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Internet skills and the digital divide

Alexander van Deursen and Jan van Dijk
University of Twente, The Netherlands

Abstract
Because of the growing amount of information on the internet and people's increasing dependence on information, internet skills should be considered as a vital resource in contemporary society. This article focuses on the differential possession of internet skills among the Dutch population. In two studies, an in-depth range of internet skills are measured by charging subjects assignments to be accomplished on the internet. Subjects were recruited by applying a random stratified sampling method over gender, age, and education. While the level of operational and formal internet skills appeared quite high, the level of information and strategic internet skills is questionable. Whereas education appeared an important contributor to all skill levels, age only appeared a significant contributor to operational and formal skills. The results strengthen the findings that the original digital divide of physical internet access has evolved into a divide that includes differences in skills to use the internet.

Keywords
digital divide, inequality, information, internet, internet skills, literacy, online

Introduction

The term 'digital divide' initially referred to gaps in access to a computer. When the internet diffused rapidly into society and became a primary type of computing, the term shifted to encompass gaps in not only computer but also internet access. Early research on the digital divide focused mainly on a binary classification of physical access. Theories of internet adoption have recognized this limitation and an increasing number of researchers have argued that more attention should be paid to social, psychological, and cultural backgrounds (Van Dijk, 2006). This has resulted in several conceptualizations

Corresponding author:
Alexander J.A.M. van Deursen, University of Twente Faculty of Behavioral Sciences, Department of Media, Communication and Organization, Cubicus Building, PO Box 217, 7500 AE Enschede, The Netherlands
Email: a.j.a.m.vandeursen@utwente.nl

of how to approach digital divide research (e.g., DiMaggio and Hargittai, 2001; Mossberger et al., 2003; Van Dijk, 2005; Warschauer, 2003). These conceptualizations reveal that while gaps in physical access are being addressed, other gaps seem to widen. One of the factors that appears to be important is the differential possession of digital skills. Changes in society demand new skills, especially those related to the internet as one of the most important means of communication in contemporary society. Because of the growing amount of information on the internet and people's increasing dependence on information, internet skills should now be considered as vital assets. When these skills are unequally divided among the population, the consequences of this skills inequality may even exacerbate existing societal inequalities (Van Dijk, 2005; Witte and Mannon, 2007).

Very few measurements and scientific investigations of the actual level of internet skills possessed by populations at large have been conducted. There are several empirical studies that address a specific aspect, e.g., navigation (Ford and Chen, 2000), orientation (Ahuja and Webster, 2001), selecting search results (Aula and Nordhausen, 2006; Pan et al., 2007), defining search queries (Spink et al., 2001), or evaluating information (Moharan-Martin, 2004). Unfortunately, the measurements do not tend to be administered on representative samples. From a sociological point of view, there are only few studies that address internet skills. These studies typically use survey questions asking respondents for an estimation of their own level of internet skills. This method has significant validity problems (Hargittai, 2005; Merritt et al., 2005; Talja, 2005). A general impression that can be drawn is that the divides of skills tend to become bigger than the divides of physical access and that, while physical access gaps are more or less closing in the developed countries, the skills gap tends to grow (Van Dijk, 2005).

Besides using less valid measurement methods, the few conducted internet skills studies among populations at large also fail to explain what the measured skills exactly comprehend. In most cases, only the command of hardware and software is considered. An explanation might be the overabundance of internet skills-related concepts, while operational definitions are almost non-existent. A deeper understanding is required in order to escape the simplification of early digital divide research in which only binary classifications of physical access were considered. Now a new simplification might appear: the simple duality of the skilled and the unskilled.

The main contribution of this article is the measurement of an in-depth range of internet skills actually commanded by the Dutch population. Since the best way to obtain a valid measure of internet skills is directly testing that skill, two large-scale performance tests are conducted. The following section contains the research questions and hypotheses.

Literature review

Internet skills

For measuring internet skills among populations at large, studies that use a range of internet skills with a sequential and conditional nature are very interesting. Steyaert (2002) and Van Dijk (2005) introduced three general types of digital skills that are also applicable to the internet. Steyaert (2002) distinguished between instrumental skills (the operational manipulation of technology), structural skills (related to the structure in which

information is contained), and strategic skills (proactively looking for information, information-based decision-making, and scanning for relevant information). Van Dijk (2005) changed Steyaert's definition to operational skills (the skills to operate computer and network hardware and software), formal information skills (the ability to understand and to handle the formal characteristics of a computer and a network such as file structures and hyperlinks), substantial information skills (the ability to find, select, process and evaluate information in specific sources of computers and networks), and strategic skills (the capacities to use information as the means for specific goals and for the general goal of improving one's position in society). These definitions enable in-depth measurements of internet skills and provide an opportunity to investigate how the different skills levels are distributed among social segments in the population. Furthermore, they go beyond the more traditional definitions of media literacy by suggesting a more (inter)active use. While traditional media enable active mental processing, digital media require users to interact with interfaces. A minimum level of active engagement with the medium is required, and the possibility of interactions, transactions, and interpersonal communication is offered. Using the internet constitutes action, interaction, and transaction.

