



Improving digital skills for the use of online public information and services

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ABSTRACT

There are recent indications regarding the use of online public services that force the government to focus on the more refined conceptualizations digital divide research has produced. This paper addresses one of the factors that appears to be important in several conceptualizations of how to approach the digital divide; the differential possession of so-called digital skills. The problem of being short of skills becomes urgent when governments suppose that citizens are able to complete about every task on the Internet. Operational definitions for operational, formal, information and strategic skills are used to measure the Internet skills of the Dutch population at large, by giving 109 subjects nine government related assignments to be accomplished on the Internet. Subjects were recruited following a two step approach; randomly select a sample from the book/list of fixed telephony subscribers, followed by drawing a selective quota sample for the strata of gender, age and educational level. The results indicate that on average 80% of the operational skill Internet tasks, 72% of formal Internet skills tasks, 62% of the information Internet skills tasks and 22% of strategic Internet skills tasks assigned have been successfully completed. The Dutch government's expectation that every citizen with an Internet connection is able to complete the assignments following tasks the government thinks every Internet user can perform, clearly is not justified. The article provides two types of policy recommendations to change this state of affairs. Recommendations for improving government websites and for improving the skill levels of Dutch citizens are suggested.

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1. Introduction

An important research area on both the politic and scientific agenda is the divide between people that have and do not have access to computers and the Internet (Van Dijk, 2005, 2006). While original research in this area mainly focused on a binary classification of physical or material access, recently more refined understandings have come forward, taking several other factors into account (e.g., DiMaggio & Hargittai, 2001; Van Dijk & Hacker, 2003). Theories of Internet adoption and use have recognized the limitations of the overemphasis of material resources (Freese, Rivas, & Hargittai, 2006).

It is important that the extension of the concept of the digital divide beyond mere physical access to computers and the Internet gains more footing in the public sector, where the implications are major when access data appear more positive than they actually are. After all, many policy makers at the national and local levels of government think the access problem is solved as soon as the large majority of the population is connected. They tend to believe that the Internet already is a generally accessible channel for both citizen information and communication. This results in the online distribution of as much governmental information and services as possible. Unfortunately, this policy is characterized by barely funded

presuppositions of what citizens want to do and what they can do on the Internet (Van Deursen, van Dijk, & Ebbers, 2006).

Not all potential users and information seekers will equally benefit from the new opportunities. Information divides do not only exist between industrialized nations and developing countries, but also between those with easy access to information and those who do not how and where to find it within individual societies (Goulding, 2001). It is often believed that overcoming this divide is easily solved by providing multiple access points, physical and digital. However, those most in need of information are unlikely to have easy access to the information technology required to retrieve the information or may they have the necessary skills to use information services provided by ICT (Goulding, 2001). The use of more traditional service channels, like the telephone and service desks, remains the most important means of interaction, despite the efforts of the government to persuade citizens in using electronic rather than traditional channels (Ebbers, Pieterse, & Noorman, 2008). At least in the Netherlands many of the services offered online are hardly being used and only a few services are responsible for the bulk of the eservice usage (Van Deursen et al., 2006; Van Dijk, Pieterse, Ebbers, & van Deursen, 2007).

The observations described force governments to go beyond obvious access data and focus on the more refined conceptualizations digital divide research has produced. This study considers one of the factors that are shown to be important in all these refinements: digital skills. This topic has gained more prominence in digital divide literature

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recently due to the recognition that access to, or ownership of a computer is not equal to the capacity to operate and use a computer (e.g., Bertot, 2003; Hargittai, 2002a; Van Dijk & Hacker, 2003). It is has been shown that these skills influence the take up of online government services (Van Dijk et al., 2007). Even when citizens have equal access to computers and the Internet, they may not have the skills to use the online public services offered to them. The problem of being short of skills becomes urgent when governments suppose that citizens are able to complete about every task on the Internet. Although there are various policies that attempt to resolve particular aspects of the digital divide (Bertot, 2003), policy advisors often believe that the problem of a lack of connectivity and participation will solve itself over time when the present, mainly elderly generation of computer illiterates has become extinct (Van Deursen, 2007).

