Science System Assessment

The Layperson and Open Access to Scholarly Research

A Report on Civic Scientific Literacy

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Preface

Civic scientific literacy is a prominent issue for many countries who want citizens that can participate in a modern, knowledge-based economy. A scientifically literate population is as essential to economic prosperity as it is for social inclusion: individuals who possess some knowledge of scientific facts and concepts can follow science news and participate in public discourse on science-related issues.

Although civic scientific literacy has been a vital part of academic scholarship for several years (since the 1950s in the US), research has shown that there has not been much change over time regarding the American public's level of knowledge about science. In Europe there has been a marked increase: Germany, Ireland, Luxembourg, and The Netherlands recorded double-digit increases in the number of scientifically literate citizens between 1992 and 2005 (see Science and Engineering Indicators, 2006).

The purpose of this research is to generate a preliminary look at how Dutch citizens perceive Open Access to scholarly/scientific research and its advantages or disadvantages for lay society. The lay public needs to be both information literate and science literate to make use of and benefit from scholarly/scientific literature now that it is freely available on the Internet in Web journals and institutional repositories.

This report is organised as follows:

- Key terms (*Open Access*, *laity, information literacy, digital information literacy; civic scientific literacy*) and their definitions are provided including facts about Open Access in the Netherlands (*Section 1.1*).
- In *Section 1.2* we provide a background analysis of the Public Understanding of Science (PUS) and the evolution of this concept vis-à-vis three science communication models – the education model, the co-production model and the Open Access model (*Section 1.3*). Special attention is given to the Open Access model since it places emphasis on the individual as information-seeker and information consumer.
- In *Section 2* we describe the focus group method used for the study and our rationale for using this method rather than a traditional survey design.
- *Sections 2.3 and 2.4* present the results of the pre-focus group literacy questionnaires and the focus group exercises. Brief summaries conclude all sections (*2.4.1 to 2.4.6*) to explain what the group exercises and discussions mean in light of civic scientific literacy.
- To conclude the study (*Section 3*) we examine why civic scientific literacy matters, including current debates surrounding this construct, and how it has been measured over time. We also focus onThe Netherlands' policy concerning public awareness of science and student enrolments in science and technology studies. Since Open Access has potential to reformulate what it means to be scientifically literate in a digital-age society we consider the role that this movement might play in support of this policy.

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1 Introduction

1.1 Terms and Definitions

The following terms are used throughout this report:

Open Access (OA): Scholarly research literature that is freely available on the Internet either in an online journal or a university/institute digital repository. Open Access means that any user is permitted "to read, download, copy distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose without financial, legal, or technical barriers other than those inseparable from gaining access to the Internet itself" (Budapest Open Access Initiative, 2002).

Layperson / Laity: A layperson is someone who does not have the specific background training or skills to conduct or evaluate research in a specific field of science. Laity is defined as "the mass of the people as distinguished from those of a particular profession or those specially skilled" ("laity". Merriam Webster Online Dictionary, 2008).

Information literacy: Information literacy requires an individual to determine the nature and extent of information that is needed. The individual should be able to access the information effectively and efficiently, evaluate the information and its sources critically, and later, incorporate selected information into his/her knowledge base and value system. The individual also should know how to use the information effectively to accomplish a specific purpose, and understand the economic, legal, and social issues surrounding the use of information, as well as access and use it ethically and legally (Association of College & Research Libraries, 2000).

Digital literacy: Digital literacy is a type of information literacy that demands a certain degree of fluency in a digital information environment. People who are digitally literate know how to use "specialized tools [and skills] for finding digital information," (e.g., Internet search engines and Boolean commands) and know "how digital information is different from print information" (Illinois Mathematics and Science Academy, 2002).

Civic Scientific Literacy: A scientifically literate individual possesses a vocabulary of basic scientific constructs, an understanding of the process or nature of scientific inquiry, and some level of understanding of the impact of science and technology on individuals and on society (Miller, 1998).

1.2 Open Access in The Netherlands

- March 2007 press release:

> "All the universities in the Netherlands have signed the Berlin Declaration [drawn up in 2003]. In this declaration (an initiative of the Max Plank society) a large number of universities throughout Europe and beyond declare to make all their scholarly and scientific articles [i.e., the results of publicly funded research] available in open access archives" (Surf Foundation, 2007).