To encourage research to focus on in-depth skill measurement and to support the achievements of digital divide research, Van Deursen and Van Dijk (2009a, 2010) elaborated the range of internet skills by proposing:

- Operational internet skills. These are derived from concepts that indicate a set of basic skills in using internet technology.
- Formal internet skills. These relate to the hypermedia structure of the internet which requires the skills of navigation and orientation.
- Information internet skills. These are derived from studies that adopt a staged approach in explaining the actions via which users try to fulfill their information needs.
- Strategic internet skills. These are the capacity to use the internet as a means of reaching particular goals and for the general goal of improving one's position in society. The emphasis lies on the procedure through which decision-makers can reach an optimal solution as efficiently as possible.

This division of four internet skills provides opportunities to investigate how these different internet skills levels are distributed among segments in the population. The definition avoids a technologically deterministic viewpoint by both accounting for aspects related to the use of the internet as a medium (operational and formal) and substantive aspects related to the content provided by the internet (information and strategic). The four types of internet skills have a sequential and conditional nature. Content-related skills somehow depend on the medium-related skills because the absence of medium-related skills means that one will not even come to perform the content-related skills. Altogether, these skills are considered necessary for the general population to function well in an online environment. The conceptual definition of internet skills is listed in Table 1. The first research questions is:

RQ 1: What are the levels of operational, formal, information, and strategic internet skills of Dutch citizens?

Table 1. Medium- and content-related internet skills

Medium-related internet skills	
Operational internet skills	*Operating an internet browser:* Opening websites by entering the URL in the browser's location bar; Navigating forward and backward between pages using the browser buttons; Saving files on the hard disk; Opening various common file formats (e.g., PDFs); Bookmarking websites. *Operating internet-based search engines:* Entering keywords in the proper field; Executing the search operation; Opening search results in the search result lists. *Operating internet-based forms:* Using the different types of fields and buttons; Submitting a form.
Formal internet skills	*Navigating on the internet, by:* Using hyperlinks embedded in different formats such as texts, images, or menus. *Maintaining a sense of location while navigating on the internet, meaning:* Not becoming disoriented when navigating within a website; Not becoming disoriented when navigating between websites; Not becoming disoriented when opening and browsing through search results.
Content-related internet skills	
Information internet skills	*Locating required information by:* Choosing a website or a search system to seek information; Defining search options or queries; Selecting information (on websites or in search results); Evaluating information sources.
Strategic internet skills	*Taking advantage of the internet by:* Developing an orientation toward a particular goal; Taking the right action to reach this goal; Making the right decision to reach this goal; Gaining the benefits resulting from this goal.

Source: (Van Deursen and Van Dijk, 2009a, 2010).

Internet skills determinants

Since digital exclusion is strongly associated with traditional forms of social exclusion, differences between several demographic groups with regard to internet skills can be suggested. The second research question is:

RQ 2: Which factors determine internet skills levels?

Regarding gender, the outcomes are not consistent. Goulding and Spacey (2002) claim that men possess more knowledge about the internet and the way to use it than women since the latter have been slower to start using the internet than men have. Wasserman and Richmond-Abbott (2005) found that the level of internet use was related to web knowledge, and that this was higher among men than among women. Schumacher and Morahan-Martin (2001) concluded that men possess greater internet skills than women do. Hargittai and Shafer (2006) found that men and women do not differ greatly in their online abilities, but that women's self-assessed skill is significantly lower than that of men.

H1. There are no differences of internet skill levels between men and women.

Older people are often regarded as 'laggards' in the diffusion process for innovations (Rogers, 1995). Young people get to know the internet at an early age and are considered more skillful than seniors. It is often believed that the so-called digital generation possesses the highest level of internet skills. Seniors have never had the opportunity to acquaint themselves with the internet at school and lag behind in their use of the internet as well as their digital skills (De Haan and Huysmans, 2002). In line with these statements, Hargittai (2002) concludes that age is negatively associated with one's level of internet skills.

H2. With age an increasing number of adults show a lower level of internet skills.

Education is the most consistent global predictor of the use of ICTs. The higher educated more often own computers, have internet access at home, and connect through broadband and spend more time online (Buente and Robbin, 2008). Strongly related to educational attainment are cognitive resources that are largely responsible for differences in internet use and in the digital skills of different educational groups (De Haan et al., 2002). Goldin and Katz (2008) argue that the more highly educated are able to keep up with technological advancements and therefore increase their lead over people who are not able to keep up. However, they also concluded that education in digital skills cannot keep up with technological developments, which has resulted in wage inequality in the US.

H3. With educational level an increasing number of people show a higher level of internet skills.

People who spend more time online will acquire more knowledge about the internet and thus develop better online skills (Hargittai, 2002, 2005). Moreover, people who have been internet users for a longer period of time are expected to be better at finding information online because they have more experience to draw upon (Hargittai, 2002, 2005). Indeed, Hargittai (2002) found years of experience and intensity of use to serve as strong predictors of internet skills. In general, for both computers and the internet, the length of previous experience and the amount of current usage have been associated with greater technological expertise (Schumacher and Morahan-Martin, 2001).

