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SUMMARY

The use of technology (Information and Communication Technology, ICT) in education is inevitable in the 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. The potential of educational software for improving the quality of education is tremendous and promising. An important advantage of the use of technology in education is the facilitation of differentiation and individualization in education. Moreover, students seem to be more 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. Differences between students are associated with, for example, gender and the socio-economic and ethnic background of students. From the viewpoint of equality in education, these differences between students should be taken into account if educational technology is used.

This thesis aimed to explore selective effects of educational use of ICT on girls and boys and on students with different socio-economic and ethnic backgrounds. Therefore, we combined the concept of 'scripts' derived from a sociology of technology approach with the perspective of curriculum theory.

The concept of 'scripts' indicates that technological products are never neutral, but always imply human choices which are embedded in a cultural context. Assumptions about the supposed user are incorporated into the design of technical products, such as computers and software, including educational software (Akrich, 1995; Woolgar, 1992). The resulting scripts will usually function unintentionally, as a part of the 'hidden curriculum'. When these scripts do not suit certain groups of students and these students are not able to identify themselves with the supposed user, this may inhibit their learning. At the same time, users of technology do not necessarily need to accept the scripts as constructed by the designers. In processes of 'domestication' they can modify the scripts, or they even may reject them (Oudshoorn, Rommes, & Stienstra, 2004). 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. Modifica-

tions of scripts initiated by students may be difficult. Students are supposed to use the selected tools, and they are supposed to use them 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). In this thesis, we elaborated the concept of script as 'social scripts' which refer 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, Frances, & 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 levels are addressed.

The formal curriculum level refers to the design of the tool. 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 either boys or girls. The operational curriculum level refers to the way in which the application is used in classroom practice by teachers and students. Teachers may deal with inclusiveness in educational technology in various ways, their actions may diminish or reinforce the inclusiveness of the educational tool. Finally, the experiential curriculum level refers to students' experiences when using the educational tools. 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 how it is experienced by students (experiential level). Teachers can use a less inclusive tool in a more inclusive way (and the other way around), and students may be more or less affected by the scripts incorporated in a tool.

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 both may be related to students' socio-cultural background and gender.

The problem definition of the research was: "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?". The research project consisted of three types of research: a review study, a survey and qualitative studies. The research was reported in the chapters 2 through 5 by addressing the following research questions:

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

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

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

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

CHAPTER 2

In this chapter, the results of a literature review on gender, ethnic and socio-economical status differences related to ICT in primary and secondary education were presented. The aim of the review was to obtain more insight into scripts and the design characteristics of applications that may enhance or unintentionally restrict the attractiveness and accessibility of learning to different groups of students (research question 1: How and to what extent do the characteristics of educational technology enhance or inhibit learning for different groups of students?). The review included literature on empirical studies, and reflective theoretical or practice-oriented articles. A number of characteristics relevant in terms of gender or socio-cultural inclusiveness of educational technology, are discussed. Three main topics could be distinguished, into which these characteristics could be grouped: the content, the visual and audio interface, and the instructional structure of the educational tools. A common argument in the articles is that the subject matter should be meaningful to all students, and students should be able to identify themselves with the content and audio and visual interface of the educational tool. For example, different interests and preferences should be taken into account. Secondly, it is argued that the learning process should be structured or facilitated by the tool in such a way that it suits different groups of students. Students should feel both comfortable and challenged when working with the tool. For example, different levels of prior knowledge and different learning activities should be addressed. The results were used to design an 'index of inclusiveness', in which these elements were eleborated. The chapter concludes with a discussion of dilemmas associated with the idea of the index and suggestions for its use in research and educational practice.

CHAPTER 3

In this chapter, we examined the inclusiveness of educational tools in classroom practice (research question 2: How are the social scripts of inclusive and non-inclusive tools enacted in classroom practice in terms of teacher and student behaviour?). A small-scale qualitative empirical study has been conducted at four schools of secondary education. Participating schools had a mixed student population and well implemented technology facilities. We considered two different curriculum

levels (formal and operational curriculum level), in order to gain insight into the selective effects of particular educational tools.

Firstly, the inclusiveness of the design of seven educational tools, which were used at the participating schools, has been analyzed at the formal curriculum level. The instrument for the analysis of the tools was an elaboration of the 'index of inclusiveness' as presented in the review study. The analysis showed that educational tools indeed differed in the extent of inclusiveness for different groups of students, particularly in their instructional structure. The tools could be distinguished to be less, or more inclusive tools.

Secondly, 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 described how teachers use the tools in interaction with their students, and how students use the tools. The results of the study suggested that at the operational curriculum level teachers hardly modify the social scripts in the design of the educational tools. Moreover, teacher behaviour that might be interpreted as reinforcing the inclusiveness of the instruction was shown more in relation to the tools that were already more inclusive, compared to the less inclusive tools. The tools which 'needed' the modifications mostly, were not adjusted.

The inclusiveness of educational tools seemed to affect student activities. When more inclusive educational tools were used, all students participated more actively, they read the texts better, they asked fewer questions and they collaborated more. Furthermore, the results indicated that more inclusive tools enhance student activities which suit girls and minority students more than the less inclusive tools do.

