Using Online Public Services: A Measurement of Citizens' Operational, Formal, Information and Strategic Skills

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Abstract. It is important to take digital inequality research in consideration when focusing on electronic public service delivery. From this point of view, this paper considers four digital skills that citizens need when using online public services. Measurements of these skills in the Netherlands indicate that on average 80% of the operational skill Internet assignments, 72% of formal Internet skills assignments, 62% of the information Internet skills assignments and 25% of strategic Internet skills assignments have been successfully completed. Performances are significantly different for people with high, medium and low level of education attained and in some cases for people with different age. The Dutch government's expectation that every citizen with an Internet connection is able to complete the assignments clearly is not justified.

Keywords: digital skills, online public services, digital divide, citizens.

1 Introduction

An important research area on both the politic as scientific agenda is the divide between people that have and don't have access to computers and the internet [1]. While original research in this area mainly focused on a binary classification of access, now a more refined understanding exists, taking several other factors into account [e.g., 2, 3]. 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. This policy, characterized by few barely funded presuppositions regarding what citizens want and can do [4], conflicts with research results that indicate that the internet is still not a general accessible channel. A possible result of this policy is that the use of electronic services lags behind with the demand in the public sector, as described by Van Deursen

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et al. [4]. 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 [5]. Furthermore, many of the services offered online in the Netherlands are hardly being used and only a few services are responsible for the bulk of the eservice usage in the Netherlands [6].

The observations described force the government to go beyond the obvious access data and focus on the more refined conceptualizations digital divide research has already outlined. This study considers one of the factors that appears to be important in all these refinements; digital skills. It is has been shown that these skills influence the take up of online government services [6]. 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. In the explanation of different usage of the Internet, the level of digital skills appears to be one of the most important factors. The problem of being short of skills becomes urgent when governments suppose that citizens are able to do about everything on the Internet. 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 [7].

Very little scientific research has been done on the actual level of digital skills possessed by citizens. For using online public services it is non-existent. Measurements that are performed, took place in small educational settings or as a part of computer classes. Most important however is that almost every measurement of the actual level of digital skills has been done by survey questions asking respondents to estimate their own level of digital skills. This kind of measurement has significant problems of validity [8,9,10]. The only way to obtain a direct measure of a skill is by means of a test which measures that skill. A final remark is that most of the digital skill research uses a limited definition of these skills, not going beyond so-called 'button knowledge'.

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. 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 provides an in-depth investigation of the Dutch citizens' skills when using online public services and public information, activities that relate to the concept of e-citizenship [11]. An in-depth digital skill investigation might help both the future development of eServices and formulation of public policies. The next section covers the research background and the framework used for measuring digital skills. Section 3 describes the methodology and section 4 presents the results. Finally, in section 5 conclusions are drawn.

2 Research Background

2.1 A Framework for Measuring Digital Skills

Unfortunately, there is no agreement on what constitutes digital skills or why they are required [12]. A lot of interpretations are given to a wide range of terms. This stipulates the need for more academic research to escape the simplification of early digital divide

research where only binary classifications of access were considered. A new simplification might appear: the simple duality of can's and can-nots. To prevent this duality, Van Deursen & Van Dijk [13] proposed a digital skill framework that is applicable in multiple digital domains. In the context described here, their framework considers:

- Operational skills: the skills to operate the Internet (browser).
- 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 on the Internet.
- Strategic skills: the skills to employ the information contained in digital media as a means to reach a particular personal or professional goal.

We will apply this framework to measure citizens' digital skills. The following sections provide operational definitions.

2.2 Operational Skills

Useful operational definitions emphasizing operational skills are presented by Bunz [14] and Larsson [15]. Partly based on these definitions, Van Deursen & Van Dijk [13] defined operational skills as 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);
  - Book marking 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.

2.3 Formal Skills

Van Deursen & Van Dijk [13] defined formal skills as the skills to use hypermedia (of which the Internet is the classic example). According to Gilster [16], hypermedia allows users to choose their own non-linear paths since graphics, audio, video, plain text and hyperlinks intertwine. In contrary, the old media are mostly linear which gives the users little control over the flow of information. On the internet, users cannot only move forward, but also backward and to unknown locations, referred to as cross-referencing. Cross-referencing enables the user to redirect the flow of information, but also characterizes a difficult problem for users of the Internet [17]. Without a

sense of location, distance, and necessary direction, it is not surprising that users often have a strong sense of disorientation [17]. Van Deursen & Van Dijk [13] consider the following indicators for measuring formal skills:

- Navigating on the Internet, by:
  - Recognising and using hyperlinks (e.g., menu links, textual links, image links) in different menu and website lay-outs.
- Maintaining 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.