H4. With internet experience an increasing number of people show a higher level of internet skills.

H5. With internet usage time an increasing number of people show a higher level of internet skills.

Social resources consist of access people have to other sources of help and training (Robinson et al., 2003). According to Warschauer (2002), users should participate within a social setting: 'digital literacy' is a social practice, involving access to physical artifacts, content, skills, and social support. Van Dijk (2006) considers the social context of internet users to be a decisive factor in the opportunities they have for learning internet skills. Thus, uptake and also further usage of the internet may be significantly affected by the amount of social support to which a user has access.

H6. People who have access to social support when using the internet show a higher level of internet skills than people who do not.

Other factors that might be significant in the possession of internet skills are socio-economic position, the location of internet use, and participation in an internet course. Students and people in jobs are more likely to use the internet than people that are retired or unemployed (although also undergraduate students with a relatively high level of education demonstrate limitations in internet skills (e.g., Davis, 2003; Volman et al., 2005).

H7. With socio-economic status increasing, people show a higher level of internet skills.

People forced to use the internet at school or in libraries have less time to practice which might result in a restriction of their internet skills.

H8. People who use the internet most often at home will show a higher level of internet skills than people who most often use it elsewhere.

Finally, a myriad of internet courses are offered both in education and in labor organizations. Those that take part in these courses and learn to use the internet are more likely to possess sufficient internet skills than those who do not (Anandarajan et al., 2000). These might help people to improve their level of internet skills.

H9. People who participated in an internet course show a higher level of internet skills than people who did not.

Method

Sample

Two studies were conducted to measure the level of internet skills among the Dutch population. In line with the procedure used by Hargittai (2002), we used the condition of invitation that the subject used the internet at least once every month for more than just e-mail. This condition excluded approximately 20 percent of the Dutch population, but ensured that low-frequency users who were nonetheless familiar with the internet were

included. The subjects were not informed about the exact intention of the studies. The invitation policy put people who feared a test at ease.

To be able to generalize from the findings, the subjects were recruited by applying a stratified random sampling method. First, a sample was randomly selected from a telephone book of an eastern region in the Netherlands. Subsequently, a selective quota sample was drawn from the strata of gender, age (equal number of subjects in the categories of age 18–29, 30–39, 40–54, and 55–80), and educational level of attainment (equal number of subjects in the categories low, middle, and high) to reach equal subsamples. Digital divide research has repeatedly shown that access to and use of the internet is heavily stratified by these variables. When respondents indicated they were willing to participate, contact details were recorded, and a time for the research session was scheduled. Respondents received a confirmation letter in the mail. The day before the study, respondents were reminded of the session by phone. After the session (which took approximately one and a half hours), subjects were rewarded with 25 Euros.

Procedure

The first study took place between September and December 2007 and the second study between September and December 2008. Both performance tests were conducted in a university office. Although this forced subjects to use a computer that might be configured differently from the machine they normally use, this approach does control for quality of the hardware/software and internet connection and ensured that the setting is similar for all.

After arriving at the laboratory, subjects were given verbal instructions about the procedure. Prior to the test, a ten-minute questionnaire was administered to gather personal data. After the subjects completed the questionnaire, they were given a sequence of nine assignments, one at a time. Subjects themselves decided when they were finished or wanted to give up on an assignment. No encouragements were given because the pressure to succeed is already higher in a laboratory setting than at home. After a specific maximum amount of time had passed (determined from pilot-tests), the test-leader gently asked the subjects to move on to the next assignment. If the correct answer was not found, the task was rated as not completed. The test-leader directly measured successful completion of the tasks and the time spent but refrained from influencing the subjects' strategies.

During the assignment completion, subjects used a keyboard, a mouse, and a 17-inch monitor. These were connected to a laptop from which the test-leader could watch the subjects' actions. The laptop had access to a high-speed university network for internet use and was programmed with the most popular internet browsers. This allowed subjects to replicate their regular internet use. No default page was set on the browsers, and all the assignments started with a blank page. To ensure that subjects were not influenced by previous users' actions, the browser was reset after each session by removing temporary files, cookies, and favorites. In addition, downloaded files, history, form contents, and passwords were removed, and the laptop was rebooted.

Assignments

Two assignments (consisting of eight tasks) were used to measure operational internet skills, two (consisting of four tasks) for measuring formal internet skills, three for

measuring information internet skills, and two for measuring strategic internet skills. The total outcome for every type of internet skills is measured as the number of tasks solved successfully and the time spent on these tasks. All assignments were fact-based and have a specific correct action or answer. Open-ended tasks are avoided because of the ambiguity of interpretation of the many potential answers.