Very little scientific research has been done on the actual level of digital skills possessed by citizens. Unfortunately it is extremely difficult to determine the actual level because most digital skills are not the result of computer courses, but of learning through practice in particular social user environments (Van Dijk, 2005). So far, there are only few estimates of skills. A number of large-scale surveys have revealed dramatic differences of skills among populations, also among populations of countries with large new media diffusion (Van Dijk, 2005; Warschauer, 2003). However, these surveys measure the actual level of digital skills possessed by questions asking respondents to estimate their own level of digital skills. This kind of measurement has obvious problems of validity (Hargittai, 2002b; Merritt, Smith, & Renzo, 2005; Talja, 2005). Measurements of real performances only occur in small educational settings or as a part of computer classes. The problem of these measurements is that they are fully normative: whether the goal of a particular course has been reached. A problem for both types of measurements, surveys and course exams is that they mostly use a limited definition of digital skills that does not go beyond operational skills. The only way to obtain a valid and complete measurement of digital skills is to charge people with performance tests of computer and Internet tasks that they regularly meet in daily life. Performance tests have so far only been done by Hargittai (2002b). She charged a number of 54 demographically diverse American experimental subjects with five rather different Internet search tasks. The results revealed enormous differences of accomplishment of these tasks and the time needed for them. Performance tests taking different digital skills in consideration have also been done in the investigation reported here for tasks in using online government services in the Netherlands.

The Netherlands is the second country of the world in broadband diffusion after South Korea. The general level of education is high and therefore digital skills are not expected to be a problem. Thus, the Dutch government pays a lot of attention to the supply of electronic services in order to make communication with citizens as effective, efficient and transparent as possible. This study casts doubts on the effectiveness of this policy providing an in-depth investigation of the Dutch citizens' actual skills when using online public services and information. The next section covers the research background and the framework used for measuring digital skills. Section three describes the methodology and section four presents the results. In section five conclusions are drawn and in section six policy recommendations are derived. Finally section seven provides issues of discussion.

2. Research background

2.1. Introduction

When focusing on digital skills, two aspects are considered most important in the context of electronic government: online information and online services, brought together in the term "e-citizenship" (Eurocities & Deloitte, 2005) and also covered in the new ECDL (European Computer Driving License) module 'e-citizen'. Unfortunately,

the ECDL approach is limited because it mainly pays attention to operational skills, so called 'button knowledge'. A broader definition of digital skills is required. Only few studies are able to provide theoretical support for such a definition. In general, the literature regarding digital skills is not consistent in the terms used and in the underlying concepts. Bawden (2001) was one of the first to address this problem. However, not much has changed since 2001. Still, a lot of extended definitions and interpretations are given to the term digital skills. One should not expect agreement on the issues of what constitutes digital skills or why they are required (Martin, 2006). Most studies trying to measure digital skills lack theoretical justification. Instead they are solely based on common sense. As a result, different operational definitions are used that fail to cope with the full range of skills required.

2.2. Measuring digital skills

As the concerns about adequate digital skills of citizens are growing among policy makers, there is a strong need for an operational framework that can guide both research and policies. Most frameworks do not go beyond the stage of conceptual definition. The framework suggested tries to make a further step producing an elaborate system of indications and empirical measurements of four types of digital skills. This framework is applicable in multiple digital domains, both stand-alone computers or multimedia and networks such as the Internet. It starts with a distinction of four types of digital skills (Van Deursen & Van Dijk, 2008):

- Operational skills: the skills to operate digital media;
- Formal skills: the skills to handle the special structures of digital media such as menus and hyperlinks;
- Information skills: the skills to search, select and evaluate information in digital media;
- Strategic skills: the skills to employ the information contained in digital media as a means to reach a particular personal or professional goal.

In this study these definitions are applied to the Internet or to the so-called Internet skills.

2.3. Operational framework

Based on this cumulative framework operational definitions are elaborated for online government services and information on the Internet. These definitions are used to measure the skills of Dutch citizens when using these services. A full explanation of the four types of skills is available (Van Deursen & Van Dijk, 2008).

Operational skills mean being able to:

- Operate an Internet browser:
 - Opening websites by entering the URL in the browser's location bar;
 - Surfing forward and backward between pages using the browser buttons;
 - Saving files on the Hard Disk;
 - Opening various common file formats (e.g., PDF, SWF);
 - Bookmarking websites;
 - Changing the browser's preferences (e.g., start page);
 - Using hyperlinks.
- Operate online search engines:
 - Entering keywords in the proper field;
 - Executing the search operation;
 - Opening search results in the search result lists.
- Complete online forms:
 - Using the different types of fields and buttons (e.g., drop-down menus);
 - Submitting a form.