We concluded the chapter with the argument that tools indeed seem to evoke selective effects, which affect students' learning activities. As in the Netherlands teachers design or at least choose the tools they use in their classes, teachers' awareness of inclusiveness of educational tools seems to be relevant.

CHAPTER 4

In order to improve our understanding of which characteristics of educational tools determine inclusiveness, it was important to consider the appreciation of different groups of students in relation to the index of inclusiveness. In chapter 4, the results of a survey were presented and discussed (research question 3: How are gender and ethnic background of students related to their appreciation of educational technology in secondary education?). The survey has been administered to 495 students in the 8th and 9th grade (age 13-15) from 9 schools for general secondary education in the Netherlands. This questionnaire has been developed on the basis of the literature in our review on cultural sensitivity and gender-inclusiveness in educational software. We investigated to what extent students from different gender and ethnic backgrounds appreciated various characteristics of ICT tools (experiential curriculum level). Students had to answer the questions with a specific tool in mind, which they preferred working with. The same questions had to be filled out in relation to a tool which they did not like to work with.

Our study on students' appreciation of ICT tools showed that the gender differences generally confirm differences reported in the literature (see chapter 2). We argued that, although girls find it important that applications are supportive and easy to work with, it seems obvious that such a design of the instructional structure is beneficial to all students. Suggestions to make a tool more attractive to boys were to include a competitive element or a game as an extra feature, as well as to present a choice of images.

The differences between ethnic groups in the Netherlands appeared to be related to language achievements and ICT skills. Some minority groups were attracted to applications with explanatory images, which required less reading. Other minority students felt it was necessary to understand the language well. All the minority groups in the study stressed the importance of ICT skills. To make a tool more inclusive to students from different ethnic backgrounds, it seemed to be important to take into account different levels of prior knowledge, especially regarding computer skills and language. The results of the study showed that the questionnaire is an appropriate instrument for distinguishing between tools which are positively or negatively evaluated by different groups of students. Several index elements which are of importance to specific groups of students, are also important to other students. While students reported that they learned more when working with the tool they appreciated most, we would suggest that the improvement of these elements of an ICT application seems to be useful for all students, but for girls and students from minority groups, in particular.

CHAPTER 5

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. In our previous empirical research, we also found differences between boys and girls. In the study, reported in chapter 5, we further explored these differences. We investigated 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. We investigated students' experiences in relation to specific educational tools in the four schools which also participated in the research on the operational curriculum level (research question 4: In what way is the inclusiveness of educational technology related to the learning experiences of boys and girls?). Student interviews (n= 24) and learner reports (n= 160), supported by class observations (n= 12) and student observations(n= 24), have been analyzed to gain insight in learning experiences of boys and girls. The learning experiences we examined comprised students' attitude, participation and learning results (experiential curriculum level).

The results indicated that inclusiveness of educational tools do affect learner experiences. Students' learning experiences generally can be improved by the use of more inclusive educational tools. However, the extent of inclusiveness of the tools does not seem to matter much to boys, whereas learning experiences of girls are quite different in favour of the 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. The chapter concluded with a discussion on these results.

CHAPTER 6

In the final chapter, we presented a summary of the results of the studies, followed by a discussion of the main results, and recommendations for future research and educational practice.

In this thesis, differences between students in relation to technology were traced on the basis of a review study on gender inclusiveness and socio-cultural sensitivity, which resulted in an index of inclusiveness. The index was the basis of our research on inclusiveness of different curriculum levels of educational technology.

In sum, the research proposed that scripts are built in the design of educational tools. At the operational curriculum level scripts are not essentially modified. We concluded that the design of the tools seemed to determine the inclusiveness of educational tools. We proposed the alternative conclusion that teachers' awareness of inclusiveness plays a crucial role in how inclusiveness of educational tools works out in class, as in the Netherlands teachers commonly design or at least choose the tools they work with. In Dutch educational practice, the formal and the operational curriculum level seems to be closely connected.

Another point of reflection posed the question whether inclusiveness of educational tools addresses general characteristics which refer to powerful principles of learning for all students (e.g. Dewey, 1916; De Corte, 2000) in educational theory, or to principles of learning especially suitable for girls (AAUW, 2000) and minority students (Wang & Reeves, 2007). We argued that the results support the idea that less inclusive tools bother girls, and might address mainly the needs of boys. The more inclusive tools, in contrast, might address both boys and girls. We proposed that the use of inclusive educational technology seems to provide good quality teaching, which means that it supports the learning of students with different gender and socio-cultural backgrounds.

Finally, we reported some issues in relation to the scope of the research and we put forward recommendations for future research. In addition, some recommendations for educational practice were proposed. We pointed out that students' learning experiences in general can be improved by the use of more inclusive educational tools. Girls and minority students seemed to benefit most of inclusive technology. We recommended attention to various characteristics in the design of educational tools, in relation to the index of inclusiveness. Furthermore, we suggested that teachers' awareness of inclusiveness is an important topic, which should be paid attention to in teachers' education.