In the first study, the assignments related to government information and services. The second study used a more popular context, in which general, leisure-related assignments geared toward the consciousness of all internet users had to be completed (see http://www.alexandervandeursen.nl/nms/ for the complete list of the assignments). In the operational internet skills assignments, subjects were for example asked to save a file, bookmark a website, or fill out an online form. The formal internet skills assignments included for example navigating different website designs and surfing between different websites and search results. The information skills assignments charged subjects with finding information. The assignments ranged from looking up a Michelin-awarded restaurant in Amsterdam to finding minimum wage levels in a specific year. Finally, in order to complete the strategic skill assignments, subjects, for example, had to work in a structured manner and make decisions based on retrieved information. They were for example asked to book a specific trip as profitably as possible, or find the political party that best matches some particular positions.

Explanatory variables

All discussed explanatory variables are accounted for in the internet skills measurements. Gender is included as a dichotomous variable and age as a continuous variable. Data on education were collected by degree. These were subsequently divided into three overall groups of low, medium, and higher educational attainment. Internet experience was measured as the number of years people have been using the internet. The amount of internet use was measured by the number of hours respondents spend browsing the internet weekly (the week before the survey was used as reference). Furthermore, participation in an internet class, whether at school or elsewhere, was considered dichotomous (no/yes). In the regression analyses reported later, the data on social support, location of internet use, and working situation, are also transformed to dichotomous variables. Working situation was divided into active (employers, employees, and students) or inactive (retired, disabled, homemakers, unemployed) groups. This transformation was performed because the number of subjects in some of these groups is very low (see Table 2) and because adding these as dichotomous variables provides information about the variables as a whole, instead of each separate group.

Missing data

The number of missing values was low. During the assignment completion, the test-leaders were instructed to check all data carefully for missing answers. This resulted in only two missing values in the first study and three in the second study. The available data of the subjects that forgot to answer a question were still used, given the limited number of subjects in both studies.

Results

Sample

In both studies, 109 subjects performed the tests (response rates to the invitation were 28% and 32% respectively). Table 2 contains the characteristics of the subjects. The quota sample applied was designed to ensure a sufficient number of subjects in different gender, age, and educational groups to obtain valid data. The average years of internet

Table 2. Subjects over gender, education, age, location of internet use, requiring assistance, socio-economic status, and participation in an internet course

	Study 1		Study 2	
	n	%	*n*	%
Gender				
Male	51	47	57	52
Female	58	53	52	48
Age				
18–29	25	23	27	25
30–39	27	25	23	21
40–54	27	25	28	26
55–80	30	28	30	28
Education				
Low (e.g., Primary school)	32	29	34	31
Middle (e.g., High school)	37	34	34	31
High (e.g., College and University)	40	37	41	38
Primary location of internet use				
At home	95	87	104	95
At work	13	12	5	5
At school	1	1	0	0
At friends or family	0	0	0	0
At a library	0	0	0	0
Assistance when using the internet				
No	51	47	45	41
Yes, from family	32	29	29	26
Yes, from friends	18	17	27	25
Yes, from colleagues	5	5	5	5
Yes, from a helpdesk	2	2	3	3
Socio-economic status				
Employee	54	50	52	47
Retired	18	17	19	18
Student	14	13	16	15
Houseman/housewife	10	9	11	10
Employer	7	6	5	5
Disabled	5	5	3	3
Unemployed	1	1	2	2
Participation in an internet course				
No	84	77	81	74
Yes	25	23	28	26

experience was 8.1 (*SD* = 3.0) and 8.3 (*SD* = 3.2) and the average amount of internet use was 9.7 (*SD* = 9.7) and 9.5 hours a week in studies 1 and 2 respectively. Overall, the people who participated in the studies represented a diverse group of internet users.

Table 3. Overview of successful task completion and time spent

	Task completion		Time (s) spent	
	Study 1 *M*(*SD*)	Study 2 *M*(*SD*)	Study 1 *M*(*SD*)	Study 2 *M*(*SD*)
Operational tasks (8)	6.3(1.9)	5.9(1.9)	553(254)	409(185)
Formal tasks (4)	2.9(1.0)	3.2(1.0)	616(255)	443(214)
Information tasks (3)	1.9(0.8)	1.6(1.0)	939(449)	919(327)
Strategic tasks (2)	0.5(0.7)	0.6(0.7	1,466(575)	1,628(534)

Levels of internet skills

According to Table 3, the subjects in the first study altogether completed 7.2 of the nine operational tasks (80%). They completed an average of 2.9 of the four formal skills tasks (72%) and an average of 1.9 of the three information skill tasks (62%). Most problematic are the two strategic tasks of which the subjects only completed 0.5 overall (25%). Only 11 percent of the subjects were able to complete both strategic skill tasks. In the second study, the results are similar. Here, the subjects altogether completed an average of 6.6 of the nine operational tasks (73%), an average of 3.3 of the four formal skills tasks (83%), an average of 1.6 of the three information skill tasks (53%), and an average of 0.6 (30%) of the two strategic skill tasks. In both studies, the time spent on the information and strategic tasks varies substantially.

