

Integrating critical Web skills and content knowledge: Development and evaluation of a 5th grade educational program

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Available online 12 March 2007

Abstract

Although the Web is almost omnipresent in many children's lives, most children lack adequate Web searching skills as well as skills to process and critically evaluate Web information. In this article, we describe and evaluate an educational program that aimed at acquiring Web skills in the context of a content knowledge domain. Through a multiple case study design we wanted to gain insight into the contextual factors that influence the realization of such program and into the learning gains in the participating classes in terms of content knowledge and Web skills. Four 5th grade teachers carried out the program, which consisted of eight weekly sessions and focused on teaching students Web searching, reading and evaluating skills within the subject of healthy food. Data from a variety of sources were collected: videotaped and written lesson observations, interviews with teachers and students, teacher diaries, student questionnaires and student assignments. The results show that the teachers appeared to be able to carry out the program to varying degrees. Contextual factors that influenced the realization of the program were partly related to specific conditions as the investment of time and effort by the teacher and the school's way of organizing computer work and its supervision. The extent to which teachers' teaching styles corresponded with the program's assumptions also played an important role. Students' knowledge and skills improved during the program with regard to both content knowledge and Web skills. However, most students appeared to remain inconsistent Web users, and did not act upon their knowledge of Web searching, reading and evaluating skills. Although generally speaking there were differences between stronger and weaker performing students, all students showed unexpected, inconsistent or inflexible behavior.

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1. Introduction

It is impossible to imagine children's lives today without the Web. They use it for gaming, for instant messaging and downloading their favorite music. They are also adept at becoming Web authors themselves by constructing their own websites. Children often perceive the Web as a user-friendly resource because it contains a great deal of information as well as pictures that are not only easily accessible, but can be downloaded and relocated for their own purposes. Also at school, many students use the Web; primarily as an information resource, but also as a means of communication and sometimes as a learning environment. The Web certainly is a potentially useful supplement to the educational tools traditionally used in the classroom. However, it has not been designed for use by children, nor for use in educational settings. Moreover, teachers often perceive children's Web skills as better than their own. Children's navigational skills often are, but when it comes to searching, processing and evaluating skills the picture is different. There is ample research showing that, although children may be confident Web users, they often do not have sufficient Web skills at their disposal. Most children lack adequate Web searching skills, as well as skills to process and critically evaluate Web information (e.g., Bilal, 2000; Fidel et al., 1999; Lorenzen, 2001; Schacter, Chung, & Dorr, 1998; Shenton & Dixon, 2003; Pritchard & Cartwright, 2004). As a result, searching for information usually leads to insufficient knowledge, understanding, and insight.

Researchers and practitioners from both library and information science (LIS) and educational science recognized this problem. Library and information specialists have a long tradition in studying the interaction between information resources and their users. Children's Web information seeking behavior has been addressed regularly in recent years. Most studies focus on students' search processes, i.e. the collecting of information. However, the subsequent phase of processing the information is often not addressed (Kuiper, Volman, & Terwel, 2005). Many authors themselves have pointed out this lacuna. Bilal (2002), for example, mentions the ways children's information seeking on the Web may lead to meaningful learning, as an important question for future research.

Educational researchers, on the other hand, are not primarily interested in Web searching processes as such, but in the ways in which the Web may be used for educational goals (e.g., Hoffman, Wu, Krajcik, & Soloway, 2003; Jones, 2002; Wallace, Kupperman, Krajcik, & Soloway, 2000). The Web is seen as a new learning tool that offers new possibilities, but also new challenges for education. Research is focused on the conditions for using the Web as an information resource in the classroom. In such approach, students' lack of Web skills often is countered by offering scaffolds such as a preselection of websites on a certain subject matter (e.g., Jones, 2002) or interfaces that guide students through inquiry activities on the Web (e.g., Hoffman et al., 2003). One could argue that while LIS research focuses primarily on the Web *skills* children should acquire, educational research is also much concerned with the *products* of Web use, i.e. content knowledge children should acquire through using the Web. More recently, reading researchers focusing on reading comprehension processes, have looked more closely at the differences between Web and print reading processes and the searching, reading and processing skills that are conditional for using the Web for knowledge construction (Coiro, 2003; Leu, Kinzer, Coiro, & Cammack, 2004).

Although there is rather ample research on both children's Web search behavior and the way the Web may be used as an educational tool, empirical research on teaching Web skills is relatively scarce and mostly aimed at upper grade and university students (e.g., [Walton & Archer, 2004](#)). However, teaching Web skills is necessary already at the primary school level because children themselves use the Web at a young age. Many schools recognize this need, as is reflected in the abundance of examples of worksheets and lesson plans that can be found on the Web. These 'good practices' mostly refer to certain fragmented aspects of Web skills (e.g., worksheets with practical guidance to help students assess the usefulness of a specific website) and in general are not based on research. By exploring possibilities for creating novel teaching and learning environments with regard to teaching Web skills at the primary school level, our research wants to fill the gap between these 'good practices' and theoretical notions on how children should learn to cope with all difficult aspects the Web implies (e.g., [Burbules & Callister, 2000](#); [Frechette, 2002](#); [Snyder, 2002](#)). In this article, we describe and evaluate an educational program that aimed at acquiring Web skills in the context of a content knowledge domain. We wanted to explore the possibilities for teaching Web literacy skills in an integrated way during one course in which students practiced these skills within one such domain (i.e., 'healthy food').

In our research, we use the term 'Web literacy' to refer to the ability to handle the Web critically. Web literacy is in fact an umbrella term that comprises a combination of various skills regarding the critical and meaningful use of the Web. LIS and educational researchers, as well as reading researchers have elaborated which components such critical Web use could encompass, the former two mostly starting from notions from empirical research (e.g., [Bilal & Kirby, 2002](#); [Brand-Gruwel, Wopereis, & Vermetten, 2005](#); [Enochsson, 2005](#); [Fidel et al., 1999](#); [Shenton & Dixon, 2003](#)), the latter also referring to more theoretical notions on differences between reading print and Web information (e.g., [Bruce, 2000](#); [Coiro, 2003](#); [Leu, 2002](#); [Snyder, 2002](#)). In general, all agree that the size and topicality of the Web imply that students must have good searching skills to be able to find what they are looking for. They also must be capable of making decisions on their own information needs. The Web's accessibility implies that students must be aware of its negative sides and learn to cope with such negative aspects. The use of hypertext makes high demands on critical reading skills because it invites the reader to follow his or her own path through Web texts. The multimodal character of the Web requires specific skills to be able to 'read' all sorts of non-textual information elements as illustrations and animations and to relate these elements to textual information. For the benefit of our research, we distinguish three principal subcategories of skills: Web searching skills, Web reading skills and Web evaluating skills. Searching skills include for example the ability to define appropriate key words and locate relevant information. Reading skills comprise for example, the ability to handle hypertext elements and to explore great amounts of diverse information, as well as knowing what information to use and explore and what to ignore. Evaluating skills include the ability to assess the relevance, reliability and authority of Web information.

In our research on teaching Web skills, we take an interdisciplinary approach. We try to combine the focuses of LIS and educational research in designing educational programs that aim at teaching both Web skills and content matter. LIS researchers argue that children need to be taught relevant Web skills to grow into competent information literate persons. However, educational researchers are right in emphasizing the importance of knowledge and insight as products of all information seeking processes. We think there certainly is a task for education in both respects.

In looking for ways for schools to fulfill this task, we argue from socio-constructivist theories on teaching and learning. Socio-constructivist theories suggest that students should be activated to construct their own knowledge, building on what they already know and can do. Constructing knowledge is seen as a preferably non-individual activity; collaboration with fellow students can enhance knowledge building, since it challenges students to assume an active role (e.g., Van der Linden, Erkens, Schmidt, & Renshaw, 2000). The role of the teacher in constructivist teaching no longer lies in the transmission of knowledge, but in providing students with support in their learning processes. This is reflected in alternation of teacher-guided instruction, whole class discussion and students working individually or in groups. Elements of constructivist learning environments are the centrality of an ill-defined, authentic problem that drives student learning, teacher support through modeling, coaching and scaffolding, and the use of a variety of learning tools (Jonassen, 1999).