- DAREnet or network of Digital Academic REpositories is a Web-based search service which gives free access to "154053 Open Access publications and research output from all Dutch universities, the KNAW, the NWO and a number of scientific institutes." As of April 2008 DAREnet became a "subset of NARCIS" and "all DAREnet members are responsible for their own repository." (NARCIS, 2008)

1.3 Background to the Study

Open Access (OA) is a scholarly communication movement developed by scholars, for scholars to increase the impact of future scientific research and create a cost-effective publication system. The goal of Open Access (OA) is to enhance scientific knowledge work by making peer-reviewed research literature openly available on the Web with the creation of institutional preprint repositories or archives (i.e. the *green* route) and free online journals (i.e., the *gold* route).

Open Access has been discussed widely in terms of publishing economics, institutional archiving, copyright law, and issues of distributive injustice (see Jacobs, 2006); yet little attention has been given to the broader issue of lay access to specialized knowledge. At present, we have very little understanding of the impact that free scholarly research literature might have on the knowledge and interests of laypeople.

Willinsky (2006) states that Open Access may

> mean little enough, admittedly to most [lay]people, most of the time. Still, it is not difficult to imagine occasions when a dedicated history teacher, an especially keen high school student, an amateur astronomer, or an ecologically concerned citizen might welcome the opportunity to browse the current and relevant literature pertaining to their interests (p. 111).

Proponents of the Budapest Open Access Initiative also state that:

> the public good is the world-wide electronic distribution of the peer-reviewed journal literature and completely free and unrestricted access to it by all scientists .....and other curious minds. Removing access barriers to this literature will accelerate research, enrich education, share the learning of the rich with the poor and the poor with the rich, make this literature as useful as it can be, and lay the foundation for uniting humanity in a common intellectual conversation and quest for knowledge (Budapest Open Access Initiative, 2002).

If Open Access is expected to 'lay the foundation for uniting humanity in a common intellectual conversation' the average layperson will have to demonstrate a motivation to look for and read peer-reviewed scientific literature. Once this literature is found and read, the person will have to work towards understanding it, and if it is not understood, then someone will have to mediate its value.

To understand what motivates laypeople to look for and use Open Access literature, it is important to consider their everyday information seeking behaviours. Information seeking research is concerned with modelling the cognitive and affective behaviours of individuals with information needs, including how these needs arise in context (Wilson,1981; 1999), how individuals make sense of situations to bridge knowledge gaps (Dervin,1992), manage feelings of uncertainty (Kulthau, 1997), and move through stage-related processes (Ellis,1989; Ellis, Cox & Hall, 1993; Kulthau, 1991). Information seeking occurs in various information use environments (Taylor, 1991) and when information is received by an individual, it has potential to change his/her knowledge structure (Cole, 1997). Individuals who search for information often do so as a coping mechanism, due to psychological stress, or because they are motivated to find answers to serious problems (Wilson, 1999). People also have particular source preferences, and an individual's preference usually depends on the information source's familiarity and credibility within their immediate social milieu (Chatman, 1991; Spink & Cole, 2001; Wilson, 1983).

Credibility is a concept that we often associate with believability: "credibility strongly influences the impact of a message" (Wathan and Burkell, 2002, p. 134). It also relates to cognitive authority because both are perceived in terms of quality (Wilson, 1983). A person will judge whether or not a piece of information or person delivering information is a quality source and whether or not to trust the source (Fogg & Tseng, 1999; Rieh, 2002; Self, 1996). Some laypeople will *presume* that an information source is credible, while others may think a source is credible by its *reputation*. Credibility judgements can also be based on the *superficial scanning* of an information source, or through *repeated first-hand experience* with the source (Tseng & Fogg, 1999).

When a scholarly or scientific information source is consulted two additional factors play a role: *verifiable credibility* and *cost-effort credibility* (Liu, 2004). A scholarly document is *verifiably credible*, if a user can see that it has been evaluated, cited, linked to another credible source on the Web, or published in a printed journal. Cost-effort credibility refers to the document's ease of access and whether or not a piece of Web-based information is free, must be purchased or requires a subscription fee. Liu (2004) suggests that "the ease in accessing free scholarly information may have an impact on credibility perception." Laypeople "may take free information from the Web for granted" and/or find it increasingly difficult to determine which document should be believed and used" (p. 1036).

Recognizing or perceiving the credibility of a piece of scholarly/scientific information may be difficult for an individual if he/she is not able to comprehend the work and make sense of it. Research concerning the public understanding of science focuses on the degree to which laypeople "understand the process or nature of scientific inquiry" (Miller, 2004, p. 273). Most scholars and scientists agree that we want a scientifically literate public to be sure that progress in science makes sense to them and that they are aware of the impact that new discoveries can have on daily living. Many also believe that a scientifically literate public "needs to have sufficient levels of accurate information on which to base their assessments of policy alternatives [so] that their policy preferences best reflect their own self or group interests" (Sturgis & Allum, 2004, p. 56).