Table 4 reveals that 39 percent of the subjects were able to complete all operational internet skills tasks, 33 percent were able to complete all formal internet skills tasks, 21 percent were able to complete all information internet skills tasks, and only 11 percent of the subjects were able to complete both the strategic skills tasks in the first study. In the second study these figures were 25, 55, 16, and 13 percent respectively. As much as 62 percent of the subjects in the first study and 56 percent of the subjects in the second study could not complete any of the two strategic internet skills tasks successfully.

Internet skills determinants

To identify factors that influence the level of internet skills, two linear regressions for all four internet skills were conducted: one with the number of assignments completed successfully as dependent variable and one with the time spent on these assignments as dependent variable.

According to Table 5, age is the main contributor for number of operational skill assignments completed and the time spent. The older the subject, the fewer assignments are completed and the more time is spent on the assignments. Educational attainment is

Table 4. Number of tasks the subjects failed to complete successfully

	# Failed tasks	% of subjects	
		Study 1	Study 2
Operational internet skills	0	39	25
	1	17	13
	2	10	16
	3	11	18
	4	12	8
	5	5	9
	6	5	6
	7	1	4
	8	0	0
Formal internet skills	0	33	55
	1	32	22
	2	22	16
	3	11	6
	4	1	0
Information internet skills	0	21	16
	1	52	45
	2	18	22
	3	8	17
Strategic internet skills	0	11	13
	1	28	31
	2	62	56

Table 5. Linear regression results of the number of operational internet skills tasks completed successfully and time spent

	# Tasks completed successfully		Time spent	
	β – Study 1	β – Study 2	β – Study 1	β – Study 2
Gender (m/f)	–.06	–.07	–.08	.05
Age	–.30***	–.50***	.43***	.57***
Education (low-medium-high)	.32***	.20**	–.27***	–.06
Years online	.15*	.03	–.18**	–.20**
Hours online weekly	.04	.15	–.10	–.15*
Internet class (no / yes)	.03	–.04	–.01	.06
Assistance required (no / yes)	–.12	–.07	.13	.11
Primary location of internet use (at home / elsewhere)	.08	–.16*	–.07	.04
Working situation (inactive / active)	–.15	–.11	–.16*	.08
R^2	.52	.55	.64	.65
F	14.02***	15.46***	22.34***	23.09***

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 6. Linear regression results of the number of formal internet skills tasks completed successfully and time spent

	# Tasks completed successfully		Time spent	
	β – Study 1	β – Study 2	β – Study 1	β – Study 2
Gender (m/f)	.08	.09	–.15	–.05
Age	–.25**	–.35***	.46***	.48***
Education (low-medium-high)	.26*	.27***	–.16*	–.11
Years online	.13	.21	–.13	–.17*
Hours online weekly	–.02	–.02	–.13	–.13
Internet class (no / yes)	.07	.10	–.02	–.11
Assistance required (no / yes)	–.26**	–.03	.13	.10
Primary location of internet use (at home / elsewhere)	–.18*	–.24**	–.05	.19**
Working situation (inactive / active)	.12	–.17	–.09	.09
R^2	.49	.51	.57	.55
F	12.39***	11.36***	16.46***	15.64***

*$p < .05$, **$p < .01$, ***$p < .001$.

also significant for the number of tasks completed and in the first study also for the time spent. Other factors appear less important. Internet experience is significant in the first study for the number of tasks completed, and in both studies for the time spent.

Regarding formal internet skills, age again appears the most important predictor in both studies. In addition, educational attainment is significant for the number of formal tasks completed. See Table 6.

The regression results reported in Table 7 indicate that educational attainment is the main contributor to the number of information tasks completed in both studies. Age is

Table 7. Linear regression results of the number of information internet skills tasks completed successfully and time spent

	# Tasks completed successfully		Time spent	
	β – Study 1	β – Study 2	β – Study 1	β – Study 2
Gender (m/f)	–.13	–.10	–.01	.15
Age	–.12	–.05	.23	.31*
Education (low-medium-high)	.36***	.28***	–.22*	.16
Years online	.07	.13	–.04	–.25
Hours online weekly	–.11	.03	.02	.02
Internet class (no / yes)	.02	–.02	.00	.17
Assistance required (no / yes)	.00	–.21*	.19	.11
Primary location of internet use (at home / elsewhere)	.11	–.08	–.07	–.05
Working situation (inactive / active)	–.04	–.06	–.16	.03
R^2	.13	.27	.23	.18
F	2.82***	3.99***	4.67***	3.55***

*$p < .05$, ***$p < .001$.

Table 8. Linear regression results of the number of strategic internet skills tasks completed successfully and time spent

	# Tasks completed successfully		Time spent	
	β – Study 1	β – Study 2	β – Study 1	β – Study 2
Gender (m/f)	–.06	–.10	–.11	.14
Age	–.17	.02	–.03	.02
Education (low-medium-high)	.42***	.42***	.13	.14
Years online	.02	.06	.06	.10
Hours online weekly	–.15	–.06	–.14	.03
Internet class (no / yes)	.03	–.01	.05	.21
Assistance required (no / yes)	–.16	–.12	.14	.07
Primary location of internet use (at home / elsewhere)	–.05	–.09	–.03	–.06
Working situation (inactive / active)	.14	–.07	–.08	–.02
R^2	.30	.25	.01	.09
F	6.09***	3.75***	.84	1.07

***$p < .001$.

significant for the time spent on the tasks. Finally, using help from peers is significant for the number of tasks completed in the second study.

