WebQuests in special primary education: Learning in a web-based environment

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Abstract
The present study investigated the differences in learning gain when performing a WebQuest with a well-defined versus an ill-defined assignment. Twenty boys and twenty girls (mean age 11; 10), attending a special primary education school, performed two WebQuests. In each WebQuest, they performed either a well-defined or an ill-defined assignment. Knowledge acquisition was assessed by means of a concept map (ie, associative knowledge) and a knowledge test, based on facts concerning the subject (ie, factual knowledge). Results indicated that the learning gain on both WebQuests was higher for participants who worked on the ill-defined assignments. In the long term, factual knowledge remained intact. The results of this study indicated that the use of WebQuest can be a valuable tool to enrich the educational curriculum in special education.

Special education is provided for children for whom it has been established that a special approach is most appropriate. The use of constructivist learning integrating technology can be useful for children in special education, since earlier research (Lin & Hsieh, 2001) indicated that constructivism allowed children in special education to be more active in defining their own learning goals. This leads to higher learning gains then when learning goals are fixed in advance (Lin & Hsieh, 2001). The use of information and communication technology (ICT) in special education could provide opportunities to put self-generated learning questions into context (Florian, 2004), including problem-based learning (Savery & Duffy, 1995) and anchored instruction (Glaser, Rieth, Kinzer, Prestidge & Peters, 1999). The present study tried to establish what learning gains children in special education can have in a sheltered learning environment on the Internet, contrasting more or less self-regulated learning in two different types of exercises.

Several studies on the use of Internet in special and mainstream primary education (Lin & Hsieh, 2001; Pear & Crone-Todd, 2001) found that, when using the Internet, children will be actively involved in their own learning processes. Moreover, children can judge for themselves whether a text is relevant. Consequently, the intrinsic motivation to participate in that subject will grow.

However, there are also disadvantages to the use of Internet for children. First of all, there is the problem of quantity (Kuiper, Volman & Terwel, 2005). Without pre-structuring, the given information on the Internet, a child may not oversee the amount of information concerning a given subject. Furthermore, there is a qualitative problem (Kuiper et al, 2005). The reliability as well as the relevance of information can be questionable. An Internet user usually develops an ability to
judge the available information and separates the irrelevant from the relevant. This attitude is not sufficiently developed in most children in primary education (Burbeles & Callister, 2000).

Because of these problems, it is obvious that a certain amount of structure is necessary for children just beginning to explore the Internet and this may especially be the case for children with lower cognitive and reading abilities. We therefore adopted the WebQuest concept in the present study as a means to provide structure, but also to be able to give the children certain amounts of freedom (cf. Segers & Verhoeven, 2009), so they can still generate their own learning questions. Therefore, a WebQuest can be used as a constructivist tool in special education (Lin & Hsieh, 2001). Moreover, a WebQuest may be able to reduce the problems the Internet causes for some users and provide a means by which to tackle them. A WebQuest (Dodge, 1995) is a pre-structured web-based learning environment on the Internet, in which children perform several tasks, based on pre-selected information. Research showed medium learning effects in both primary (Segers & Verhoeven, 2009) and secondary education (Wagman, 2005) on subject-related knowledge, but empirical research on the impact of WebQuests on learning is still scarce (Abbit & Ophus, 2008), and children in special education have not been the focus of attention in this line of research.

For struggling readers in special education, Wentink, Wouters, Wennekers, Van Hertum and Reuvekamp (2006) emphasised the importance of using functional writing and reading tasks, because these kinds of tasks link up with the child’s experiences. In a WebQuest, functional writing and reading tasks are included and therefore an authentic and realistic context can be created. A WebQuest may thus contribute to the learning processes of children in special primary education, but the type of task can influence the learning process.

Well-defined and ill-defined tasks
The tasks used in WebQuests can be subcategorised into a continuum from well defined to ill defined, but differences in effectiveness in these different kinds of WebQuests have not been studied before. When performing an ill-defined task (Jonassen, 1997), the answer to the pre-defined question is not clear; an ill-defined task does not have only one correct solution. The solution-finding process can follow different paths and therefore lead to different solutions (Bilal, 2002; Jonassen, 1997, 2000). Ill-defined tasks thus, seem to relate to a constructivist point of view.