2.4 Information Skills

There are a number of studies in information-seeking behavior that follow a staged approach to explain the search process. The model described by Marchionini [18] best suites digital environments. Taking cues from this model, the first relevant step is choosing a specific system, which depends on the information seeker's previous experience with the task domain, the scope of his/her personal information infrastructure, and the expectations about the answer that may have been formed [18]. After choosing a search system, a user formulates search queries. Selecting the most relevant results is the next step and often a difficult one. When only few search results are returned, they can be scanned quickly, browsed systematically, or inspected comprehensively. However, when people use broad search strategies in large-scale engines, a vast number of often unsuitable results will appear [19]. This problem is reinforced by the fact that information seekers often don't venture past the first page of the search result pages [e.g., 20, 21, 22]. Finally, the evaluation of information sources is considered. Information is not always of the same quality, calling upon specific skills that enable users to check the actual correctness of data and the reliability of the sources. Van Deursen & Van Dijk [13] consider the following indicators for measuring information skills:

- Locating required information, by:
  - Choosing a search system or appropriate website to seek information;
  - Defining search queries;
  - Selecting information (on websites or in search results);
  - Evaluating information sources.

2.5 Strategic Skills

The three types of skill discussed so far relate to an effective use of the internet. Strategic skills are related to the purpose of this use. Van Dijk [23] defines strategic skills as the capacity to use computer and network sources for particular goals and for the general goal of improving one's position in society. Although strategic skills will hardly depend on operational and formal skills alone, together with information skills they serve as the means to reach a particular goal by one's own initiative. In order to acquire strategic skills, users must be critical, analytical and must have a high degree of information skills. According to Van Deursen & Van Dijk [13], taking advantage

of the internet is a process that entails four steps. The first step is goal orientation. This means being aware of the opportunities the web offers and selecting one or more of these opportunities for a particular personal goal. Keeping an eye on this goal and acting towards this goal, is difficult and hard to learn, especially in a digital media landscape that offers an enormous amount of distracting stimuli. The second step is taking the right actions on the Internet. This means using the massive amount of information selectively and combining the various possible information sources. After the right actions are taken it is time to make decisions to reach the original goal by using the (often excessive amount of) information retrieved selectively. Making decisions is the third step and should be done by consulting the right information sources, relevant for work, study or personal life. The final step is gaining benefits on one or more of these areas. When the right decisions are made they can be turned into benefits of a personal, social, professional or educational nature.

Taking these four steps in consideration, Van Deursen & Van Dijk [13] consider the following subsequent indicators for measuring strategic skills:

- Taking 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..

2.6 Research Questions

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

- RQ 1: Do Dutch citizens have an adequate level of operational, formal, information and strategic skills to use online public information and services?
- RQ 2: Do these skill levels differ between citizens and in what respect?

3 Method

3.1 Subjects

Subjects were recruited in July 2007 by randomly dialing telephone numbers in villages and cities in the Twente region. Cities and villages were chosen according to a distribution that equals the national distribution of the Netherlands. A condition of invitation was that the participant acknowledged to use the internet at least once every month and for more than only using e-mail. Although this condition excluded around 20 percent of the Dutch population, it ensured that also low frequency users who are nonetheless familiar with the Internet are included. The invitation policy also made sure that not mainly ‘computer lovers’ accepted the invitation by reassuring people who feared the test. Subjects were promised 20 euros for their participation in a one and a half hour research session about their internet use and were assigned according to their availability (appointment).

Ultimately a number of 109 people performed the tests. To rate the overall representativeness of this sampling approach it should be compared more to the standards

of an experimental survey than a survey. Compared to the standards of an experiment the number is high. However, we think here bigger than average experimental groups are needed because we had to take into account the large social and cultural differences of computer use and experience that could be expected in the sample strata. 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 inch 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 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 [13].

3.4 Questionnaire

Prior to the experiment, a 10 minute questionnaire was administered to gather some personal data such as age, gender, ethnic background and information about the frequency and location of respondents' regular Internet use, the types of activities they perform online and their social support networks.

4 Results

4.1 Operational Skills

For measuring operational skills, two assignments were administered, consisting of nine tasks altogether. The first assignment tested whether subjects 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 subjects had to complete a web based form on a public website.

The subjects completed an average of 7.2 (SD=2.0) tasks and needed 553 seconds (SD=254). According to table 1 education, age and experience are the main predictors of the level of operational skill. They are significant both for number of tasks completed and time spent on the tasks.

Table 1. Linear regression results for the number of operational tasks completed and the time spent

	Nr of tasks completed		**Time spent on tasks**	
	t	**Beta**	**t**	**Beta**
Gender	-0.82	-.06	-1.30	-.08
Education	3.86	.32***	-2.75	-.27***
Age	-3.13	-.30***	5.11	.43***
Internet experience (years)	1.90	.15*	-2.56	-.18**
Weekly time online (hours)	0.55	.04	-1.44	-.10
Internet course (no/yes)	0.45	.03	-0.14	-.01
Support at home (no/yes)	-1.47	-.12	1.83	.13
Location (at home/elsewhere)	1.15	.08	-1.15	-.07
Working condition (inactive/active)	1.62	-.15	-1.97	-.16*
Adjusted R^2	.52		.64	
F	14.02***		22.34***	

*p < .05, **p < .01, ***p < .001. N=109.

