewpoint of equality in education, differences between students in relation to the educational use of technology, should be taken into account. This thesis aims to explore selective effects of educational use of ICT on boys and girls and students with different socio-economic and ethnic backgrounds.

1. DIFFERENCES BETWEEN STUDENTS IN RELATION TO ICT

The relationship between the use of ICT and equality in education is far from unequivocal. Whereas some claim that the use of educational technology favours disadvantaged students, others have pointed out several ways in which technology may cause or increase inequality in education.

Firstly, although the digital divide in access to ICT is diminishing (De Haan & Huysmans, 2002; Steyaert & Gould, 2007), D'Haenens (2003) reported remaining issues in access to a PC, CD-ROM, and/or Internet connection for ethnic minorities in comparison with their ethnic majority peers. Furthermore, socio-economical background is the most important determinant in access to computers at home (OECD, 2006). Moreover, more subtle mechanisms of inequality in relation to ICT are of importance. Some authors point out that the digital divide has shifted from computer access, to computer use. Differences in skills to use ICT in relation to strategies and information in a network society still follow the traditional lines of social inequality (De Haan & Huysmans, 2002; Van Dijk, 2003). Students start to acquire most ICT knowledge and skills at home (Vier in balans monitor, 2007). Teachers often suppose that students who manage to deal with computers have enough skills to search for information on the Internet as well (De Haan & Van 't Hof, 2006). A teacher's expectation that students are skilful computer users may be a disadvantage for those who have not acquired the necessary skills. Especially exploring the Internet in a useful way in education, can be assumed to be related to students' backgrounds. Hargittai and Shafer (2006), for example, investigated gender differences in adults' web-use skills. Their results suggest that males benefit more from the web than females because of their higher self-assessed ICT abilities. In primary and secondary schools, girls report generally fewer ICT skills and less ICT knowledge than boys do (Volman & Van Eck, 2001).

Secondly, schools appear to differ in the ways ICT facilities are used. Poor and minority-group students are more likely to use the computer for drill and practice activities, whereas their white peers are more likely to use advanced technology and/or the Internet (Volman, Van Eck, Heemskerk, & Kuiper, 2005). Also within schools differences occur between students in the extent and the kind of computer and Internet use (Solomon, 2002; Schofield & Davidson, 2002). For example, girls

take fewer technology classes in high school than boys (Pinkard, 2005), and girls e-mail more often at school than boys (Volman et al., 2005).

Thirdly, apart from how ICT is used at school, other important factors determine students' experiences while working with educational technology at school. These factors are students' experiences with ICT outside school, and their interests, attitudes and learning approaches. These factors tend to be different for boys and girls (Christensen, Knezek, & Overall, 2005; Cooper, 2006), and for students with different socio-cultural backgrounds (Damarin, 2000). For example, computer attitudes of girls are still found to be less positive than those of boys; girls feel less confident in working with ICT (Colley & Comber, 2003; Li & Kirkup, 2007) and they value the influence of computer knowledge on their future jobs less than boys do (Volman et al., 2005). Li and Kirkup (2007) investigated differences between Chinese and British students in Internet use. They found that British students are more likely to use computers for study purposes than Chinese students. They also found Chinese students to be more self-confident about their advanced computer skills whereas British students are more self-confident about using applications such as word-processing. These differences are explained by different points of attention in computer education in the two countries, and the different ways in which ICT is used in education.

The appeal of applications to different groups of students has, in particular, been described in the literature on gender and technology (Volman & Van Eck, 2001). Gender differences in ICT knowledge and skills, in participation in activities involving computers at school, and in computer attitudes have been explained by pointing out that computer games and other educational software are often unintentionally tailored to the interest of boys (Cooper, 2006). The development of gender-inclusive educational software has been advocated for many years now. More recently, similar arguments have been formulated in relation to differences between ethnic or cultural groups, and a plea has been made for increased socio-cultural sensitivity when the use of ICT in education is concerned (e.g., Gillani, 2000; Wang & Reeves, 2007).