In academia, two prevailing theories exist regarding the public understanding of science; one is the *deficit* model and the other is the *contexualist* perspective. The deficit model assumes that people are "deficient" in their knowledge of science and that due to "a lack of proper understanding of relevant facts, people [will] fall back on mystical beliefs and irrational fears of the unknown" (Sturgis & Allum, 2004, p. 57). The contextualist perspective asserts that it is not enough for laypersons to have a textbook understanding of science – i.e., to "recall large numbers of miscellaneous facts" – but to also have "a keen appreciation of the places where science and technology articulate smoothly with one's experience of life" (Sturgis & Allum, 2004, p. 58; Jasanoff, 2000).

If laypersons are to achieve an optimal level of understanding of science, a set of combined elements are needed. First the individual has to understand the formal content of scientific knowledge. Secondly, he or she needs to understand the methods and processes of science, and thirdly, members of the general public needs to recognize how science is embedded institutionally, who its patrons are, how it is socially organized and how it adheres to a particular system of control (Sturgis & Allum, 2004; Wynne, 1995).

Sometimes laypeople are not able to understand, interpret or easily appreciate the value of a scientific research project; thus a mediator or individual is needed to explain the work in lay terms. While science production is "aimed at the advancement of knowledge," scientific communication is "aimed at bridging the distance between science and the public." The impetus for bridging this gap is the "political duty in democratic societies to inform citizens" (Bensaude-Vincent, 2001, p. 99).

Science mediators or 'popularizers' have previously been criticized for their role: some scholars believe that their 'noble mission' is simply a mechanism for "self-legitimization" (Hilgartner, 1990; Jurdant, 1969). Others are convinced that the inherent problem with science communication is not so much the gap itself, but the reiteration that a piece of scientific knowledge (e.g., a peer-reviewed article) goes through before it is deemed suitable for the public. Bensaude-Vincent (2001) explains that "the communication of ideas always results in a change of the content, and each passage from one collective to another one creates a new meaning rather than simply transferring a stable message" (p. 100). Although a gap usually does exist, it is important also to consider Latour's (1987) notion that it is natural: the technical and specialized nature of scientific research is not negative, but essential to the construction of hard facts.

To close the gap between scientists and the public, a number of universities across Europe have adopted a co-production model of science. Co-production models of science target people belonging to trade unions, pressure groups, non-profit organisations, social groups, environmentalists, consumers etc. and reinforce the idea that "laypeople have knowledge and competencies which enhance and complete those of scientists and specialists" (Callon, 1999, p. 8). In the Netherlands, this model is represented by the creation of science shops; mediating agents tied to universities, which give or have given graduate students opportunities to carry out research relevant to particular citizen groups (Leydesdorff & van den Besselaar, 1987; Leydesdorff & Ward, 2005).

The public education model of science, compared to the co-production model, is more prominent because it exists widely for people regardless of what they want to know. With this model, new scientific discoveries are mediated by television, newspapers, in science magazines and on the Internet. Studies confirm that there are advantages and disadvantages associated with each form of mediation, and people tend to select

certain mediums to suit particular needs (Dijkstra et al., 2005; Koolstra et al., 2006), The clear benefit of the Internet is that it allows individuals to process information at their own rate and provides opportunities for interactivity (Koolstra et al., 2006).

As we enter into a new Open Access era, online research literature can be used to create a new kind of public awareness; whereby the traditional networks of popular science versus academic science need not exist in parallel anymore. With the availability of more scientific literature on the Web there may be more network interaction or cross-linkages between the two sides. Scholarly insight indicates that in the past "'popular science' did not necessarily mean 'popularized science'" (Bensaud-Vincent, 2001, p. 105); hence with Open Access there is an opportunity to move towards 'popularizing' science proper. This means that scientists might choose to take on a more prominent role as mediators and make use of the Internet or other aspects of the Web (eg., blogs; videos; pages) to help members of the lay public become more aware of their work.

1.4 The Open Access Model

The aim of this study is to identify what citizens in the Netherlands know about Open Access and how they perceive the various advantages, disadvantages, and other issues associated with this scholarly communication movement.