According to Table 8, educational attainment is the only predictor for the number of strategic tasks completed in both studies. There are no significant predictors for the time spent on the strategic tasks.

Hypotheses

Hypothesis H1 – that there are no differences of internet skill levels between men and women – is supported. Gender did not appear as a significant contributor for any of the four internet skills.

Hypothesis H2 – that with age an increasing number of adults show a lower level of internet skills – is partly supported. The elderly perform more poorly than the younger generations with regard to operational and formal internet skills. However, age did not appear as a significant contributor to the level of information and strategic internet skills.

Hypothesis H3 – that with educational level an increasing number of people show a higher level of internet skills – is supported. The level of educational attainment affects all four types of internet skills.

Hypothesis H4 – that with internet experience an increasing number of people show a higher level of internet skills – is only supported for the operational internet skills. It appears that formal, information, and strategic internet skills do not grow with years of internet experience.

Hypothesis H5 – that with internet usage time an increasing number of people show a higher level of internet skills – is rejected with the partial exception of operational skills. Internet usage time only negatively contributed to the time spent on the operational tasks in the second study.

Surprisingly, Hypotheses H6 – that people who have access to social support when using the internet show a higher level of internet skills than people that do not, and H7 – that with socio-economic status increasing, people show a higher level of internet skills, and H9 – that people who participated in an internet course show a higher level of internet skills than people who did not – are all rejected. Only the primary location of use had some minor influence on mainly operational and formal internet skills. People who use the internet most often at home, rather than at work, libraries, with friends or in internet cafés seem to perform slightly better on these skills. Thus Hypothesis H8 – that people who use the internet most often at home will show a higher level of internet skills than people who most often use it elsewhere – is partly supported.

Research questions

Regarding research question 1, it appears that the Dutch population on average has a fairly high level of operational and formal internet skills, but that the levels of information and especially strategic internet skills attained are much lower. The latter leave much room for improvement. It is important to understand that operational and formal internet skills are not sufficient for effective use of the internet and that information and strategic internet skills are more troublesome. The general assumption that assistance can always be provided to those who have insufficient skills might be partly true for relatively basic operations, but certainly not for more complicated ones that require information and strategic internet skills. The results of the performance tests force policy makers and new media developers to adjust their beliefs that, with the exception of some seniors, everybody has access to and can use the internet.

Regarding research question 2, it appears that age and educational attainment are the most important contributing factors. Age is significant for operational and formal skills. The younger generation performed better on operational and formal skills, but not on information and strategic skills. Educational attainment appears significant for all internet skills. Other research results revealed that people learn digital skills more in practice, by trial and error, than in formal educational settings (De Haan and Huysmans, 2002; Van Dijk, 2005). We argue that this is probably the case for operational and formal skills, but certainly not for information and strategic internet skills. Internet experience only contributes to the level of operational internet skills. It appears that formal, information, and strategic internet skills do not grow with years of internet experience. Furthermore, amount of time spent online weekly only negatively contributed to the time spent on the operational tasks in the second study. Survey research that uses internet self-efficacy as a dependent variable often finds prior internet experience to be a very strong predictor. An explanation for the observed weak relation of internet experience and time spent online with operational and formal skills might be the fact that people often keep repeating similar mistakes when using the internet. Computer users tend to rely on acquired skills, even when they are aware that they could learn more efficient procedures for achieving the same results (Cahoon, 1998). This probably also accounts for internet use. People learn by trial and error, but when they more or less achieve the goals they had in mind, people will persist in making the same mistakes online.

Discussion

The two studies discussed intended to measure an in-depth range of internet skills actually commanded by the Dutch population. While other definitions of internet skills often focus on specific aspects of internet use, we have applied a definition of internet skills that is derived from multiple research directions and subsequently arranged in a particular order. An important characteristic of the applied definition is the sequential and conditional nature of four types of internet skills. The results of the study emphasize the value of this particular distinction by revealing that especially the information and strategic internet skills appear to be the most difficult in performance tests and leave much room for improvement. A second characteristic of the applied definition is that it concentrates on task- and goal-oriented internet use. This goes beyond the more traditional definitions of media literacy by suggesting a more (inter)active use (consisting of interaction with programs or people, transactions in goods and services, and making decisions). A third characteristic of the applied definition is that the considered internet skills should be commanded by every internet user if they want to effectively use this medium at all.