Formal skills mean being able to:

- Navigate on the Internet, by:
 - Recognizing and using hyperlinks (e.g., menu links, textual links, and image links) in different menu and website lay-outs.
- Maintain a sense of location while navigating on the Internet, meaning:
 - Not getting disoriented when surfing within a website;
 - Not getting disoriented when surfing between websites;
 - Not getting disoriented when browsing through, and opening search results.

Information skills mean being able to:

- Locate required information, by:
 - Choosing a search system or place to seek information;
 - Defining search queries that focus on the information problem;
 - Selecting information;
 - Evaluating information sources.

Strategic skills mean being able to:

- Take advantage of the Internet, by:
 - An orientation towards a particular goal;
 - Taking the right action to reach this goal;
 - Making the right decision to reach this goal;
 - Gaining the benefits belonging to this goal.

2.4. Research questions

The problems described and the framework proposed lead to the following research question:

RQ 1: Do Dutch citizens have an adequate level of operational, formal, information and strategic skills to use online government information and services?

Probably these four digital skills are not equally divided among Dutch citizens. Several factors are taken into consideration: gender, age, education, societal position, internet experience, amount of Internet use, support from peers when using the Internet, the primary location of Internet use and participation in an Internet course. The second research question is:

RQ 2: Do the skill levels differ between particular categories of citizens and if so, in what respect?

When the answers to these questions reveal a problem because the level of particular digital skills among citizens is not adequate, policy questions appear. How can performances be improved? Two very general ways of improvement are available here. Governments could either make a better supply of services that are more easy to use, or they could assist citizens demanding these services in developing their own digital skills. This brings us to the following research questions:

RQ 3: How can the government improve its supply offering online services that require less digital skills of citizen users?

RQ 4: How can the government and other responsible actors support the demand of online services improving the level of digital skills among (particular groups of) citizens?

3. Method

3.1. Subjects

Subjects were recruited in July 2007 by randomly dialing telephone numbers. Cities and villages proximate to the University of Twente were selected to equal the national distribution of the Netherlands according to the distribution of the number of inhabitants—skills can

differ in the city and the countryside. A minimum condition of invitation was that subjects used the Internet at least once every month and for more than only e-mail. This ensured that also low frequency users who are nonetheless familiar with the Internet are included. The invitation policy also reassured people that might fear a test. Subjects were told that the experiment was about their Internet use. They received 20 euros for their participation in a one and a half hour research session.

The sample procedure followed a two step approach. As indicated, first a sample was randomly selected from the book/list of fixed telephony subscribers. Subsequently, a selective quota sample was drawn for the strata and quota of gender (51 male and 58 female), age (18–29: 25, 30–39: 27, 40–54: 27 and 55–80: 30) and educational attainment (low: 32, medium: 37 and high: 40). The sampling result is not statistically representative for the Dutch population—109 subjects is a large number for an experimental test, not for a survey—but gives a fairly good indication of the performance level of the Dutch population as much trouble was taken to reach sample dispersion.

3.2. Technical specifications

The studies were conducted in an office of the University of Twente, where the setting was equally new for all participants. Participants used a keyboard, a mouse and a 17 in. monitor connected to a laptop that provided the three most popular internet browsers (Internet Explorer, Mozilla Firefox and Opera). This allowed participants to replicate their usual internet behavior. No default page was set on the browsers and all new assignments started out with a white page. To ensure that participants were not influenced by previous user's actions, the browser used was totally reset. The laptop was connected to the Internet with a high-speed university network.

3.3. Nine performance test assignments

Nine assignments in the field governmental or political information retrieval strictly following the operational framework described above were prepared. Two tasks were made to measure operational skills, two for formal skills, three for information skills and two for strategic skills. The selection and creation of the assignments accounted for the following rules:

- The assignments consisted of actions that the government assumes citizens are able to perform;
- When tasks pointed to a particular website,—and were not chosen by the subjects themselves browsing on the Internet to find answers to questions—sites that score well on usability in a Dutch benchmark for public websites were offered;
- All assignments were pilot-tested with twelve participants to check the understandability, difficulty and applicability of tasks.