When connecting these learning principles with the aim of teaching critical Web skills, we want to argue that within socio-constructivist ways of teaching, skills are acquired within a relevant and meaningful context. As a consequence, students should not be taught Web skills through isolated assignments or worksheets that treat these skills as separate entities, as is practice in many schools. By embedding the teaching of Web skills within teaching and acquiring content matter, the intention is that these skills become meaningful for students. Students should foremost gain insight in the connection and interrelatedness of these skills, as well as their functionality. Although randomly surfing is a preferred activity by both children and adults, at school children have the opportunity to experience the advantages of using Web skills.

We designed an 8 weeks program for 5th grade teachers and their students (aged 10–11 years old) on the subject healthy food. In the lessons, the teachers offered the students instruction on Web searching, reading and evaluating skills. The students got structured assignments to practice these skills; all assignments focused on aspects of healthy food and used or required the use of websites on this subject. The teachers also discussed both the Web skills and the subject with the students.

By studying the program in four different class contexts, we expected to gain insight into the contextual factors that may influence its possibilities and limitations. The evaluation of the program, being explorative in nature, was guided by the following research questions:

- How do the teachers implement the program and how do contextual factors influence the realization of the program?
- What are the learning results of the program in the participating classes in terms of both content knowledge and Web skills?

2. Method

2.1. Participants and setting

Four 5th grade teachers (three male, one female) from four different schools and in total 82 students participated (43 male, 39 female; mean age 10.4 years). The classes that participated in our study differed in aspects as class size, teacher experience, teaching style,

teacher's Web skills, the students' ethnic and socio-economic background and their reading ability. All schools shared a more or less traditional view on education, which can be described as being rather teacher-directive, working with fixed curricula, and little experience with collaborative learning and project work. All schools had ample ICT facilities and both teachers and students were used to working with all sorts of ICT applications. Although the teachers differed with respect to their own Web skills, all were convinced of the value of teaching Web literacy skills. They also were willing to extend their own teaching practice by participating in our research, which asked them to practice a more socio-constructivist teaching style. With regard to the participating students, classes differed significantly in two respects, i.e. the main language spoken at home and the parents' native country. There were no significant differences between the classes with regard to Internet connection at home, the time students spent at the computer at home, self-reported Web skills and their preference for either books or the Web as information resource for school assignments.

*Acton School*¹ is situated in a town's suburb. Most of its students come from lower class Turkish or Moroccan families. The participating class of 14 students (5 girls, 9 boys) also has some white lower middle class students and a refugee from Afghanistan. The school has good ict facilities; in the participating class students have six computers at their disposal that are placed in the classroom. Their teacher Nigel is a very experienced computer and Web user himself. The school has a traditional view on education, with much attention on providing clear structure and guidance for the students. Nigel has worked at the school for 5 years and welcomes the project as an opportunity to practice project work and stimulate student collaboration. His students are weak readers; their average reading comprehension score is 39.0, which is far below the national average of 49.0.² Several students are subject of the teacher's concern because of their problematic behavior. The teacher hopes to establish a safe learning environment for all students by being very strict in certain class rules and by expecting students to behave according to these rules.

Barnton School is located in a town's suburb. Its student population is mixed: many white, lower middle class and middle class children but also students from various other origins (Surinam, Turkish, Moroccan). The school has rather traditional views on education. The use of ict is integrated in the school curriculum and the students are used to work with the computer in several ways. Mike, the 5th grade teacher who participated in the study is a trainee teacher in his last year of training. He teaches the students for 2 days a week, under supervision of an experienced teacher who is absent in the classrooms most of the program's lessons. Mike has a lot of ict expertise but is of course less experienced in didactical matters. His class of 31 students is a difficult class to work with because of a lot of animosity between students, especially the boys. Some students have rather serious behavioral problems. The problems in the class became of such nature that the school principal decided to split up the class. As a result, one half of the class was not able to finish the program because they got a new teacher. Mike completed the program with the 16 students that stayed in his part of the class (6 girls and 10 boys). Their average test score on reading comprehension is 44.7, which is below the national average.

¹ Names of schools and people have been changed to ensure anonymity.

² Derived from a standardised Dutch National School Achievement Test (from the CITO, the Dutch National Institute for Test Development).

Calmore School is situated near the center of the same town as *Barnton School*. Most students come from white lower and middle class families. The school has good ICT facilities; the computers are situated in the corridor outside the 5th and 6th grade classrooms. As in *Barnton School*, classes are divided in two during computer lessons, half of the students are staying in the classroom. Mary, the 5th grade teacher has 25 years of teaching experience. She sees herself as an ignorant computer and Web user and invested a lot of time during the program in practicing her own computer and Web skills. Her class of 26 (15 girls and 11 boys) has a lot of active students who like to participate in all sorts of class activities. Their average test scores on reading comprehension are 49.4, which is around the national average of 49.0.

Dunham School is situated in a village. Most students are from white upper middle class families. The school has good computer facilities; computers are situated in an open space near the classrooms. Charles, the 5th grade teacher has 5 years of teaching experience at this school. His teaching style is rather directive and strict and he expects students to behave polite and to obey class rules. He is rather experienced in using the computer and the Web in his teaching. The participating class (13 girls, 13 boys) has an average reading comprehension score of 45.4, which is slightly below the national average, but there is much diversity between students.

2.2. Materials

2.2.1. The educational program

The educational program comprised 8 weekly lessons of 1.5–2 h each. The program had one overall subject, ‘healthy food’, which was chosen both because of its connection with children’s everyday lives and because of the opportunities for acquiring relevant Web skills. Being a broad, interdisciplinary subject related but not restricted to the schools’ curricular goals, it offered much possibility to acquire and practice Web searching, reading and evaluating skills.

In order to connect the teacher’s school context and teaching style with the socio-constructivist starting points discussed in the previous section, we chose to design a program in which elements of a structured teaching method (e.g., all students practiced the same exercises at the same time; the teacher manual prescribed the lessons in detail) were combined with elements such as a great focus on class discussion and on collaboration between students. Moreover, while the first five lessons of the program focused on acquiring Web searching, reading and evaluating skills, the last three lessons aimed at integrating the Web skills and specific content knowledge on the program’s subject, healthy food. [Table 1](#) shows the overall structure of the program. The aspects of Web literacy, which were addressed in the lessons, are summarized in [Table 2](#).

The first five lessons were designed in a similar pattern, beginning with teacher initiated instruction and discussion which was followed by a period in which all students worked in pairs at the computer. The lesson was completed by a teacher-led discussion of difficult aspects of the computer assignments and revision of the main learning points of that lesson. In general, the teacher began the lesson with a whole class discussion on the lesson subject. For example, she discussed with the students the ways they searched the Web for homework assignments and their views on several Web searching strategies. In the lessons on Web reading skills she discussed students’ opinions on the differences between reading a book and reading on the Web. In a similar way, in the Web evaluating lessons

Table 1

Overall structure of the program

Lesson 1	<i>Web searching skills and strategies:</i> Instruction into the various Web searching strategies and the skills they require; practice of searching strategies and skills; discussion of the various strategies possibilities and limitations
Lessons 2 and 3	<i>Web reading and interpreting skills and strategies:</i> Instruction into various Web reading strategies and their specific use; practice of these strategies; discussion of each strategy's possibilities and limitations
Lessons 4 and 5	<i>Web assessment and evaluating skills and strategies:</i> Instruction into various useful criteria for the evaluation of both textual and visual Web information; discussion of the necessity of Web evaluations; practice of applying evaluating strategies on particular websites.
Lesson 6	<i>Web assignment 1: Am I a healthy eater?</i> Joint application of the Web searching, reading and evaluating skills and strategies
Lesson 7	<i>Web assignment 2: What does a label say?</i> Joint application of the Web searching, reading and evaluating skills and strategies
Lesson 8	<i>Web assignment 3: Food advertisements</i> Joint application of the Web searching, reading and evaluating skills and strategies

students' opinions on and knowledge of the necessity of those skills was subject of class discussion. Both during and after these class discussions, the teacher gave instruction on the Web skills that were the focus of that particular lesson. After this instruction, students worked in pairs at the computer for about 45–60 min. All student pairs had their own workbook with assignments and background information about the several Web skills. All assignments were on the program's overall subject 'healthy food'. The teacher supported students when necessary. After the computer time, the teacher discussed with the students their work, focusing on difficult parts of the assignments. The use of a computer projector in these discussions enabled the teacher to model the desired skills and to practice together with the students possible ways to accomplish the assignments. As can be seen in Table 1, searching skills were the subject of one lesson, both reading and evaluating skills were dealt with in two lessons. Searching skills were relatively familiar for both teachers and students; the schools paid already some attention to these skills. Reading and evaluating skills were new elements and were supposed to require more lesson time.