2. SOCIAL SCRIPTS IN ICT

The sociology of technology can contribute to the understanding of how the design of educational tools may inhibit the active involvement of students in learning. Analyses from a sociology of technology approach show that technological artefacts are never neutral, but always imply human choices which are embedded in a cultural context. Assumptions about how the supposed user will use the artefact are incorporated into the design of, for example, bicycles, microwave ovens and electric shavers (Oudshoorn, Saetnan, & Lie, 2002). These assumptions can change over time. For example, bicycles were initially designed for young, sportive, male users, unfit for women wearing long dresses. Later on, producers introduced other models, which suited women more. Similarly, computers and software, including educational software, are not neutral media (Chisholm, 1995). Assumptions about the supposed user – or 'scripts' (Woolgar, 1992; Akrich, 1995) – are built in. Such assumptions may pertain to the prior knowledge, learning approaches, interests and attitudes of students, or to the effectiveness of ways of structuring the curriculum or organizing student

activities (De Vaney, 1998). It has been pointed out that computers and software are predominantly Western, white and male artefacts, and that both computers and the Internet are still characterised as 'masculine' (see Li & Kirkup, 2007). The resulting scripts will usually function unintentionally, as a part of the 'hidden curriculum'. When these scripts are not suitable for certain groups of students and these students are not able to identify with the supposed user, this may inhibit their learning.

At the same time, users of technology do not necessarily need to accept the scripts constructed by the designers. Scripts can be modified or rejected. Oudshoorn, Rommes, and Stienstra (2004), describe how in processes of 'domestication' new meanings can be created or how new usage of objects can be created. Finally, users can become non-users. These processes are situated in a cultural context, in which cultural codes are important. For example, gender codes play an important role in processes of domestication of the Internet (Van Zoonen, 2002). In an educational context, teachers play a role in modification of scripts, while they coach their students in the use of the application, and they can choose whether they use the application in their classes or not. Modifications of scripts initiated by students may be difficult. Students are supposed to use the selected tools, and they are supposed to use it in a way which is limited by the boundaries teachers offer. Using technology which does not suit students may lead to a loss of their involvement and engagement. In the end, this can result in differences in participation, attitudes and learning outcomes (Van Eck & Volman, 1999). Oudshoorn, Saetnan, and Lie (2002) elaborated the concept of scripts as 'gender scripts', in order to indicate the inscriptions and de-inscriptions of representations of masculinities and femininities in technological products. In this thesis we extended this concept to 'social scripts', which refers to scripts which may be related to gender as well as socio-cultural characteristics, resulting in more or less inclusiveness of educational tools to different groups of students.

The different levels in which scripts and inclusiveness of technology show, is approached from the perspective of curriculum theory (see Goodlad, Klein, & Tye, 1979; Van den Akker, 1998). In this theory, manifestations of the curriculum are distinguished in six curriculum levels; the ideal, the formal, the perceived, the operational, the experiential and the realized curriculum level. ICT as an educational tool can be seen as a curriculum product with manifestations at all these levels. In this thesis the formal, operational and experiential curriculum level are addressed. The formal curriculum level refers to the design of the tool, and the operational curriculum level refers to the way in which the application is used in classroom practice by teachers and students. Finally, the experiential curriculum level refers to students' experiences using the educational tools.

3. SOCIAL SCRIPTS AND LEARNING

From a constructivist perspective the importance of meaningful learning is particularly emphasized (Lave & Wenger, 1991; Ten Dam, 1999). Meaningful learning implies learning activities that suit students' prior knowledge, personal experiences, attitudes and skills. Students should be offered the possibility to identify with the

subject matter and the way it is presented, and each student should feel both comfortable and challenged when working with educational tools. Social scripts in the design of educational technology may promote or hinder meaningful learning for specific groups of students. In other words, educational tools can be more or less inclusive to students with different socio-cultural backgrounds, and to boys or girls. Teachers may deal with this point in various ways, their actions may diminish or reinforce the inclusiveness of the educational tool. As 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. So, in addition to the social scripts in educational tools, teachers' awareness of inclusiveness is related to the inclusiveness of the tools as enacted in classroom practice. Sensitivity to social scripts that implicitly and unintentionally exclude particular groups of students presupposes insight into the elements that make software attractive and pleasant to work with for all students. Students' appreciation of specific characteristics of educational tools and learning experiences in classroom practice, may be related to students' socio-cultural background and gender.

4. RESEARCH QUESTIONS AND STUDIES

The selective effects of the use of educational technology on different groups of students will be central in this thesis. The opportunities and risks associated with the use of computers of the teaching-learning process will be analyzed from the theoretical perspective that 'assumptions about the user' (scripts) are built into technological products. In this thesis three curriculum levels are addressed in order to understand how scripts and processes of domestication function in relation to inclusiveness of educational technology. Distinguishing between various levels of curriculum is necessary since inclusiveness of technology can work out differently at different curriculum levels. The inclusiveness of a tool at the formal curriculum level, does not by definition determine how the tool is used by the teacher (operational level) or is experienced by students (experiential level). The problem definition is: "What scripts are inscribed in the design of the tools and the use of technology in secondary education and how do these scripts work out for boys and girls and for students with different socio-economic and ethnic backgrounds?" This problem is laid out in four research questions.