Subjects' performances were measured both by successful assignment completion and by the time (in seconds) spent on each assignment. Participants themselves decided when they were finished or wanted to give up on an assignment. After some time a deadline appeared when the test leader gently asked the subjects to pass to the next assignment. Only one answer or action was defined to be correct in advance. If the correct answer was not found, the task was rated as not completed. A full overview of the assignments is available in [Appendix A](#).

3.4. Questionnaire

Prior to the experiment, a 10-minute questionnaire was administered to gather personal data such as age, gender, education, ethnic background and information about the frequency and location of respondents' regular Internet use their social support networks and societal position.

4. Results

The results of the assignments are discussed in this section, for every type of skill. Linear Regression Analysis provides the factors that are most important in predicting the level of the four types of skills.

4.1. Operational skills

For measuring operational skills, two assignments were administered, consisting of nine tasks altogether. The first assignment tested whether participants were able to perform some basic operations, including clicking a link, saving a PDF, downloading files, adding a website to the Favorites and performing a search operation. In assignment 2 participants had to complete a web based form on a government website.

Participants completed an average of 7.2 (SD 2.0) of a total of 9 tasks and spent an average of 553 s (SD 254). According to Table 1, education, age and internet experience are the main predictors for the level of operational skill. They are significant both for number of tasks completed and time spent on the tasks.

4.2. Formal skills

For measuring formal skills, two assignments were administered, consisting of four tasks. The first assignment tests whether a participant is able to follow multiple links in a menu, doesn't get disorientated when a new window is opened and can browse and open (more than one) search results. The second assignment tests whether participants are able to locate similar contact information in different website layouts and designs.

Participants completed an average of 2.9 (SD 1.0) of a total of 4 tasks and spent 616 s (SD 255). As presented in Table 2, education and age again are the main predictors for the number of formal tasks completed. Additionally, the amount of time spent online each week appears to be negatively related to the time spent on the formal tasks.

4.3. Information skills

For measuring information skills, three assignments were administered. In the first assignment participants had to find information in a closed environment, a municipal website. The other two assignments are open web tasks (no specific homepage or search engine assigned).

Participants completed an average of 1.9 (SD 0.8) of 3 assignments and needed 939 s (SD 449). Regression results in Table 3 indicate that education is the only significant predictor for the number of information tasks completed.

Table 1
Linear regression results for the operational skill assignments (n=109)

	Number of tasks completed		Time spent on tasks	
	T	Beta	T	Beta
Gender (male/female)	-0.82	-0.06	-1.30	-0.08
Age (young-old)	-3.13	-0.30***	5.11	0.43***
Education (low-high)	3.86	.32***	-2.75	-0.27***
Internet experience (years)	1.90	0.15*	-2.56	-0.18**
Weekly time online (hours)	0.55	0.04	-1.44	-0.10
Followed an Internet course (no/yes)	0.45	0.03	-0.14	-0.01
Using peers for help (no/yes)	-1.47	-0.12	1.83	0.13
Primary location of Internet use (at home/elsewhere)	1.15	0.08	-1.15	-0.07
Working situation (inactive/active)	1.62	-0.15	-1.97	-0.16*
R ²	0.52		0.64	
F	14.02***		22.34***	

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 2
Linear regression results for the formal skill assignments (N=109)

	Number of tasks completed		Time spent on tasks	
	T	Beta	T	Beta
Gender (male/female)	1.06	.08	-2.17	-.15
Age (young-old)	-2.58	.25**	5.01	.46***
Education (low-high)	2.94	-.26*	-1.98	-.16*
Internet experience (years)	1.56	.13	-1.68	-.13
Weekly time online (hours)	-0.30	-.02	-1.66	-.13
Followed an Internet course (no/yes)	1.00	.07	-0.24	-.02
Using peers for help (no/yes)	3.08	-.26**	1.65	.13
Primary location of Internet use (at home/elsewhere)	2.40	-.18*	-0.76	-.05
Working situation (inactive/active)	1.26	.12	-1.07	-.09
R ²	0.49		0.57	
F	12.39***		16.46***	

* $p < .05$.

** $p < .01$.

*** $p < .001$.

4.4. Strategic skills

For measuring strategic skills, two assignments were administered. In the first assignment participants had to find out what benefits they could gain when being underpaid (the benefit being the retrieval of unpaid salary). The second assignment demanded that subjects indicated their favorite political parties in succession, taking three political positions into account. To accomplish this task, participants needed to visit the websites of the three relevant political parties or combine the parties' names with a specific position in a search engine.