However, many of the tasks in online WebQuests are well defined (Abbit & Ophus, 2008). A well-defined task (Jonassen, 1997) is characterised by the fact that the complete solution process is already provided to the student. All the information the student receives is specific, unambiguous and clearly defined. The research question can therefore be answered with one specific answer (Jonassen, 1997). Well-defined tasks thus seem more related to an instructivist point of view.

Most research on the effects of well-defined versus ill-defined tasks, focused on the information seeking process and found participants to be more successful in finding the right information in ill-defined tasks (Bilal, 2002; Large & Beheshti, 2000).

Cerdán and Vidal-Abarca (2008) studied the effectiveness on learning of two kinds of tasks, and found that for university students, the more integration a task requires in order to be performed or the more ill-defined the task is, the more the student will learn as a result.

In another study, Segers, Droop, Damhuis, Buijs and Verhoeven (2007) examined the effects of well-defined versus ill-defined WebQuests on associative learning gain in primary school children. The results showed no difference in knowledge acquisition between the two groups, but the quality of work was higher for the group who performed the ill-defined WebQuest. To the best of
our knowledge, no research conducted so far, has focused on the use of well-defined versus ill-defined environments in special education.

The present study
A WebQuest can be a valuable tool to enrich the educational curriculum in special education. The use of ICT in special education creates new possibilities and tools, which can be beneficial for children with disabilities and in need for special support. When using ICT, a lot of attention is usually given to the technology and not the educational method to support learning (Brodin & Lindstrand, 2003). This could be a problem for children in special education because they often need both technology and educational methods to benefit from computer-based applications.

Empirical research on the impact of WebQuests on learning is scarce, and it is unclear whether children in special education have the ability to work in such an environment when they become more responsible of their own learning in such a way. This is especially the case in the ill-defined condition, because the general belief is that these children need more direct and explicit instruction to learn (cf. Kroesbergen, Van Luit, & Maas, 2004). WebQuests on the Internet vary from well defined to ill defined, but differential effects of these have not been studied before.

Based on the aforementioned studies, we could hypothesise that children in special primary education will profit more from a WebQuest with an ill-defined task than from a WebQuest with a well-defined task. However, if these children need more direct and explicit instruction to learn (cf. Kroesbergen et al., 2004), they would profit more from a WebQuest with a well-defined task. In both cases, however, we expect the children to benefit from doing a WebQuest, since these offer a layer of structure between the child and the Internet to prevent common problems when using the Internet (Segers & Verhoeven, 2009). Furthermore, the use of Internet will actively involve the children in their own learning process (Lin & Hsieh, 2001; Pear & Crone-Todd, 2001), using functional writing assignments (cf. Wentink et al., 2006).

An attempt was therefore made to answer the following research question: What are the differences in learning gains (both directly after the intervention and in a retention test) between a WebQuest with a well-defined versus an ill-defined assignment for children in special primary education?

Method
Participants
Forty children attending a school for special education participated: 20 boys and 20 girls (mean age 11; 10, range 10; 7–12; 11, mean intelligence quotient [IQ] 84, range 66–115). All children experienced mild learning difficulties in reading, mathematics or other school-related areas, with no additional sensory or physical impairments. The children were divided into two groups, matched on IQ, reading ability, vocabulary, gender and ethnicity (all p’s > 0.200). The first group first performed a well-defined WebQuest about fire and then an ill-defined traffic, while the second group began with an ill-defined WebQuest on fire and then performed a well-defined about traffic.

The educational system of the Netherlands distinguishes between two types of primary education, namely mainstream primary education and special primary education. Special education refers to a separate system of special provision. Since 1990, schools for children in special primary education with specific and general learning difficulties have been organised in regional networks of school clusters, in which about fifteen mainstream schools cooperate with one special education school (Ministerie van Onderwijs Cultuur en Wetenschappen, 2002). Special primary education caters to the same age group as mainstream primary schools. The age at which pupils are admitted varies: at some schools, children may be admitted at the age of three, whereas the minimum age is six at other schools. Special primary education caters to children...
with learning problems as well as social-emotional problems. Any child with a diagnosis from the Diagnostic and Statistic Manual of Mental Disorders, fourth edition, is referred to the Regional Expertise Centers (Ministry of Education, Culture and Science, 2002) and is therefore not included in the present study.