The last three lessons were designed differently and aimed at acquiring specific content knowledge on healthy food by using the Web skills in an integrated way. In each of these lessons, the students got an assignment on one particular aspect of healthy food: respectively, the nutrition needs of children aged 10–12 years, the information about ingredients and nutritive value on food packings and labels, and advertisements and claims regarding (supposed) food healthiness. In these lessons, we wanted students to use the Web skills they had learned and practiced in the previous lessons and to prevent a mere 'skills approach' in which the various Web skills would become isolated from the content and daily life contexts in which they are actually used. Therefore, the assignments were connected to the students' home activities as keeping 'eating diaries' and collecting packings and labels of food they had eaten themselves. In these lessons there was also more explicit attention on the appropriation of knowledge on healthy food than in the previous lessons in which the various Web skills were prominent. Students were supposed to search the Web for specific information and had to compose their own text based on that information.

Table 2
Aspects of Web literacy addressed in the program

Searching for Web information	<ul style="list-style-type: none"> – Possibilities and limitations of search engines – Meaning and proper use of URL's – Browsing strategies – Formulating key words – Navigating through lists of results from search engines – Evaluating the relevance of these results – Using search strategies in a flexible way
Reading and interpreting Web information	<ul style="list-style-type: none"> – Various ways in which websites may be structured – Practising reading of several types of Web texts – Using navigational aids such as toolbars and menus – Skimming Web texts to identify key words or phrases – In-depth reading of relevant passages – Purposeful use of links in Web texts
Assessing and evaluating Web information	<ul style="list-style-type: none"> – Assessing one's own level of understanding of specific Web texts – Getting insight into the relative accuracy and reliability of Web information – Judging the accuracy and reliability of Web information – Relating the information found on one's own question or need for information – Assessing the function and meaning of visual website elements

For example, in the sixth lesson, they were asked to write a text on the healthiness of their own eating habits. After comparing each other's eating diaries, they had to search the Web for information on guidelines for healthy eating habits of children of their own age. Finally, they were asked to write a text in which they compared their own eating habits with these guidelines. Although all assignments were written out very clearly, the students were supposed to work much more independently than in the previous lessons. They also had much more opportunity to connect their own interests and experiences with these assignments. The teacher discussed these assignments in detail with the students and supported the students during their work.

The teachers had a teacher manual at their disposal in which all lessons were described in detail, as well as their learning goals and the necessary preparation. All teachers received a 5-h teacher training course in advance, focusing on aspects as the background and learning goals of the program, the design and content of the lessons and the necessary teaching skills. All student pairs had a workbook at their disposal in which all exercises were written out clearly for them together with helpful tips and background information. The exercises have been tried out by some students of the same age beforehand and adapted when necessary. All teaching materials and student exercises have been discussed with experts in the field of teacher training, Web literacy skills and school advisement.

2.3. Instruments and procedures

A variety of data were collected both on the experiences of the teachers and on the learning processes of students, with a view to an in-depth study of the program. Lesson observations, field notes and face-to-face interviews with teachers were combined with student interviews, student questionnaires, and final student assignments. This variety of data sources also served triangulation of the data.

Lesson observations, field notes, and interviews with teachers. Observation data focused primarily on the teachers' actions and on the dialogue between teachers and students. Every other week a whole lesson was videotaped for each class. In this way, every lesson in the lesson plan was videotaped in two different classes. All videotapes were transcribed. Diaries with field notes on these same lessons served as supplementary observation data, as well as observation checklists focusing on aspects such as teacher instruction, student involvement, class climate, and the way the teacher supported the students. The field notes served as primary material in initial data analyses, which provided direction for later observations.

Every other week the teachers were interviewed. In addition, the teachers also maintained diaries for all lessons. Both interviews and diaries focused on the implementation of the program and on the students' learning processes. Teachers were explicitly invited to share their opinion of the program with the researchers, and to discuss their experiences. This enabled us to compare our research observations with the teacher's experiences.

Student questionnaires, observations and interviews with students, and final assignments. From the total of 82 students, 76 students filled out a questionnaire both before and after the program. Part of this questionnaire focused on aspects of students' backgrounds and their attitudes towards computers in general and the Web in particular. Another part consisted of 10 knowledge items on the subject of healthy food and 15 knowledge items on searching and evaluating Web information (all multiple choice items). On both subjects, no reliable tests to determine differences between students of this age are available. [Kuhlemeier and Hemker \(2005\)](#), when constructing a broad test on Internet skills for high school students, deliberately left out items on evaluating Web information because of the failure to construct reliable and valid test items on such critical Web use. Therefore, we decided to construct a questionnaire that consisted of items on a range of aspects of healthy food and critical Web use, without aiming at constructing a coherent test that could determine differences between students and between times. This is reflected in rather low reliability scores ($\alpha = 0.55$ for items on healthy food; $\alpha = 0.64$ for items on critical Web use). With regard to healthy food, some items were directly related to the declarative knowledge students had come across during the program (e.g., "What are ingredients?"); others were meant to give an indication of a general way of thinking critically about eating habits (e.g., "What is the best solution when you eat not enough vitamins?"). The items on Web use focused on searching/navigating skills and (to a lesser extent) on evaluating skills. Web reading skills were not explicitly addressed, as a pencil-and-paper questionnaire can not reflect the complexity of Web reading in practice. Some elements of reading on the Web were imitated by offering screenshots of Web pages on which the students had to choose between links (e.g., "On what part do you click when you want to know the entrance fee of the zoo?"). Furthermore, students' test scores on reading comprehension were used as background information.

In each class, three students pairs were selected and more intensively observed, using an observation checklist that focused on aspects of students' involvement, collaboration between students and the way students worked with the teaching materials. These students were also interviewed every other week. In these interviews students were free to discuss their opinions on the lessons, on what they had learned that week and on the teaching materials. We aimed at diversity between the student pairs, choosing students of mixed gender and ability. After the program was finished, these 12 student pairs carried out

six final assignments that all focused on the application of critical Web skills. Although Web searching, reading and evaluating skills all play a role in Web activities, in each assignment one or more of these skills were more prominent than others. In assignment 1 and 2 students were asked to find a specific answer on the Web. For example, assignment 1 asked students to find an answer to the question “What language do the inhabitants of the island Madagascar speak?” They were free to use the Web as they wanted, which made it possible to observe their spontaneous Web searching, reading and evaluating strategies and skills. The assignments differed in level of complexity, assignment 1 being more simple and straightforward, while assignment 2 was more complicated both with regard to the phrasing and the difficulty of finding the right answer. Assignment 3 focused more exclusively on reading skills. This assignment provided students with a specific website (i.e., the website of the Dutch Royal family), and asked them to search specific information on that website (i.e., the names of the children of one of the of the Dutch crown prince’s nephews). Searching skills were less important in this assignment. The assignments 4–6 focused on aspects of evaluating websites. In these assignments, students were provided with one specific website and asked to comment on an aspect of Web evaluation. Assignment 4 asked students to mention spontaneously positive and negative elements of a website on animal protection (www.dierenbescherming.nl). Assignment 5 asked them to discuss the specific purpose of a website about preservation of Dutch wetlands (www.waddenvereniging.nl), an aspect of evaluating websites that had been prominent in the lessons. Assignment 6 asked students to discuss the usefulness for children of a website about safe Internet use (www.kinderconsument.nl), which appeared to be nice and useful for children, but which happened to be written for parents when evaluating its content.