Participants completed an average of 0.5 (SD 0.7) of these 2 tasks and needed 1466 s (SD 575). According to Table 4 education is the main predictor for the number of strategic tasks completed. No significant time differences are reported.

5. Conclusions

5.1. Do Dutch citizens have an adequate level of operational, formal, information and strategic skills to use online public information and services?

The general public opinion in the Netherlands is that 80% of Dutch citizens have access to the Internet and can easily consult online government information. For those that do not have access or cannot use the Internet, a common belief is that there are always proximate others that can provide assistance. This assumption might be partly true for the relatively simple government information and services

Table 3
Linear regression results for the information skill assignments (n=109)

	Number of tasks completed		Time spent on tasks	
	T	Beta	T	Beta
Gender (male/female)	-1.35	-.13	-0.15	-.01
Age (young-old)	-0.89	-.12	1.84	.23
Education (low-high)	3.12	.36***	-2.06	-.22*
Internet experience (years)	0.60	.07	0.38	-.04
Weekly time online (hours)	-1.02	-.11	0.15	.02
Followed an Internet course (no/yes)	0.27	.02	-0.85	.00
Using peers for help (no/yes)	-0.00	.00	1.82	.19
Primary location of Internet use (at home/elsewhere)	1.12	.11	-0.75	-.07
Working situation (inactive/active)	-0.31	-.04	-1.36	-.16
R ²	0.13		0.23	
F	2.82***		4.67***	

* $p < .05$.

*** $p < .001$.

Table 4
Linear regression results for the strategic skill assignments (N = 109)

	Number of tasks completed		Time spent on tasks	
	T	Beta	T	Beta
Gender (male/female)	-0.72	-.06	-1.11	-.11
Age (young-old)	-1.42	-.17	-0.19	-.03
Education (low-high)	4.24	.42***	1.06	.13
Internet experience (years)	0.21	.02	0.54	.06
Weekly time online (hours)	-1.60	-.15	-1.23	-.14
Followed an Internet course (no/yes)	0.31	.03	0.47	.05
Using peers for help (no/yes)	-1.61	-.16	1.20	.14
Primary location of Internet use (at home/elsewhere)	-0.61	-.05	-0.26	-.03
Working situation (inactive/active)	1.29	.14	-0.62	-.08
R ²	0.30		0.01	
F	6.09***		0.84	

*** $p < .001$.

offered, but certainly not for the more complicated ones. To the 20% of the Dutch citizens that still have no Internet access at home one has to add 15% of the Dutch population that do have access in their household, but never use the Internet themselves (Van Dijk, Peters & Ebbers, 2008). Altogether this is about one third of the population. For them in particular, other service channels are kept open by the government. Of those two-thirds of the Dutch population that do use the Internet, only 56% (of those above 18) use it for government information in 2006 (Van Dijk, Peters & Ebbers, *in press*). The level of digital skills among this part of the population is questionable. In the experimental tests reported here a large number of assignments that are considered performable, were in fact not completed. The actual level of completion outside the laboratory might be even lower as the subjects were stimulated by the experimental circumstances in the test. Probably they were more motivated to finish the task than they normally would be; 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 reach the answer. Indeed, other research indicates that users of public websites often give up and turn to the telephone or a front desk (Pieterse & Ebbers, 2008).

We are tempted to conclude that Dutch citizens have a fairly high level of operational and formal skills. On average 80% of the operational skill assignments and 72% of the formal skill assignments were successfully completed. However, the levels of information skills and strategic Internet skills attained are much lower. Information skill assignments are completed on average by 62% and strategic skill assignments on average by only 25% of those subjected to these performance tests. Unfortunately, there are no standards of comparison since comparable performance tests in other countries are non-existent. Anyway, the Dutch government's expectation that every citizen with an Internet connection is able to complete the assignments following tasks the government thinks every Internet user can perform, clearly is not justified.

5.2. Do the skill levels differ between particular categories of citizens and if so, in what respect?

The level of digital skill performance is quite different among categories of the Dutch population. Educational level attained is the most important correlating factor. All performances, both in the number of tasks completed and amount of time spent on tasks with all four types of digital or Internet skills, are significantly different for people with high, medium and low education. Age is the second most important correlating factor. However, this only goes for operational and formal skills. An interesting conclusion is that the so-called 'digital generation' (18–29), that in this investigation also scores relatively high in operational and formal tasks, does not perform

significantly better in information and strategic skills than the older age groups, despite the fact that the elderly score lower on operational and formal skills.