Although the results of both studies are similar, the temptation to draw conclusions about absolute levels of performance should be avoided. There are a few other performance tests of users' internet skills, but these did not distinguish between the four skills applied here. Unfortunately, this means that there are no direct standards of comparison within the Netherlands, or any other country. Four general claims can be made:

1. The Netherlands is a country with very high household internet penetration (93% in 2010) and a high level of educational attainment. It is to be expected that performance in many other countries in the world will be lower.
2. Evidently, the results depend on the difficulty of the assignments. In the first study, relatively simple tasks of using online government information were selected. In the second study, an even more feasible context was used, as virtually everyone is familiar with the leisure activities used for the internet assignments. The results of both studies appeared similar, suggesting that previously existing knowledge about government issues seems to have had a minor effect on the level of internet skills.
3. The two studies were administered to Dutch-speaking subjects only. Since the amount of content available in other languages, especially English, is larger than available content in the Dutch language, employing information and strategic internet skills in these languages might be even more difficult.
4. In actual internet use outside the artificial test situation, performances can be expected to be lower. In a test situation, subjects are often more motivated to complete an assignment (though, in this case, they were not explicitly spurred). In their own environments, many of them would have grabbed the phone or run to a service desk or someone else in their social environment to get the answer. Other research among the Dutch population indicates that users of public websites often give up and turn to the telephone or a front desk (Pietersen and Ebbers, 2008).

In our studies we did not account for communication skills since this would have made the performance tests that already required 1.5 hours from the subjects an unrealistic effort. The skills necessary for content creation and content sharing have also been neglected. However, in our view, both information and strategic internet skills are also crucial for these activities. Active participation and user-generated content require a high level of internet skills, particularly for 'serious' as compared to entertainment applications. Both limitations are tasks for future research.

We do not know whether the lack of information and strategic skills we have observed appears to the same extent in the information retrieval of traditional media. Further research should address this question by including comparable information and strategic skills performance tests in the use of media other than the internet. A comparison of the results of these tests would reveal whether internet use produces better test results or introduces another barrier because many people do not master the special skills required for appropriate use of the internet. Finding information in a traditional library might be more difficult for inexperienced information seekers than finding the same information on the internet using a 'simple' search engine. However, the internet makes information seeking and improving literacy more difficult, as they assume a number of new operational and formal skills. This raises yet another barrier in addition to the skills of reading and writing. Confirmative research is necessary to reveal whether operational, formal, information, and strategic skills together increase the gap between people of differing ages and educational and occupational backgrounds in terms of the new (as opposed to traditional) media.

Conclusion

The results of the conducted studies strengthen the findings that the original digital divide (defined as the gap between people who have and do not have physical access to computers and the internet) has developed a second divide that includes differences in the skills to use the internet. For a better understanding of these skills divides, it is important to consider both medium- and content-related internet skills in future measurements. In digital divide research, the conclusion that operational and formal internet skills are not sufficient for an effective use of the internet so far only received little attention. Information and strategic internet skills are also required. In contemporary (and future) information society these skills increasingly determine people's positions in the labor market and in social life. Unfortunately, these skills appear to be the most problematic and a large part of the Dutch population seems to be struggling to equip themselves with the skills they need to participate in contemporary society.

If people with low levels of internet skills fail to find information online while an increasing amount relevant to daily life become easiest to access on the internet, they become increasingly disadvantaged. The results of the studies strongly indicate that large parts of the population will be excluded from actual and effective internet use. This especially goes for less educated populations. While these groups have always been socially disadvantaged, their life chances are now further in danger. They are increasingly excluded from all the benefits the internet now has to offer, ranging from economic opportunities such as privileged access to jobs, health opportunities such as better diets

or improved exercise habits, or political opportunities such as online services and participation. This exclusion appears over all age groups within society. In the beginning, groups with fewer internet skills will be persuaded in negative ways; flights will be booked, concerts will be sold out, jobs will be given away, and dates will primarily be granted to those having access. Continuing the transformations towards the internet in the most important domains of life will eventually lead to serious problems if the lack of internet skills among large parts of the population is not accounted for. Unfortunately, only the lack of operational and formal internet skills might be considered as a temporary problem (until a better accessible technology appears). The lack of information and strategic skills seems to be more structural. These skills strongly relate to education and intellectual capacities and should therefore gain a more central position in future research. While originally the digital divide could be 'easily' addressed by providing physical access, this now seems to be much harder when content-related internet skills are considered. Although several recommendations can be provided (see, for example, Van Deursen and Van Dijk, 2009b), one might seriously question whether the digital divide can be closed at all.

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References

Ahuja JS and Webster J (2001) Perceived disorientation: An examination of a new measure to assess web design effectiveness. *Interacting with Computers* 14(1): 15–29.

Anandarajan M, Simmers C and Igbaria M (2000) An exploratory investigation of the antecedents and impact of internet usage: An individual perspective. *Behaviour & Information Technology* 19(1): 69–85.

Aula A and Nordhausen K (2006) Modeling successful performance in Web searching *Journal of the American Society for Information Science and Technology* 57(12): 1678–1693.

Buente W and Robbin A (2008) Trends in internet information behavior 2000–2004. *Journal of the American Society for Information Science and Technology* 59(1): 1743–1760.

Cahoon B (1998) Teaching and learning internet skills. *New Directions for Adult and Continuing Education* 78: 5–13.

Davis PM (2003) Effects of the web on undergraduate citation behavior: Guiding student scholarship in a networked age. *Libraries and the Academy* 3(1): 41–51.