All students worked in pairs, as they had done during the program. For each assignment, they got a maximum of 10 min. All sessions were captured with Camtasia Studio screen recording software, which also recorded the conversations of the student pairs. No technical problems occurred during the assignments, with the exception of assignment 6 which could only be made by the students of the Calmore and Dunham schools because that particular website was ‘under construction’ on the day the students of the other two schools carried out the assignments.

2.4. Design of the study and data analysis

We used a multiple case study design for our research (Yin, 2002), in which data from a variety of sources were collected and analyzed. The same program was implemented in four classes. The first phase of data analysis focused on the within-class description of the implementation of the program in each class. Then, cross-class analysis was performed to determine which contextual factors at the class level affect the realization of the program and students’ learning.

Analysis of lesson observations, field notes and teacher interviews. The videotapes of the lessons were transcribed and analyzed with a view to characterizing the learning environment in each class. Our focal points were:

- the way the teachers gave instruction on the various Web skills and discussed the students’ exercises;
- the way teacher and students discussed the various Web skills and the student assignments;

- the way the teachers supported the students during their computer work;
- the way students collaborated;
- students' involvement in the program.

The transcribed videotapes and the written observations were combined on these aspects. Lesson segments were described, highlighting key events, after which each classroom was characterized by identifying what elements were present. Also the way the teacher worked with the provided teaching materials and guidelines was analyzed. Transcriptions were also made of all teacher interviews. These transcripts were analyzed in two ways: with a view to both the focal points used for the analysis of the observation data, and the teachers' ways of reflecting on their own way of working, on the program as a whole and on the provided teaching materials. The interviews also served triangulation, by comparing and contrasting them with the observation data.

Analysis of student interviews, observations, questionnaires, and final assignments. The transcriptions of the student interviews were analyzed with a view to their opinion on the program's materials (e.g., the workbook), on the way the teacher worked with the program, and on the usefulness of the program. The student observations primarily served triangulation, by comparing and contrasting them with the interview data.

Students' answers on the knowledge items of the questionnaires were scored, both for the total group of 76 students and for the four classes separately. We performed *T*-tests to compare mean scores of the four classes.

The Camtasia screen and audio recordings of the final assignments of all student pairs ($n = 12$) were transcribed. These transcripts provided insight into students' ways of working with the Web as well as their collaboration and discussions. The recordings and transcripts of the assignments 1 and 2 were analyzed with the help of a list of Web searching, reading and evaluating strategies the program had paid attention to (see Table 2). All searching, reading and evaluating strategies student pairs used in these assignment were counted. In this first analysis, we used a clear distinction between the three categories; as a consequence, reading strategies were restricted to 'reading on a specific website'. However, reading on the Web concerns not only reading on a website, but also concerns for example reading search engine results. Moreover, using a certain searching or reading strategy does not provide information about its adequacy in the context of a specific task or question. For example, using only one keyword when searching at Google may be adequate in the context of the Madagascar-assignment, but inadequate in the context of another task. Therefore, we designed a coding procedure in which each separate reading and searching activity was first coded and then scored as either 0, 0.5 or 1, depending on its adequacy in the context of that specific task. The reliability of the coding procedure was calculated by coding about 50% of the activities twice, by two independent researchers (Cohen's kappa = 0.87). Appendix 1 shows the coding scheme, with the definitions used to identify activities and examples. These scores were added up and then divided by the total amount of reading and searching activities each pair had conducted in that assignment. In this way, an overall score (laying between 0 and 1) for each student pair's adequacy in using Web searching and reading skills was calculated.

In the assignments 4–6 that focused primarily on students' Web evaluating skills, students did not have to find specific answers, but were asked to discuss the quality, intentions or usefulness of a specific website. We did not score individual student pairs' way of working with these assignments, but wanted instead to get an overview of all arguments

students used as well as their relation with the aspects of evaluating Web information that were discussed in the lessons. The transcripts of the student pairs' dialogue and screen behavior during the assignments were analyzed with a view to this. Jointly, these data provided insight into the Web literacy skills students were able to use, as well as their specific Web search behavior during the various assignments.

Finally, data from multiple sources (teacher and student observations and interviews, and students' final assignments) were analyzed in relation to each other and between classes.

3. Results

First, a within-class description is presented of the implementation of the program in the four classes. Then, the cross-class comparison will focus on differences with regard to this implementation. Finally, students' learning results will be addressed.

3.1. *Within-class description of the implementation of the program*

3.1.1. *Acton School*

Because in this school the computers were situated in the classroom, all student pairs could work together at the same time without any need to go outside. This had several positive effects, e.g. the opportunity for students to finish their work at other times during the week and the teacher's close guidance of all students working together at the computers. This was especially important because for many students the program was hard to work with. Their reading problems forced them to invest much time in finishing all exercises and they also were not used to work in such an independent way. At the same time, they liked the lessons very much: they liked to work with the computer and the Web, and they also felt important as participants in the researcher's work. They were never bored and always glad when program time began and seemed to look at the lessons as an opportunity to learn something new.

Teacher Nigel's teaching style was reflected in the way he organized class discussion and instruction. Nigel started the discussion by asking a question, and either waited for fingers raised, or gave all students one by one a turn. He did not stimulate discussions between students but was very keen on giving all students equal opportunity to answer or say their opinion. Despite his efforts, the boys joined class talk much more than the girls. Many students seemed not being used with discussing their own opinions, which may also be influenced by their difficulties with speaking Dutch fluently. The teacher prepared all lessons well and followed the teacher manual more or less literally. Although it took a great deal of his time during the week, he liked the program because of its learning goals and opportunities for collaboration. Students also worked much better than he expected; especially their drive to finish the exercises and the way they collaborated surprised him from time to time. After the program, he used the Web more in his lessons and also mentioned the program's Web skills from time to time to the students. In his view, the students had learned a lot during the lessons, although he would have liked to spend more time on the subject healthy food.

3.2. *Barnton School*

Existing problems in this class affected the program from the first lesson on. The teacher (Mike) had to spend a lot of time on troublesome student behavior that interrupted the

lessons. As a result, the lessons often did not work out in the way Mike expected, despite his careful preparation of all lessons. Class discussions were often interrupted or disturbed by conflicts between students. The instruction took more time than estimated and sometimes could not be finished because of time constraints. This was also a consequence of the way computer work was arranged at this school. Classes were divided in two during computer time, with one half working in the computer room and the other half taking lessons from another teacher. This meant a tight time schedule; students could not finish their work at all times because other classes booked the computer room. The problems in the class together with Mike's little teaching experience also were at the expense of the time he could spend on actually supporting students in their work, especially in the computer room. Although some student pairs worked together well, the unrest in the class affected all students in some way. The students did not really become involved in the program (as in any other class activity); they viewed themselves as 'the troublesome class' in which nothing really worked out well.

After the principal's decision to split up the class, the class atmosphere in Mike's half class of 16 students became more positive. As a result, he was able to spend more time on class discussion and on supporting students during their working at the assignments in the last three lessons. After all, Mike is positive about the program, especially with regard to the teacher manual and the content of the lessons. For him, the program not only was a means to practice teaching the students Web literacy skills, but also a way to practice supporting students while doing project activities. However, particularly with regard to the students' workbooks he mentions the problems students have with reading the information and the length of the exercises in the workbooks. For many children in his class who are rather weak readers, it sometimes was too much work to finish a particular lesson's exercises in one computer lesson.

3.3. Calmore School

From the first lesson on, teacher Mary took the program very seriously. She prepared the lessons in great detail and made her own version of the lesson plans in the teacher manual. She liked the class discussions during instruction time and took ample time for them. Because of the students' active attitudes, these discussions often became lively and entertaining. From the third lesson on, Mary used a computer projector in all lessons. By doing so, she was able to direct the students' attention to the lesson themes and to illustrate the various skills while demonstrating them on the computer, thereby also modeling students' Web behavior. Mary also talked about both lesson content and Web skills learned during other lessons. For example, in a biology lesson students recognized information about the necessity of calcium for bone structure as something they had come across during one of the program's lessons. The teacher also connected Web reading skills with her lessons in reading comprehension. Although she was a rather inexperienced Web user herself, she was able to support students very well during computer time, especially with regard to reading and evaluating Web information. Although most student pairs worked well together, the teacher took time to support student pairs with regard to collaboration every lesson.