A remarkable conclusion is that internet experience only correlates with the number of operational tasks completed and time spent on them. Amount of time spent online weekly only correlates with time spent on formal Internet tasks. It appears that information and strategic skills do not grow with years of Internet experience and amount of time spent online weekly.

Taking an Internet course, having a support network, the location and working condition have minor influence on all skill types.

So, one of the most important general conclusions is that operational and formal Internet skills are a necessary but not sufficient condition for the performance of information skills and strategic skills when using online government services.

6. Policy recommendations

The government should be accessible for all citizens. We have proven that this is not the case for the Internet channel in the Netherlands. What should happen to change this state of affairs? In this section research questions three and four are addressed. Recommendations for improving government websites and for improving the skill levels of Dutch citizens are suggested.

6.1. How can the government improve its supply offering online services that require less digital skills of citizen users?

The levels of operational and formal skills reached by Dutch citizens seem to be high, though no comparative data are available. Anyway, there are two groups that still experience problems, the low educated and seniors. Results of this research indicate that seniors will probably profit the most when websites account for a low level of operational and formal skills. After all, seniors do not seem to be inferior to younger citizens on both information and strategic skills.

Public agencies all have their own distinctive emphasis when developing sites. This makes interaction between governments and citizens different for every single website. Citizens meet different designs and layouts on every site, causing problems for the low educated and seniors in particular. They have to engage in more or less successful learning processes over and over again. One might ask whether it really is necessary that every government institution has its own website design made for image building. For citizens, they are all 'government'; within governments image competition should be out of the question. The most important goal should be to provide the Internet as a means for simple information retrieval and service supply.

It might be a good idea to offer government websites in two versions, an advanced version for the more experienced Internet users and a relatively simple version for seniors and low educated users. This second version can offer an 'exaggerated' explanation of the operation of the website and the steps one is able to take on this site, among others when one has to go to the more complicated version. Considering design and didactic approach, this version should be equal for every agency. It is important to show a recognizable identical and simple design that leaves out options that are hardly being used. The simple sites with identical designs and menu structures can be linked in a network of government websites that covers all basic information and transaction needs of citizens in a particular country.

The level of information skills appeared to be quite low in our performance tests. In general the search process took too many steps and too much time. This is caused both by a shortage of information skills of users and by insufficient anticipation on low levels of information skills by website developers. In depth analyses indicated that defining proper search queries is hard for many citizens, especially the low educated. Too general search queries lead to

irrelevant search results that make the selection of relevant sources harder to achieve. In depth analysis of the data also showed that people do not look further than the first couple of search results and do not critically evaluate search results at all. Surprisingly, this was also true for the higher educated subjects.

The problem of a shortage of information skills is reinforced by two website characteristics observed. First, government websites that are listed in the search results, do not all contain the information citizens expect to find in these sites. Second, similar government information is available on different sites. As long as this information is complete, this is no problem. Unfortunately, this is not the case. It might be recommended to offer less government websites. The remaining ones should contain specific information following a clear task division that is continually scrutinized for its quality.

The current main government website policy in the world is to offer large-scale portals that try to create order in the chaos of government websites. In our tests it appears that this does not make it easier for citizens. Usually, their scope of information and their menu design are too broad. The excessive amount of information offered only makes the relevant sources harder to find for many users. Instead, our subjects immediately turned to Google, by far the most important search engine in the Netherlands. When the subjects were allowed to choose the way to find the information themselves they passed all government portals and special sites and turned to Google. The government should carefully consider the added value of a portal, before it gives the orders to develop such a site. Also, portals should profoundly state for what purposes they are made, who offers them and what people might expect.

Using online government information to gain strategic benefits, for example to inform whether it makes sense to lodge an appeal against a decree or a tax assessment seems only granted for small minority of citizens. Taking into account low levels of strategic skills is a difficult challenge for website developers. It is recommended to develop more decision support software that is programed with information about actual citizen's behavior in decision taking. Software already exists in the shape of electronic voting guides. Such guides can also be developed for other services citizens need.