Materials
Language skills
Reading ability was assessed with the ‘Drie-Minuten-Toets’ (Three Minutes Test) (Verhoeven, 1995), a commonly used reading task in the Netherlands. Children have to read three different word cards as quickly and as accurately as possible. The stimuli go from Consonant-Vowel-Consonant-words (eg, ‘cat’), to words with consonant clusters, to multi-syllabic words. Each card contains 150 words and there is a time limit of one minute per card. The total number of words read per minute minus the number of words incorrectly read per minute results in a score for each card.

Reading ability was also assessed by measuring text reading. To assess this skill, we used the ‘Analyse van Individualiseringsnormen’ [Analysis of Individualization Norms], a commonly-used test in the Netherlands that gives an indication of the reading ability on text level (range: 0–9). In this task, the participant has to read a text as quickly and as accurately as possible. To proceed to the next level, the participant had to read within a given time and within a fixed amount of errors. When a participant succeeds, a text one level higher than the accomplished one was given until the participant failed.

To determine the level of general passive vocabulary, we used the ‘Leeswoordenschattaak’ (Reading Vocabulary Test) from the ‘Taaltoets Allochtone Kinderen Bovenbouw’ (Language Test for Immigrant Children, grades 4–6) (Verhoeven & Vermeer, 1993). In this multiple choice task, the participant had to read 50 sentences, each containing one underlined word. The participant had to choose the correct synonym for each underlined word, from four options.

Measuring knowledge
Two types of knowledge acquisition were assessed: factual knowledge, which can be assessed by a knowledge test based on facts concerning the subject, and associative knowledge, which can be assessed by using a concept map.

A questionnaire containing ten open questions was designed for this study and used to assess the factual knowledge of each of the themes in the WebQuests, both before and after each WebQuest. Children in both conditions had to answer the same ten questions. Answers to all of the questions could literally be found in the text of both types of WebQuest. An example of one question is: ‘How should you treat a burn?’ For each correct answer the participant received one point. Ten percent of the tests were scored by two assessors. A correlation of 0.86 between the two, showed a good inter-rater reliability.

A second test assessed the associative knowledge of each of the themes in the WebQuests, both before and after each WebQuest. The participant had to write as many words as possible that related to a central word (which was given). The central word was relevant to the theme of the WebQuest. A word (eg, ‘cleaning’) that was not related to a central word (eg, ‘witches’), but was to a word written down by a participant (eg, ‘broomstick’) did not receive any points. Each correct word received one point. Ten percent of the concept maps were scored by two assessors. A correlation of 0.90 showed excellent inter-rater reliability.

WebQuests for the intervention
The structure of a WebQuest is fixed. The introduction of a WebQuest always provides background information and also serves to enable pre-knowledge about a given subject. In the task
section, the learner receives an explanation about the task at hand. Next, a proposition of actions is presented to the learner. The learner can accomplish the given task, by following all the steps of the proposition properly. In the present study two different task types were contrasted. In the resource section, all necessary hyperlinks to accomplish the proposition of actions are presented to the learner. The evaluation section gives an overview of the aspects in which the learner will be assessed. Finally, the conclusion sums up what the learner has learned during the WebQuest (Dodge, 1995).

During the intervention, the participants were asked to perform two separate WebQuests, each with a different theme. Both themes were translated into a well-defined WebQuest and an ill-defined WebQuest. During the first theme, ‘Fire’, the participants were given an anchor video depicting an enormous fire. In order to activate prior knowledge and stimulate the participants’ motivation, the participants were given the opportunity to explore their own school building and to search for precautions the school had taken against the possibility of fire. The participants also photographed each of these precautions to use in their own paper. After that, they used a proposition of actions that guided them through the information from a Dutch website called ‘The National Newspaper for Children’ (http://www.nationalekidskrant.nl, 2006). An example of a step in the well-defined WebQuest was: ‘Search under the title “why is fire so dangerous” for the reasons that fire can be dangerous for people’. An example of a step in the ill-defined WebQuest was: ‘Use the available information from the website to make a well-balanced article on fire prevention. Mention all the information in your article that you think is important.’ In the current study, this WebQuest is also referred to as Fire WebQuest.