Although the program was carried out very well in this class, some aspects proved to be difficult either for the teacher or for the students. The teacher found it sometimes difficult to support the students during computer work and to recognize their problems. Some

lessons were a bit too long, especially the first lesson on searching skills. She also thought the program as a whole to be too long: after the 5th and 6th week, students became a bit bored with the subject. Both teacher and students commented on the fact that the student materials sometimes were too much elaborated; students had to read a lot during the lessons. Especially for the weaker readers this proved to be difficult. On the whole, Mary was very satisfied with the way the program had worked out in her class. Students not only had learned new and relevant Web skills and had acquired knowledge on healthy food, but in her view also had learned a lot about working together, expressing their own opinions and text composition.

3.4. *Dunham School*

Due to circumstances like illness and other school projects, the program took more time in this class than in other classes. The eight lessons were carried out in a period of 12 weeks. This resulted in fragmentation: students' attention was dispersed and students lost the program's overview. They liked the program because of the opportunity to use the Web, but did not seem to realize what the program was about. This was strengthened by the fact that teacher Charles did not start out with discussing the program's goals with the students. He either skipped class discussions on healthy food and Web use in the lessons or invested little time in them. This seemed to be part of a more general teaching attitude that was also reflected in the way instruction and discussion of the lessons worked out in this class. The students stayed rather passive because the teacher did not really engage them as partners in a discussion. He was focused foremost on providing students with the 'right answers' on the assignments and on correcting undesirable student behavior, which resulted in spontaneous remarks not being welcomed as contribution to a shared discussion.

During computer work, the class was divided in two parts, as was also the case in the Barnton and Calmore Schools. However, in this class the teacher had to supervise both the students who worked on their own in the classroom and the students who worked at the computers. This resulted in insufficient student supervision. Some of the students did not work with the exercises at all, but played games on the websites they had to visit. Others got stuck in an exercise or did not get anything done. Charles was unhappy with this but did not take any action to solve it. In his view, the students were restless and 'difficult', partly because the exercises were too much work and too difficult for them, partly because they gave up easily. Charles was not very satisfied with the way the program had worked out for his class. He still thought the learning goals to be useful and necessary, but preferred shorter lessons that focused more on sub skills and that were easier to work with for students.

3.5. *Across-class comparison*

Implementing the program: the teachers. Although all teachers had followed the same teaching training course and all had the same teacher manual at their disposal, there were several distinguishing features in the way they implemented the program. To start, working conditions were not comparable for all teachers. Especially at Barnton School the teacher's situation was different because of the problems in his class, which resulted in splitting up the students. His limited teaching experience made the circumstances even

more difficult. The teachers also worked with different student populations; especially the students of Acton School differed from others because of their reading problems. Teachers also differed in teaching style, which affected in particular the instruction and class discussions, before and after the computer lesson. The discussions moved in very different directions, from active and lively discussions in which most students participated, to structured question – answer sequences or even no dialogue at all. During instruction, teachers differed for example in their ability to connect the subjects ‘healthy food’ and ‘Web skills’ with their own and the students’ everyday lives.

Overall, two of the four teachers seem to have carried out the program’s intentions. Both the teachers of Calmore and Acton School put much time and effort in the program. The teacher of Calmore School prepared all lessons in detail and practised all student exercises, so she could support students better and was prepared for their problems. She also took the discussion afterwards very seriously and always used a computer projector during the instruction and discussion. This focused the students’ attention and stimulated them to be active and to think along with the teacher. The teacher of Acton School had a different teaching style which resulted in a different class atmosphere and a much more structured and teacher-led instruction and discussion. However, he also took great efforts in supporting students and in stimulating students to finish their lessons. This was especially important because the teaching materials were really hard to work with for his students. Both teachers also took time to discuss the conditions for collaborative working with their students, not only before but also after the lessons.

All teachers succeeded in finishing the program, although one teacher had to spread out the lessons over a longer period than the estimated 8 weeks. But all teachers struggled with the fact that the lesson time was barely enough. Lesson introduction, instruction and discussion afterwards took more time than expected, although this also depended on teaching styles and the presence of certain preconditions. Teachers differed in their opportunities to finish a lesson on a later time in the same week, e.g. sometimes there was only a fixed computer time for the students or a teacher worked only part-time. Teachers also differed in the extent to which they succeeded in teaching both critical Web skills and knowledge of healthy food. Especially the teachers of Calmore School and Acton School paid a lot of attention to both types of learning goals. At both schools the teachers sometimes connected the lessons’ content to other school subjects, for example a biology or reading comprehension lesson. For them, this possibility proved to be one of the reasons of their positive evaluation of the program. Although they also mentioned a number of shortcomings, both teachers planned to use the teaching materials again next year.

The teacher at Dunham School was rather critical of the program. In our view, this may be related to a discrepancy between the socio-constructivist learning principles that guided the teaching materials and his own teaching style. Both the teachers of Acton and Dunham School can be characterized as teaching in a rather teacher-directed style. However, the teacher of Acton School turned out to be able to work with the program in a way that served both the program’s goals and his own way of teaching in this particular class. For him, the program was a way to try out other ways of teaching, which he welcomed. The teacher of Dunham School, at the other hand, did not seem to be aware of the extent to which his teaching affected the class discussions, students’ motivation and their way of working with the program. In this class, the gap between the program’s teaching materials and the teacher’s own teaching style seemed to be too big.

All teachers had difficulties with the last three lessons, in which students worked on a particular assignment in which Web searching, reading and evaluating skills had to be integrated and applied. In these rather traditionally working schools, many students were not used to composing their own texts or in expressing their own opinions in writing. The teachers suggested to either disconnecting these assignments from the rest of the program, or taking more time to support students and to practice the (writing etc.) skills needed before the program. Especially the first suggestion may reflect a difference between the more practical way the teachers approached the program, and our intentions to offer students the necessary integration of the various Web skills that were taught and practiced separately in the first part of the program.

After the program, all teachers stayed at their initial opinion that its learning goals (in terms of both Web literacy skills and knowledge of healthy food) were useful and necessary. They recognized their students' problems with searching, reading and evaluating Web information even more clearly after the program. Especially the students' problems with reading on Web text was mentioned by all teachers: they had seen their students skipping relevant texts easily, getting lost in a website's menus and following links without a clear purpose. The teachers were concerned about the lack of focus and rather 'fleeting' behaviour of many students, even when reading short and easy texts. Moreover, they all mentioned the fact that most students also were weak readers of the texts and exercises in their workbooks, resulting in incomplete exercises. Although this was no surprise for them, the teachers struggled with the necessity of guiding students through the exercises whereas the students were supposed to work rather independently at the computer. Teachers differed in their opinions on what students had learned from the program, the teachers of Calmore and Acton School again being more positive than the other two. This seems to be related to these teachers' way of implementing the program and their ability to connect the teaching materials with their own teaching style. The teacher of Barnton School in particular had to cope with difficult class circumstances.

All teachers agreed that 8 weeks were a too short time to expect much visible results in student behavior and all plead for splitting up the program in three or four smaller ones throughout the school year. Teachers were of the opinion that students had come across Web skills they never had practiced or even discussed before. Especially the reading and evaluating skills were new teaching material; searching the Web was discussed in most classes before, as when students had to search for information for a particular class assignment. For the teachers, the reading skills were the most difficult to discuss with the students because of many students' general dislike of reading on the Web. Evaluating Web information was less difficult to teach because students could express their own opinions, which they liked a lot.

3.6. Implementing the program: the students

The students' motivation to work with the program differed greatly. Overall, students from Calmore School and Acton School were mostly positive about it; they were seldom bored and never expressed a general dislike. However, they were critical of some parts, especially lessons in which they had to read a lot, either in their workbook or on the Web. They also found some exercises difficult and sometimes too long. Especially the Acton School students had to work hard during the lessons, but for them they also meant

a welcome change from the daily class routine. They worked very well together, and stayed focused throughout the lessons.