6.2. *How can the government and other responsible actors support the demand of online services improving the level of digital skills among (particular groups of) citizens?*

Although the government has the primary responsibility for offering online information and transaction services for government purposes, there are also other parties that have a responsibility to improve the digital skill levels of citizens. The hardware and software industry for digital media, the societal organizations of citizens (e.g. organizations for seniors and for persons with disabilities), the employers and employees and, of course the individual citizens themselves all have some responsibility of improving skills required in the information society.

For children and students the most obvious way to increase digital skill levels is regular education. In the Netherlands students have a fairly high level of operational skills, but they clearly lack information skills (Cohen de Lara, 2005; Kuiper, Volman & Terwel, 2004). Unfortunately, Internet skills in general and the acquisition of information skills in particular have a minor role in Dutch classes and, as far as we know in many other countries in the world. Before using computers and the Internet in educational programs, tests should indicate whether students have an adequate level of operational and formal skills;—presently they learn them through play at home from early childhood. If not, they should be taught first. Special attention is needed for information skills. Using search engines should be the primary objective. Teachers should achieve special training in didactic and information skills suitable for the Internet. It is important to develop new educational material, designed for Internet use, to be

implemented in existing courses of the school curriculum instead of special computer classes. When learning information and strategic skills is implemented in existing courses such as language, history, biology and geography they will be more effectively picked up. Also, teachers will be more motivated to spend additional time and effort.

Finally, parents should involve their children when they use electronic government services for their children, for example for the selection of a good school, to appeal for a study grant or child support. In the Netherlands parents between 35 and 50 are the heaviest users of government online services (Van Dijk et al., *in press*).

Citizens above 35 to 40 that did not get the chance to acquire digital skills in education depend on their work and adult education to catch up later. The results of the performance tests reported here can also be applied to the skills of employees that often only receive courses in operational skills, but would also benefit from improved information and strategic skills. Especially in the information jobs this improvement would lead to increased productivity and innovation. Courses for employees should at least train formal Internet skills and the effective use of search engines.

Public and private institutions of adult education should receive more means and a competent staff to meet the needs of computer and internet courses. Citizens should be able to participate in these courses at low cost. The same goes for elementary computer and Internet instruction in the context of education and citizen programs for immigrants. Public libraries are very appropriate to train adults in the improvement of information skills, at least when they put into service a professional staff and not just place equipment. Finally, public places that offer government services (e.g. city halls, community centers, health centers, information centers) should be equipped with Internet terminals. Staff must walk around to provide assistance continually.

The elderly, first of all, need computer and Internet courses that are adapted to their speed and style of learning and to their physical inabilities that are growing with age—they learn less through play and practice like young people do. Special courses can be offered by commercial organizations and voluntary organizations. For example, in the Netherlands the organization of seniors called SeniorWeb gives 50.000 computer courses for senior members every year.

Functional and complete illiterates also need special attention. For them the use of computers and the Internet seems almost impossible. However, special aids such as audiovisual interfaces, multimedia programs and touch screens can be designed and offered for them. For persons with disabilities, of which the Internet is an environment that is for most part not designed to consider their needs, especially in e-commerce and e-government (Jaeger & Thompson, 2003; Jaeger, 2006), the government should make their websites more accessible with special aids. Jaeger (2006) for example identified several barriers to accessibility for persons with different disabilities and concluded that many public websites present barriers to accessibility. He provided several recommendations on how federal agencies may be able to improve their websites. Also, the government should provide additional services (e.g. homecare). Additionally, voluntary organizations of people with disabilities could give computer classes adapted to the need of special disabilities.

For ethnic minorities the supply of government services should be designed for more multicultural choice options. One should also provide more training materials using minority languages and designs inspired by minority cultural experiences.

7. Discussion

This paper has shown that in the context of the use of online government services, information and strategic Internet skills are the most problematic and unequally divided digital skills among the Dutch population. Most likely, they also are in other countries of the world. This means that surveys that usually only try to measure operational and formal skills, give a flattering picture of the actual digital skills of

populations. It appears that observations in actual skills performance tests are more valid than survey questionnaires to measure digital skills. Therefore we call for comparable performance tests of digital skills in other countries. All specific operational definitions and measurements that can serve as a source of inspiration are available with the authors.

An important discussion point is whether the information and strategic skill divide—of which the existence is proved here—has not always been there. These skills might heavily depend on ones intellectual skills, causing a divide between the ones with more intellectual capabilities than others. In our view, this is only partly true. We believe that the divide between citizens with better and lower information and strategic skills is widening, since the amount and diversity of information available becomes larger. This means that it becomes harder to find and use required information. Citizens with a high level of information and strategic skills will be able to use the enormous amount and diversity of information for their own particular goals. This makes the Internet an enormous opportunity in a variety of ways. However, for people with lower information and strategic skills it will become harder and harder to use the Internet this way. For them, the challenge will be to be able to find correct information at all.