De Haan J and Huysmans F (2002) Differences in time between internet users and nonusers in the Netherlands. *IT&Society* 1(2): 67–85.

De Haan J, Huysmans F and Steyaert J (2002) *At Home in a Digital World: Acquiring Digital Skills between Home and School.* The Hague: Social and Cultural Planning Agency.

DiMaggio P and E Hargittai (2001) *From the 'Digital Divide' to 'Digital Inequality': Studying Internet Use as Penetration Increases.* Working Paper Series 15, Princeton University Center for Arts and Cultural Policy Studies.

Ford N and Chen SY (2000) Individual differences, hypermedia navigation, and learning: An empirical study. *Journal of Educational Multimedia and Hypermedia* 9: 281–312.

Goldin C and Katz LF (2008) *The Race between Education and Technology.* Cambridge, MA: Harvard University Press.

Goulding A and Spacey R (2002) Women and the Information Society: Barriers and Participation. Paper presented at 68th IFLA Council and general conference, Glasgow, 18–24 August.

Hargittai E (2002) Second-level digital divide: Differences in people's online skills. *First Monday* 7(4).

Hargittai E (2005) Survey measures of web-oriented digital literacy. *Social Science Computer Review* 23(3): 371–379.

Hargittai E and Shafer S (2006) Differences in actual and perceived online skills: The role of gender. *Social Science Quarterly* 87(2): 432–448.

Merritt K, Smith D and Renzo JCD (2005) An investigation of self-reported computer literacy: Is it reliable? *Issues in Information Systems* 6(1): 289–295.

Morahan-Martin JM (2004) How internet users find, evaluate, and use online health information: A cross-cultural review. *CyberPsychology and Behavior* 7(5): 497–510.

Mossberger K, Tolbert CJ and Stansbury M (2003) *Virtual Inequality: Beyond the Digital Divide.* Washington, DC: Georgetown University Press.

Pan B, Hembrooke H, Joachims T, Lorigo L, Gay G and Granka L (2007) In Google we trust: Users' decisions on rank, position, and relevance. *Journal of Computer-mediated Communication* 12: 801–823.

Pieterson W and Ebbers W (2008) The use of service channels by citizens in the Netherlands: Implications for multi-channel management. *International Review of Administrative Sciences* 74(1): 95–110.

Robinson JP, DiMaggio P and Hargittai E (2003) New social survey perspectives on the digital divide. *IT&Society* 1(5): 1–22.

Rogers EM (1995) *Diffusion of Innovations.* New York: Free Press.

Schumacher P and Morahan-Martin J (2001) Gender, internet and computer attitudes and experiences. *Computers in Human Behavior* 17: 95–110.

Spink A, Wolfram D, Jansen BJ and Saracevic T (2001) Searching the web: The public and their queries. *Journal of the American Society for Information Science* 53(2): 226–234.

Steyaert J (2002) Inequality and the digital divide: Myths and realities. In: Hick S and McNutt J (eds) *Advocacy, Activism and the internet*. Chicago, IL: Lyceum Press, 199–211.

Talja S (2005) The social and discursive construction of computing skills. *Journal of the American Society for Information Science and Technology.* 56(1): 13–22.

Van Deursen AJAM and van Dijk JAGM (2009a) Using the internet: Skill related problems in users' online behavior. *Interacting with Computers.* 21: 393–402.

Van Deursen AJAM and van Dijk JAGM (2009b) Improving digital skills for the use of online public information and services. *Government Information Quarterly* 26: 333–340.

Van Deursen AJAM and van Dijk JAGM (2010) Measuring internet skills. *International Journal of Human-Computer Interaction.* 26(10): 891–916.

Van Dijk J (2005) *The Deepening Divide Inequality in the Information Society.* London: Sage Publications.

Van Dijk J (2006) Digital divide: Research, achievements and shortcomings. *Poetics* 34: 221–235.

Volman M, van Eck E, van Heemskerk L and Kuiper E (2005) New technologies, new differences: Gender and ethnic differences in pupils' use of ICT in primary and secondary education. *Computers & Education* 45(1): 35–55.

Warschauer M (2002) Reconceptualising the digital divide. *First Monday* 7(7).
Warschauer M (2003) *Technology and Social Inclusion: Rethinking the Digital Divide.*Cambridge, MA: The MIT Press.
Wasserman IM and Richmond-Abbott M (2005) Gender and the internet: Causes of variation in access, level, and scope of use. *Social Science Quarterly* 86: 252–270.
Witte J and Mannon S (2007) *The Internet and Social Inequalities.* New York: Routledge.

Alexander J.A.M. van Deursen is a researcher at the University of Twente in the Netherlands. His dissertation, entitled 'Internet skills, vital assets in an information society' has just been released. His research focuses on digital inequality with specific attention to internet skills.

Jan A.G.M. van Dijk is Professor of Communication Science and the Sociology of the Information Society at the University of Twente, the Netherlands. He is chair of the Department of Media, Communication and Organization and Director of the Center for eGovernment Studies at the same university.