Some of the Barnton and Dunham School students were more critical or even negative about the program. Especially at Dunham School, students repeatedly said they were bored with the program and expressed a dislike of the teacher's way of giving instruction and discussing the exercises afterwards. In this class, the program's goals were not discussed with the students, resulting in students not knowing why they were doing so much trouble. This was also reflected in some students' opinion that there was nothing they could learn from the program because "when you grow up with computers at home, you already know everything". This resulted in a quite indifferent attitude. The students of Barnton School suffered from the animosity between some groups of students, which caused much agitation and prevented students from working with concentration. The program was less important for these students than the class atmosphere and its consequences.

Students from Calmore and Acton School were mostly positive about what they had learned from the program. The Acton School students mentioned primarily that they had learned better Web searching skills; Calmore School students also mentioned the fact that they were now more critical of websites and Web information and expressed the importance of reading strategies as using menus to discover the content of a website.

3.7. Students' learning results: questionnaires

An indication of the students' changed knowledge of and opinion on the Web are students' answers on a half-open questionnaire item, in which students had to state their opinion on the question "Do you think there is a difference between information found in books and information found on the Web, and why?" Students could choose between the alternatives 'No, there is no difference', 'Yes, there is a difference', and 'I don't know'. When comparing students' answers before and after the program, there is a significant change in their answers (χ^2 -test, for all students taken together as well as for the separate classes, $p < 0.05$). After the program, more students state that there is difference between the Internet and books (52% vs. 25% before the program) and the 'don't know' category has diminished (34% vs. 69% before the program). Also important are their answers on the question why they thought there was a difference. These answers showed a clear tendency towards critical statements like "books are more true", "everyone can write anything on the Web", etc. This may be an indication of their changed knowledge of the Web.

The questionnaires' knowledge items focused on students' knowledge of healthy food and critical Web skills. Table 3 gives an overview of students' mean scores for the four classes separately.

With regard to knowledge of healthy food, all classes show improvement after the program. Both Acton and Dunham School's students' mean scores are significantly higher after the program (Acton School: $t = -3.51$; Dunham School: $t = -5.00$; $p < 0.05$). The Barnton School results show no significant improvement. Although the program has been carried out very well at Calmore School, these students' mean scores on healthy food items show little progress. This may be due to their relatively high mean scores before the program, compared with the other three classes. The program's way of discussing this subject may have been little challenging for them.

The analysis of students' answers on the Web skills items shows that all classes' mean scores are higher after the program, the Calmore and Dunham School's improvement

Table 3
Overview of students' learning results (Questionnaires)

	Acton School (<i>N</i> = 14)		Barnton School (<i>N</i> = 13)		Calmore School (<i>N</i> = 26)		Dunham School (<i>N</i> = 23)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Food items (<i>N</i> items = 10)								
Before	5.86	1.29	6.38	1.39	7.46	1.63	6.17	1.85
After	6.93	1.43	7.23	1.30	8.04	1.28	7.83	1.61
Web skills items (<i>N</i> items = 15)								
Before	10.36	2.24	9.85	2.73	11.35	2.62	10.96	3.07
After	11.93	2.40	11.00	2.04	12.62	2.25	12.52	1.97

being statistically significant (Calmore School: $t = -2.20$; Dunham School: $t = -2.38$; $p < 0.05$). Contrary to our expectations when analyzing the implementation of the program in these classes, the different ways in which the program has been carried out in these classes are not reflected in the students' results on the questionnaires.

3.8. Students' learning results: final assignments

Three student pairs of each class of mixed gender and achievement level performed the six final assignments. The assignments focused on students' actual Web use. Table 4 presents the total amount of Web searching, reading and evaluating strategies students used in the assignments 1 and 2, in which students had to search the Web to find a specific answer. Average time spent at assignment 1 was 6.2 min; average time spent at assignment 2 was 8.5 min. Because students were free to use the Web as they wanted, these assignments provide information on what strategies they actually use. We used a strict distinction between searching and reading strategies and restricted the latter to the actual reading of texts on websites. Table 4 shows that students mainly used Google when searching for information.

They used no other search engines and only in some instances used a directory page or a specific URL. In fact, 'searching' meant for all students in most instances 'searching with Google'. In the lessons, they had discussed and practised the possibilities and limitations of using Google as well as other searching strategies. This did not influence their actual search behaviour, which may reflect the way they use the Web at home. Although students mostly used single or multiple search terms, they sometimes typed in the whole assignment or used spoken language. While reading Web texts, students mostly used scanning strategies and only sometimes used the menu or links on a website. This is reflected in the figures in the 'non-reading' category: students often came across a relevant menu or link but failed to recognize it. 'Non-reading' also often occurred while scanning Web texts, especially in the form of ignoring of relevant headings. With regard to Web evaluating skills, students never questioned the reliability of a specific website. They sometimes explicitly paid attention to the usefulness of a website, but only in terms of the relevance of the information (which was their first concern when trying to find an answer).

To get more insight into the quality of students' Web activities, their performances on the assignments 1–3 were studied in greater detail. Table 5 shows the scores of the student pairs of the four classes on these assignments (see also Appendix 1).

Table 4

Overview of the amount of Web searching, reading and evaluating strategies students used in assignments 1 and 2

	Assignment 1	Assignment 2	Total
Web searching strategies			
1. Google – one search term	13	5	18
2. Google – multiple search terms	14	24	38
3. Google – whole question as search term	1	5	6
4. Google – spoken language	2	7	9
5. Other search engine			
6. Specific URL	2	1	3
7. Directory page	5	2	7
8. Children's search engine		1	1
9. Search option within a specific website		4	4
Total	37	49	86
Web reading strategies			
1. Reading text on a website literally	3	6	9
2. Scanning text on a website (using keywords, headings)	17	12	29
3. Using the menu on a website	5	3	8
4. Using links on a website	5	2	7
5. 'Non-reading': Scrolling through Web texts or clicking websites away, without reading or using relevant keywords/clues	13	19	32
Total	43	41	84
Web evaluating strategies			
1. Deducing a website's reliability from its URL			
2. Deducing reliability from a website's visual elements/appearance			
3. Deducing reliability from the quantity of information			
4. Deducing reliability from the quality of information			
5. Determining usefulness of a website on the basis of understanding of the information	2		2
6. Determining usefulness on the basis of reliability/trustworthiness			
7. Determining usefulness on the basis of relevance of the information	9	7	16
Total	10	7	17

N student pairs = 12; counted are all instances a specific strategy occurred; one student pair could use a number of (the same or different) strategies during a specific assignment. Evaluating strategies are deduced from explicit remarks made about the reliability or usefulness of a specific website.

These scores show a very mixed picture of students' performances varying between student pairs as well as between assignments and therefore need elaboration with regard to the differences and similarities in students' Web behavior. Because of the variation in student pairs between the four classes (for example, the Acton School students' general reading level is lower than in the other classes), the classes mean scores can not be attributed to the classroom context. Therefore, we will look at tendencies on the level of the student pairs, taking the class context into account when necessary.

Most students seemed to act rather impulsively and often began with 'trying out' something, sometimes only to look if something showed up. Patience seemed to be a major characteristic of the better performing student pairs, who combined this with the ability to use the appropriate searching and reading strategies in a flexible way. Students who expected

Table 5
Overview of students pairs' learning results (final assignments)

	Student pair	Reading level ^a	Score assignment 1	Score assignment 2	Score assignment 3
Acton School	AS1 (2 boys)	C/D	0.53	0.45	0.64
	AS2 (2 boys)	B/C	0.75	0.70	0.75
	AS3 (2 girls)	C/D	0.34	0.23	0.54
Barnton School	BS1 (2 boys)	A/C	0.94	0.50	0.77
	BS2 (2 boys)	C/C	0.61	0.69	0.67
	BS3 (2 girls)	C/not available	0.60	0.69	0.54
Calmore School	CS1 (1 boy, 1 girl)	A/B	0.60	0.75	0.94
	CS2 (2 boys)	A/D	0.58	0.78	0.81
	CS3 (1 boy, 1 girl)	B/C	0.54	0.31	0.81
Dunham School	DS1 (2 girls)	B/C	0.69	0.43	0.78
	DS2 (2 boys)	A/D	0.67	0.72	0.63
	DS3 (2 girls)	A/D	0.70	0.41	0.70

^a On the basis of the scores on the CITO reading comprehension test, students are classified in one of five categories A–E; A representing the highest and E representing the lowest achieving students.

quick results from their searching were easily frustrated. Reading Web texts in particular asks for patience that many students lacked. They tended to overlook certain useful information, e.g., the heading of a website that could tell them that although it concerned the language spoken in a particular country, its main subject was Costa Rica and not Madagascar.