4.2 Formal Skills

For measuring formal skills, two assignments were administered, consisting of four tasks. The first assignment tests whether a subject 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 subjects are able to locate similar contact information in different website layouts and designs.

The subjects completed an average of 2.9 (SD=1.0) tasks and needed 616 seconds (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.

Table 2. Linear regression results for the number of formal tasks completed and the time spent

	Nr of tasks completed		Time spent on tasks	
	t	**Beta**	**t**	**Beta**
Gender	1.06	.08	-2.17	-.15
Education	2.94	.25**	-1.98	-.16*
Age	-2.58	-.26*	5.01	.46***
Internet experience (years)	1.56	.13	-1.68	-.13
Weekly time online (hours)	-0.30	-.02	-1.66	-.13
Internet course (no/yes)	1.00	.07	-0.24	-.02
Support at home (no/yes)	-3.08	-.26**	1.65	.13
Location (at home/elsewhere)	2.40	.18*	-0.76	-.05
Working condition (inactive/active)	1.26	.12	-1.07	-.09
Adjusted R^2	.49		.57	
F	12.39***		16.46***	

*p < .05, **p < .01, ***p < .001. N=109.

4.3 Information Skills

For measuring information skills, three assignments were administered. In the first assignment subjects 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). Subjects completed an average of 1.9 (SD=0.8) assignments and needed 939 seconds (SD=449). Regression results in Table 3 indicate that education is the only significant predictor for the number of information tasks completed.

Table 3. Linear regression results of the number of information tasks completed and the time spent

	Nr of tasks completed		Time spent on tasks	
	t	**Beta**	**t**	**Beta**
Gender	-1.35	-.13	-0.15	-.01
Education	3.12	.36**	-2.06	-.22*
Age	-0.89	-.12	1.84	.23
Internet experience (years)	0.60	.07	0.01	.00
Weekly time online (hours)	-1.02	-.11	0.15	.02
Internet course (no/yes)	0.27	.02	-0.85	.00
Support at home (no/yes)	-0.00	.00	1.82	.19
Location (at home/elsewhere)	1.12	.11	-0.75	-.07
Working condition (inactive/active)	-0.31	-.04	-1.36	-.16
Adjusted R^2	.13		.23	
F	2.82***		4.67***	

*p < .05, **p < .01, ***p < .001. N=109.

4.4 Strategic Skill Assignments

For measuring strategic skills, two assignments were administered. In the first assignment subjects 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, the subjects needed to visit the websites of the three relevant political parties or combine the parties' names with a specific position in a search engine. The subjects completed an average of 0.5 (SD=0.7) tasks and needed 1466 seconds (SD=575). According to Table 4, education is the main predictor for the number of strategic tasks completed. No significant time differences are reported. This might be due to the fact that successful completion is low on strategic tasks.

Table 4. Linear regression results for the number of strategic tasks completed and the time spent

	Nr of tasks completed		**Time spent on tasks**	
	t	**Beta**	**t**	**Beta**
Gender	-.72	-.06	-1.11	-.11
Education	4.24	.42***	1.06	.13
Age	-1.42	-.17	-0.19	-.03
Internet experience (years)	0.21	.02	0.54	.06
Weekly time online (hours)	-1.60	-.15	-1.23	-.14
Internet course (no/yes)	0.31	.03	0.47	.05
Support at home (no/yes)	-1.61	-.16	1.20	.14
Location (at home/elsewhere)	-0.61	-.05	-0.26	-.03
Working condition (inactive/active)	1.29	.14	-0.62	-.08
Adjusted R^2	.30		.01	
F	6.09***		.84	

*p < .05, **p < .01, ***p < .001. N=109.

5 Conclusions

Answering the first research question, 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, clearly is not justified.

Answering research question 2, we can conclude that 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 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, only 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 these groups score lower on operational and formal skills.

A remarkable conclusion of this investigation 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.

One of the most important general conclusions of this investigation 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 public services. For future policy, this result should be taken into consideration. For programs aiming on digital skill improvements, it is important to focus on the full range of skills outlined here. Also, recommendations for improving public websites should take into account the four skill levels and their uneven distribution.

6 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.

An important discussion point is whether the information and strategic skill divide 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 partly true. We believe that the divide between citizens with better and lower information and strategic skills is widening, since the amount of information available becomes larger for a more width spread audience. 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 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. Than, the varies skill divisions can be compared mutually.

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