The second theme was ‘Traffic’ and specifically, the use of traffic mirrors and traffic signs. This WebQuest (Traffic WebQuest) was set up in a similar way as the first WebQuest.

Because of the fact that a large group of children in special education have language problems, several precautions were taken in designing these WebQuests. First of all, all of the participants had the option to receive an explanation of difficult words by double-clicking on them. Second, the maximum number of words per text was set at 400. Third, both WebQuests required a low understanding of language. This was also the case for the texts in the resource-section. Finally, in order to prevent children with a low stimulus threshold from being distracted by irrelevant stimuli in the WebQuests, both WebQuests were clear-cut with no extra or distracting stimuli (ie, pictures or animated winks).

Procedure
Pretests were assessed in the classrooms. After the pretest, the participants performed an anchor-based task for a total of two hours. After that, the intervention started. The computers were located in a quiet room in the school building. In this room, each participant had the opportunity to work on one computer. All computers were separated from each other by a large screen. One teacher and one assistant teacher supervised the participants. In both WebQuests, children were allowed to work for four 45-minute sessions on the given assignment. Immediately after the intervention, children were retested on factual knowledge and associative knowledge. Three weeks after completion of each WebQuest, factual knowledge was assessed again.

Data analysis
To determine if the two conditions differed in learning gain, before and after completing a well- or ill-defined WebQuest, a repeated measures analysis of variance with time (pretest, posttest) or (pretest, posttest, retention test) and WebQuest (Fire WebQuest, Traffic WebQuest) as within-subject factors and condition (well defined, ill defined) as between-subjects factor was conducted for both associate knowledge and factual knowledge. During the analyses, we controlled for
reading level and vocabulary level. Possible interactions between time and condition were further investigated using analyses of covariance.

**Results**

**Associative knowledge acquisition**

In the first analysis, we found different learning gains for the two conditions on associative knowledge (see interaction between time and condition in Table 1), in both WebQuests.

A follow-up analysis showed that the children did not differ in associative knowledge at pretest ($B = 1.290, p = 0.416$) but after completing the WebQuests, children in the ill-defined condition were found to have higher scores ($B = 6.515, p \leq 0.001$, Cohen’s $d = 1.1963$) than children in the well-defined condition. Figure 1 depicts these results.

**Factual knowledge acquisition**

For factual knowledge, we also found different learning gains for the two conditions (see interaction between time and condition in Table 2), in both WebQuests.

![Figure 1: Average scores on the test for associative knowledge on the pretest (1) and posttest (2). The scores are based on the participants who performed the well-defined WebQuest ($n = 20$) and the participants who performed the ill-defined WebQuest ($n = 20$).](image-url)
A follow-up analysis also showed that for factual knowledge, the children did not differ at pretest ($B = 0.082, p < 0.922$) but after completing the WebQuests, children in the ill-defined condition were found to have higher scores ($B = 5.985, p < 0.001, \text{Cohen's } d = 1.8201$) than children in the well-defined condition. This result remained intact 3 weeks later ($B = 4.984, p = 0.001, \text{Cohen's } d = 1.1936$). Figure 2 depicts these results.

**Conclusions and discussion**

The present study investigated the use of WebQuests in special primary education. We examined whether there were differences in learning gains (both directly after the intervention and in a retention test) between a WebQuest with a well-defined or an ill-defined assignment.