Although the low scores of some student pairs (for example, AS3) reflect their low reading skills, there is no unequivocal relation between reading skills and performance. Student pair CS1 who has the highest reading score combination of all pairs, did carry out assignment 1 not very well compared with the other pairs. On the other hand, their scores on assignments 2 and 3 are high. This suggests that also other aspects at both task and student level may influence students' performances. Firstly, the variation between one student pair's scores on the three assignments may indicate that characteristics as reading comprehension level and knowledge of Web skills, do not influence the student pair's performance in a consistent way. Pairs of roughly the same reading level (e.g., CS3, AS2 and DS1) performed rather differently on the assignments. Also, although in general, the weakest readers showed less adequate Web behavior than the strongest readers, they also seem to have had bright moments or simply some luck which contributed to their scores. Vice versa, the stronger readers sometimes showed a tendency to try certain irrelevant strategies 'just for fun', to see what it would bring about. For example, they would fill in the question they had to answer in Google's search box, although they knew very well that such strategy is not always very useful.

When looking at the various ways students worked with the assignments, we saw that the weaker performing students either tended to stay at one strategy they thought useful, or to try several strategies without really exploring them, in both instances without reflecting on a strategy's relevance and adapting it when it proved to be unsuccessful. Although the stronger performing pairs reflected more on their search behavior, some of them also could be rather inflexible Web users. Sometimes they were so much convinced of their own

capabilities that they stayed at a certain strategy, arguing ‘I know it must be here’ or ‘I always do it like this and it always works’. Table 4 also reveals that several pairs show substantial variation between the scores on the three assignments. Apparently, many students were able to use sophisticated searching and reading skills at certain moments during the assignments, but did not do so consistently. As a result, many student pairs showed more or less unpredictable Web behavior.

Assignment 3 focused more exclusively on reading skills and strategies. The students did not have to search on the Web, but knew already that the required answer could be found on the provided website. Although most pairs’ scores on this assignment are higher than on the other two, there also are exceptions, for example, the pairs BS3 and DS2.

The assignments 4–6 focused on various aspects of Web evaluating skills. In assignment 4, students had to give some positive and negative comment on a particular website on animal protection. The lessons had paid attention to several aspects of evaluating Web information (such as assessing a website’s author and intentions and assessing its reliability and relevance) and had emphasized the necessity to navigate thoroughly through a website to be able to give an opinion on those aspects. In this assignment, we wanted to know which elements of a website students mentioned spontaneously and how they got to their opinions. Table 6 shows the aspects students mentioned.

The website’s appearance was an aspect all students mentioned, either positively (“the pictures are nice”) or negatively (“I don’t like the background color”). Seven pairs mentioned the aspect of information in their comment, either in a quantitative sense (“they give much information”) or in a qualitative sense (“the information is clear”). Only two student pairs navigated deeply into the website. They connected several pieces of information the website provided with each other, and commented on aspects as the appropriateness of certain pictures or the relation between the website’s mission and its pictures and text. The others either stayed at the site’s homepage, or navigated without reading content or looking at the meaning of the site’s illustrations.

In assignment 5, students had to formulate the intentions of a specific website on Dutch wetland areas. Such ‘why’ question was one of the prominent elements of the program’s lessons on evaluating Web information. The teachers had discussed several websites’ intentions with the students and students had practiced this during computer time. In the lessons, intentions were described as ‘providing information’, ‘giving an opinion on something’, ‘advertising’ (either commercial or non-commercial), ‘fundraising’, ‘entertaining’ etc. Students were told to look for more than one intention, as many websites show in fact a combination of intentions. Table 7 shows the intentions the student pairs mentioned.

Table 6
Aspects mentioned by students in assignment 4

Aspects students mention	N pairs mentioning that aspect
1. Appearance	12
2. Quantity of information/text	7
3. Quality of information/text	6
4. Amount of links on homepage	4
5. Relation between homepage and purpose of the site	5
6. ‘Fun’ elements	3
7. Usefulness for children	2
8. Information is easy to find	2

Table 7
Labels mentioned by students in assignment 5

Labels students mention	N pairs mentioning that label
1. 'Advertising' (fundraising, publicity, canvassing) ("they want you to become a member", "they want you to donate money", they want to raise money", etc.)	10
2. 'Information' ("they want to give information about the wetlands", "they want people to know more about the wetlands", etc.)	5
3. 'Opinion' ("they want to show how beautiful the wetlands are", "they want to let people know that the wetlands are threatened", etc.)	5
4. Trivial ("they want people to be less lazy")	2

Almost all pairs mentioned one or more of the labels they had learned during the lessons (e.g., 'information', 'advertising') and they also often mentioned more than one label. Two pairs connected two labels with each other (e.g., "they want to raise money/they want you to become a member so they can protect the wetlands better"). Many students did not infer their labels from a thorough investigation of the website's content. Students clicked on the menu and on links, without really knowing what to do or without reading. This was reflected in the fact that they gave the label 'advertising' very often and easily, without being able to say what the website was advertising about.

The last assignment on evaluating skills asked students to determine the usefulness of a particular website for children. Determining the usefulness of a website was one important element of the lessons on evaluating Web information. Although the website (on safe Internet use) mostly contained information for parents and teachers on risky aspects of children's Web use, the website's appearance was very childlike, due to its colors, fonts etc. Four of the six pairs that made this assignment argued the website was mostly for parents or not useful for children. Their arguments were based on the type of links (like 'Parents', 'Teachers' and 'Press') or on the 'boring information' on the website. The two pairs that thought the website to be useful for children, based their opinion on the presence of a link for children and on the site's appearance. One pair spontaneously asked themselves what the website was about and used arguments as "the language is too difficult for children" and "the information is written for parents". The others did not think about the website's intentions or purpose. As a result, they did not take such aspects into account and based their opinion on rather superficial elements.³

4. Conclusions and discussion

Our research aimed at studying the possibility of combining the acquisition of Web literacy skills and of content knowledge, by embedding these skills in an educational program on healthy food. Through a multiple case study design, we wanted to gain insight into both the possibilities and limitations of teaching students critical Web skills in such context.

We can draw some conclusions with regard to the 'workability' of the program we designed and evaluated. In general, the teachers were able to work with the program well. The teaching materials were found very useful and of great importance, especially because

³ For a more extensive analysis of students' work on the assignments see Kuiper, Volman, and Terwel (2006).

the teachers were unfamiliar with teaching Web literacy skills. All teachers regarded the subject of the program (healthy food) as being very useful for their students. Two of the four teachers were explicitly enthusiastic about the program and found it useful for themselves as well as for their students. The two other teachers had some reserve because they either had not worked with the program in the way they had wanted, or found it too long and difficult to implement.

Our program also showed certain limitations. Some lessons were too long to be finished in the estimated time, which was a problem in classes with limited computer time. The searching skills in particular were dealt with in only one lesson, which made this lesson very dense. Especially for students with less reading skills, the exercises and information in the workbooks were difficult and time consuming. Apart from specific reading problems, the workbook exercises implied a lot of reading, which many students disliked. The lessons on evaluating skills were preferred by both teachers and students. The teachers liked the discussions and exercises; the students came across a new way of looking at Web information, which made quite an impression on many of them. They liked to express to own opinions on the quality and reliability of websites. These lessons also paid less attention to acquiring rather strict formulated skills, as was the case with the lessons on searching and reading skills (which some students did not consider necessary in themselves).

All teachers suggested splitting up the program in three or four smaller projects during a school year. In such way, the searching, reading and evaluating skills could be the focus of a small project on a particular topic. At the end of the year, students should get the opportunity to practice the acquired skills in a project of their own choice. Although a valuable and also practical suggestion, this again points at some tension between the program's goals and their practicability. We aimed at teaching skills and practicing and applying them within one program, in order to realize a connection between Web skills and the context in which these skills may be applied.