Besides intellectual skills, it can be discussed whether so called bureaucratic skills play a major role when using online public services. Knowledge of the government will increase as one becomes older. Although, we doubt that these skills have influenced the results—assignments were kept quite simple—future research should account for them. This can be done by measuring these skills directly, or by performing research with the same skill range on different topics.

Appendix A

Operational skill assignments

Assignment 1. (max. 12 min)

- Task 1.1. Go to the website of the Dutch Tax and Custom Administration (www.belastingdienst.nl).
- Task 1.2. Click on the link 'Download and order' in the menu on the right.
 - Click on the subject 'Marriage', placed in the column 'private'.
 - Click on the link to the brochure 'When you are getting married'.
- Task 1.3. Open the brochure 'When you are getting married'.
 - Save the brochure in the folder 'Marriage' on the desktop of the computer.
- Task 1.4. Use the back-button to go back to the 'Download and order' page.
 - Click on the link 'Declaration 2006' placed in column 'private'.
 - Click on 'Declaration software 2006 (Windows)'
- Task 1.5. Save the file 'Electronic declaration IB 2006 for Windows' on the desktop.
- Task 1.6. Go back to the homepage of the Dutch Tax Administration.
 - Add the homepage to the favorites (or bookmark).
- Task 1.7. Use the search engine on top of the website using the keyword 'save-as-you-earn deduction'
 - Open the third search result of the search assignment.

Assignment 2. (max. 8 min)

- Task 2.1. Go to the Child care allowance website of the Dutch Tax and Custom administration: www.toeslagen.nl/reken/kinderopvangtoeslag/. Complete the fields using the information given.

Formal skill assignments

Assignment 3. (max. 10 min)

- Task 3.1. Go to the website of the Central Office of Information, postbus51.nl.

Follow the options Accommodation/Rent/Rental price/Rent Subsidy.

Choose the option: 'What is rent subsidy and how do I apply for it?'

- Task 3.2. Click on the link 'Applying for rent subsidy'.
 - Go to the homepage of the Allowance website in the new window.
 - Go back to the homepage of Postbus51 in the old window.
- Task 3.3. Perform a search on the Postbus51 website with keyword 'rental price'.
 - Open the first search result.
 - Open the second search result.

Assignment 4. (max. 10 min)

- Task 4.1. Imagine that you just moved to Nijmegen. You would like to look up the physical office addresses of the following organizations: IB-Groep, UWV and CWI.

Information skill assignments

Assignment 5. Parking (max. 12 min)

- Task 5.1. Imagine that you just moved to Rotterdam. Because it is hard to find a parking spot, you decide to buy a subscription to a parking lot. Find out how much a subscription to the car park named 'Spaanse Kade' costs. Use the homepage of the municipality of Rotterdam (www.rotterdam.nl).

Assignment 6. Theft (max. 12 min)

- Task 6.1. Imagine that, during a day at the shopping mall, your passport is stolen. Use a search engine (e.g., www.google.nl or the one you use at home) to find out what type of document you need to apply for a new passport after the old one is stolen.

Assignment 7. Salary (max. 12 min)

- Task 7.1. Imagine that you are 25 years old. In between September 1st and December 30th you had a full-time job in a factory (40 h/week). Your wage was 1275 euro gross every month. This was not much. Use a search engine (e.g., www.google.nl or the one you use at home) to find out whether you were entitled to a higher salary during this period. (Yes, because the salary was lower than _ euro./No, because the salary was higher than _ euro)

Strategic skill assignments

Assignment 8. Salary (max. 12 min)

- Task 8.1. When your employer paid you too little, what financial recourse do you have can you then personally obtain? Sort this out using the Internet.

Assignment 9. Elections (max. 30 min)

- Task 9.1. Imagine that there are national elections soon. You are in doubt whether to vote for the PvdA, the CDA or the VVD. You have the following opinions:
 - You are in favor of using nuclear energy;
 - You are in favor of a high child care allowance;
 - You are against having two nationalities.
- Using the Internet, find out which of these three political parties have your first, second and third preference.

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