The results indicated an increase in knowledge after performing both a well-defined WebQuest and an ill-defined WebQuest. However, with respect to both knowledge tests, the learning gains on both WebQuests were higher for the participants who performed the ill-defined assignments. In the long term, factual knowledge remained intact. These results are in line with other studies who also examined the effects of well- or ill-defined tasks in WebQuests (Segers & Verhoeven, 2009).
Segers et al. (2007) and the effects of well- or ill-defined tasks in general (Bilal, 2002; Cerdán & Vidal-Abarca, 2008; Schacter, Chung & Dorr, 1998). The difference between earlier research and this study is the research population. Earlier research mainly focused on participants attending mainstream education. However, in this research project, only participants from special primary education were included. This is important because in special education most of the teaching material is well structured and particularly based on the learning of sub-skills. With respect to individual achievement, the results of this study suggest that a poorly-structured environment, rather than a well-structured environment, creates the highest learning potential.

An explanation for these results could be that during the well-defined tasks, no deeper understanding of the texts was required. Because the participants only had to search for the right information in the text, no integration of knowledge took place. According to Marzano and Kendall (2007), this implies that many higher-order thinking skills will not develop and therefore many participants in the well-defined tasks were not be able to associate their knowledge with the world around them (Ikpeze & Boyd, 2007). Because in the well-defined WebQuest, no knowledge construction was required, the application and integration of it into a different context did not occur. This might have resulted in a smaller learning gain for the participants who performed the well-defined WebQuest.

Another explanation for the results in this study may be that the participants who performed the well-defined WebQuest could not process all the steps summed up in the proposition of actions. With relation to this proposition of actions, the participants in the well-defined WebQuest had to read more steps than the participants in the ill-defined WebQuest. A participant might have experienced difficulty in processing all the required steps, because he or she was overwhelmed by it. Moreover, these participants also had to seek specific information in the text. Participants often simply start reading at the top of a page and have not yet learned to skim a text for its relevance or to find more specific information (i.e., the information needed to answer a question). This might have caused cognitive overload (Schacter et al., 1998).

A limitation of the present study was that during the first WebQuest, the participants who performed the well-defined WebQuest were offered fewer resources than the participants who performed an ill-defined WebQuest. Because of the large number of resources, the participants with a higher level of vocabulary may have experienced cognitive overload while performing the ill-defined fire WebQuest. Therefore, they could not benefit from their higher vocabulary skills. During the traffic WebQuest, the number of resources was equal for both conditions. Because of this, cognitive overload may not have occurred during the ill-defined traffic WebQuest.

A second limitation is that we did not address to the heterogeneous nature of the group under study. Many children in special education suffer from psychological disorders, such as attention deficit hyperactivity disorder, disorders in the autistic spectrum and learning disorders. It is important in future research to distinguish between these groups. In gaining insight into these underlying mechanisms, the educational needs of different groups of children can be better addressed.

The role of the teacher was not our focus of interest. However, when using a WebQuest, the role of the teacher should not be underestimated. He or she is of particular importance in choosing the right subject and providing the child with a high level of learning autonomy without excluding their role as teacher or denying the necessity of guidance. This suggests that the success of WebQuest is also dependent on the extent to which the teacher contributes to the learning processes of children (cf. Hegarty, 2004). Future research should take this into account.

Finally, as mentioned in the introduction, one needs to take into account that only two WebQuests were studied, these WebQuests were designed for this study and the results may not hold for all sorts of WebQuests.
In sum, two conclusions can be drawn. First, the use of WebQuest has a positive effect on the learning processes of children in special primary education. Children in this special population proved have the ability to work and learn on the Internet when a layer of structure (cf. Segers & Verhoeven, 2009) is provided. Second, the use of ill-defined tasks results in a higher learning gain than the use of well-defined tasks, contrary to what seems to be the general opinion (Kroesbergen et al., 2004. This is also the case in the long term. The results from this study indicate that the use of WebQuest can be a valuable tool to enrich the educational curriculum in special education.

Our results seem to support the constructivist view that a more active involvement in the own learning process is more beneficial, also for children in special education, and that WebQuests could be implemented in special education. However, although the use of WebQuest may contribute to the learning processes of children in mainstream and special primary education, the use of WebQuest on its own, without a strong connection to the other teaching subjects, is not recommended. Many necessary skills cannot be taught by a computer or WebQuest. We therefore recommend the use WebQuests as part of a well-balanced educational curriculum.

References