Teachers worked with the program under different conditions. From the results we derive some contextual factors that influence the realization of the program's objectives. First, teachers must be willing to invest time and effort in the program. Good preparation of both instruction, class discussion and student support (e.g., by making the student exercises in advance themselves) helps teachers in carrying out the lessons successfully. Second, the use of some specific didactical 'tools' seems to be relevant. It proved to be important that the teacher discussed the design and learning goals of the program with the students. Students who knew what the program was about and what was expected from them, tended to be positive about it, whereas other students considered it just some other piece of schoolwork. Talking with students about the subject of a particular lesson and discussing for example their own ways of using the Web or their own opinions on the reliability of Web information, helped students to stay connected with the program and its learning goals. This seems self-evident, but in fact requires specific teaching skills, which may be difficult for teachers whose focus is primarily on transferring knowledge or supporting students. Also the teacher's use of technical tools as a computer projector proves to be useful: it focuses students' attention, promotes class discussion and makes it possible for the teacher to model certain Web behavior. Third, certain conditions on the class and school level may be relevant. Elements of the class atmosphere as students getting on well together or the presence of animosity between students affect all teaching, but are even more relevant when students are expected to work together and to discuss freely their opinions on certain subjects. Of more practical concern is the way computer work and its supervision are orga-

nized in the school. One teacher cannot support all students working together at the computer; however, splitting up the class makes class assistance necessary.

One important factor influencing the realization of the program's objectives appears to be a teacher's teaching style. The program was designed as a mixture of conventional teaching methods (e.g., all students working in the same pace with the same prescribed exercises) and socio-constructivist elements like collaboration, class discussion about the Web and the skills required to use it for knowledge construction, and much focus on the process of skills acquisition and the integration and practical use of Web skills. Not all teachers were able to connect these socio-constructivist elements in the teaching materials with their own more traditional teaching style, which was reflected in both the teachers' opinion on the program and the students' attitude towards it. This points at the importance of some correspondence between teaching style and program assumptions.

With regard to students' learning results, all classes show knowledge gain with regard to both the subject healthy food and Web skills. However, we are careful with the interpretation of these results because of the low reliability of the tests used and because our study is set up as a multiple case study and thus lacks a control group. Children of the age of our students learn a lot about the Web outside school. Although the results of the final assignments cannot strictly be interpreted in terms of the program's effects, they do show students' actual Web behaviour after the program. With regard to Web searching and reading skills, most students appear to be inconsistent Web users, who do not always act upon their knowledge of these skills. Although generally speaking, a distinction may be made between stronger performing pairs and weaker performing pairs, both groups showed unexpected Web behavior. Most students also showed little planning behavior while searching the Web. Patience seemed to be an important characteristic of stronger performing students. With regard to Web evaluating skills, students were able to use and name aspects of evaluating Web information that had been attended to in the lessons, such as a website's intentions and its usefulness for children. However, most students did not derive their opinions from a thorough investigation of a website's content and did not navigate deeply into websites.

The students who participated in our research differed in certain aspects. Especially for the Acton School students the teaching materials proved to be difficult because of their reading problems and their not being used to discussing their own opinions. This points to the importance of staying aware in both educational practice and research of an emerging 'digital divide' in terms of literacy skills. Although the Web consists of both textual and non-textual elements, it still is a very textual information resource. It appeals to complex reading skills because of its use of hypertext, which not only allows the user to compose his or her own path through the information it offers, but also makes Web information less clearly structured. Coiro (2003) points out that the Web can be a huge hurdle for weaker readers who deserve specific attention. Aspects as the non-linear character of the Web and its 'information overload' are important elements of that hurdle, as is recognized by many researchers (e.g., Pritchard & Cartwright, 2004; Rouet, 2003; Sutherland-Smith, 2002). Our program would have profited from specific support for weaker readers, especially as the materials themselves also required a lot of reading.

In spite of all the difficulties they came across, the Acton School students stayed very motivated and enthusiastic throughout the program. Compared with many other students, they seemed to look at the Web as an educational tool, something that could help them to learn, instead of seeing the Web primarily as belonging to their leisure time. Although

mere speculation, this might reflect their teacher's general emphasis on school work and diligence as being essential for their success in society.

Our results raise some concern about the possibility of teaching Web skills and subject matter in an integrated way. Teaching content knowledge and Web literacy skills together may be possible, but requires some preconditions. Practical teaching conditions like lack of time, computers, room, and student assistance, may be serious obstacles for success. Splitting up the program into smaller parts that contain only one aspect of Web literacy, could give in to the teachers' problems and objections. However, we think Web literacy is more than the sum of its parts and therefore should not be separated in sets of sub skills. The three categories of Web literacy skills – Web searching, Web reading and Web evaluating skills – overlap and are mutually connected. The use of the Web always involves all skills; for example, searching for Web information always involves reading and evaluating skills. Our students' learning results also show the importance of being able to use Web literacy skills in a flexible way. Many students lacked such flexibility. In our view, this points at the relevance of integrating the various Web skills and of treating Web literacy as a concept that must be taught as well as learned as a whole.

We suggest developing curricula that focus on embedding the teaching and learning of Web literacy skills within inquiry activities. In such way, the connection between Web literacy skills and their actual use for a meaningful goal is more easily made. In our program, this was not the case since only the last three lessons focused on the use of Web literacy skills; in the other lessons the attention was on acquiring the necessary Web skills.

In our view, there must be more research attention on meta-cognitive skills such as planning, monitoring and reflecting that play a role when using the Web for knowledge construction, especially with regard to younger students who do use the Web a lot for homework and papers, but who often still lack the necessary meta-cognitive skills. Our results show students' tendency to use the Web rather inconsistently and suggest some discrepancy between students' knowledge of Web searching, reading and evaluating strategies and their actual search behavior. This may be connected with the fact that most students use the Web more intensively at home than at school. As a result, the way they use the Web at school may reflect their use at home, where methods like randomly surfing and 'trial and error' probably are much used. At school, students are requested to use the Web for knowledge construction. This requires a more conscious use of the Web and more attention on general inquiry or meta-cognitive skills like planning, monitoring and reflecting skills.

Appendix 1. Summarized coding form used for the analysis of assignments 1–3

The form is used in order to assess the adequacy of students' searching and reading activities within the context of that specific assignment. An activity is seen as a distinct action on the screen. Talking about an activity is not counted as an activity unless talking leads to action. Activities may concern three aspects of students' Web behaviour:

T = typing a word or a couple of words;

C = clicking on a search result or a link, menu or option;

R = reading activity; reading may refer to reading a specific Web text as well as reading a list of search results. Assessing a reading activity takes both the students' screen behaviour and their conversation into account.

All activities receive the score 0, 0.5 or 1, depending on the adequacy (or relevance) of that activity in the context of a specific assignment.

- 0 The activity is irrelevant for completing the assignment and does not contribute to finding the right answer; this category also contains ‘non-actions’ such as skipping a relevant text on a website in which the answer may be found
- 0.5 The activity is somewhat relevant for completing the assignment, it might contribute to finding the right answer.
- 1 The activity is relevant for completing the assignment, it does contribute to finding the right answer

Examples (of coding for assignment 1: “Which language is spoken by inhabitants of the island Madagascar?”)

- T 0 Typing ‘language’ in Google’s search box
- T 0.5 Typing ‘Madagascar’ in Google’s search box
- T 1 Typing ‘language Madagascar’ in Google’s search box
- C 0 Clicking on a search result that has no reference to Madagascar in its heading or accompanying text
- C 0.5 Clicking on a search result that has some reference to Madagascar in either heading or text, but has no reference to language spoken on Madagascar
- C 1 Clicking on a search result that refers to both Madagascar and language spoken on Madagascar in heading or text
- R 0 Scrolling on or reading a particular Web text that contains the answer on the question, but failing to see that answer (e.g., because students read too fast); looking for the answer on a website that does not refer to Madagascar
- R 0.5 Scrolling on a particular website with the question in mind, but absent-mindedly, which may be reflected in students’ actions and talking (e.g., “we must look for headings about the language they speak” while scrolling too fast to really read anything)
- R 1 Scrolling on a relevant website or reading a relevant Web text clearly with the question in mind, which may be reflected in the way students talk while reading (e.g., “we must look for a heading about the language they speak”)

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