Not much is known about the selective effects of technology. Therefore, we conducted a review study. The aim of the review is to obtain an insight into scripts and to assign the underlying characteristics built into applications that may enhance or unintentionally restrict the attractiveness and accessibility of learning to different groups of students. This literature review is on gender inclusiveness and socio-cultural sensitivity on ICT in primary and secondary education. The results are used to assign an 'index of inclusiveness'. So, the first research question can be formulated as:

1) How and to what extent do the characteristics of educational technology enhance or inhibit learning for different groups of students?

This index of inclusiveness is used in further studies. In order to get insight into the selective effects of specific educational tools, a small-scale qualitative empirical study has been set up. Four schools of secondary education participated with a mixed student population and well implemented technology facilities. The inclusiveness of the design of different educational tools, which were used at the participating schools, has been analyzed at the formal curriculum level. The analysis of the tools was based on the 'index of inclusiveness' as presented in the review study. The aim of the analysis is to see whether educational tools can be distinguished in more or less inclusive for groups of students with a different gender or socio-cultural background. The analyzed applications have been observed in classroom practice (operational curriculum level). These observations were structured by instruments based on the 'index of inclusiveness' and describe how teachers use the tools in interaction with their students, and how students use the tools. So, the second research question can be formulated as:

2) How are the social scripts of inclusive and non-inclusive tools enacted in classroom practice in terms of teacher and student behaviour?

The relation between the formal curriculum level and the operational level is only one aspect which might be interesting to examine with respect to possible selective effects of tools. The preferences of students also influence the selective effects of tools. In order to investigate these preferences in relation to the index of inclusiveness, a survey has been administered to students from schools for general secondary education in the Netherlands. This questionnaire has been developed on the basis of the literature in our review on socio-cultural sensitivity and gender-inclusiveness in educational software. The preferences of boys and girls and students from different ethnic backgrounds were related to various characteristics of educational tools (experiential curriculum level). So, our third research question is:

3) How are gender and ethnic background of students related to their appreciation of educational technology in secondary education?

Differences between boys and girls in relation to technology is an aspect which is most prominent and well investigated in the literature on ICT in education, and it is one of the effects found in the former part of this research project. In the final part of the research, we explored the relationship between the supposed inclusiveness of particular educational tools at the formal and operational curriculum level on one hand, and the actual experiences of students with these tools on the other hand. We investigated experiences of boys and girls in relation to specific educational tools in the four schools which also participated in the research on the operational curricu-

lum level. Student interviews and learner reports, supported by class and student observations, have been used to gain insight in learning experiences of boys and girls. In this, we focus on students' attitude, participation and learning results (experiential curriculum level). Our fourth research question can be formulated as:

4) In what way is the inclusiveness of educational technology related to the learning experiences of boys and girls?

In Table 1, we show the research questions of the empirical studies in relation to the three distinguished curriculum levels; the formal, the operational, and the experiential. For each level we indicate the investigated research materials/actors (research objectives), the relation to inclusiveness, the variables, and the research instruments of the respective studies.

Table 1

Research questions.

	Formal curriculum level	Operational curriculum level	Experiential curriculum level	Experiential curriculum level
Research objectives	Design of tools	Teacher behaviour Students' behaviour	Experiences of boys and girls	Students' experiences
Relation to inclusiveness	Inclusiveness of social scripts	Enacted inclusiveness	Effect of inclusiveness on learning experiences	Appreciations of students
Variables	Items of the index of inclusiveness	Teaching behaviour in terms of the index of inclusiveness. Participation of students.	Learning experiences; Attitude Participation Learning results	Appreciations of students related to items of the index of inclusiveness
Instruments	Operationalization of the index of inclusiveness	Teacher/ class observational instrument	Learner reports Student interviews	Questionnaire based on the index of inclusiveness

		Student observational instrument	Student observational instrument	
Research question	2	2	3	4

Note: Research question 1 has been addressed in the review study.

5. LAYOUT OF THIS THESIS

In chapter 2 we present our review of the literature on gender inclusiveness and socio-cultural sensitivity related to ICT in primary and secondary education.

In chapter 3 we examine inclusiveness of educational tools in classroom practice. We investigate the social scripts in the design of particular educational tools. Furthermore, we analyze the inclusiveness of educational tools as enacted in classroom practice.

In chapter 4 the results of a survey, considering students' appreciation of characteristics of educational tools, are presented and discussed.

In chapter 5 educational tools are examined in relation to students' experiences. The aim of the study is to explore learning experiences of students while working with more or less inclusive educational tools in the classroom. We focus on differences between girls and boys.

Finally, in chapter 6, we present a summary of the results of the studies, followed by a discussion of the main results.