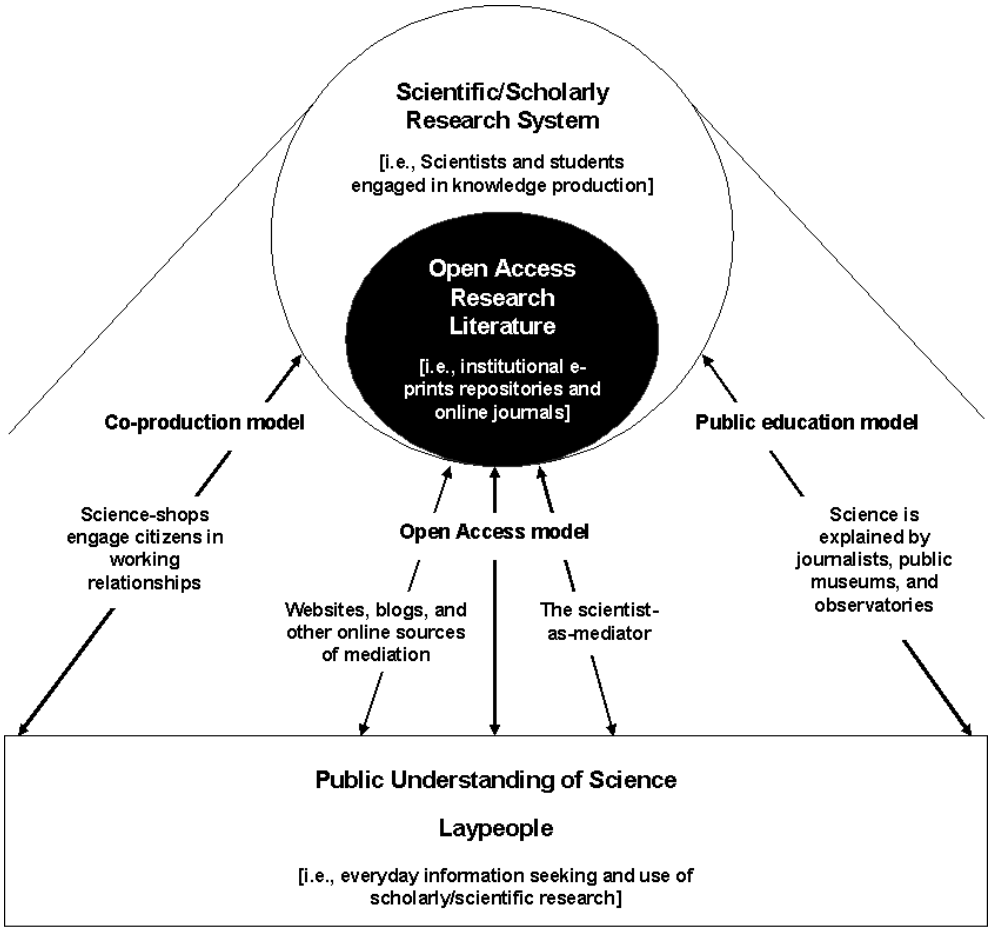


Figure 1. Relationship between the scientific research system and the public understanding of science.

Figure 1 above indicates that the Open Access model of science communication differs considerably from the co-production and public education models. The public education model is "the simplest and most widespread model" and its priority is the education of a scientifically illiterate public. Here "the ties between scientists and the public are indirect: they are the responsibility of the state" (Callon, 1999, pp. 82-83). The co-production model tries to overcome the limits of the public education model" by actively involving laypeople in the creation of knowledge concerning them" (p. 89).

Open Access is unique because it does not assume an obvious educational role, nor does it attempt to involve laypeople in close collaboration with scientists. At present, it simply provides direct opportunities for the public to encounter peer-reviewed research via the Web: anyone can "read, download, copy, distribute, print search, or link to the full texts of [digital repository and free electronic journal] articles" (Budapest Open Access Initiative, 2002).

Open Access has potential to support and encourage the public's engagement with science by making the reality of scientific/scholarly research more visible in the interactive environment of the Internet. The layperson is given a choice to read or not to read Open Access literature; however it is not entirely clear yet how important this choice is for most people, and how peer-reviewed research should be mediated or interpreted online to help improve the layperson's ability to make use of this literature to solve problems and/or make personal decisions.

2 Focus Group Method

Research pertaining to the public's attitude toward science and science-related policies is often carried out using large-scale surveys (see Bauer et al., 2007); however, **focus groups** are now beginning to "fill a gap in the toolbox of participatory policy" (Durrenberger et al., 1999, p. 342). Durrenberger et al. (1999) believe that laypersons (i.e., citizens) should be integrated more often into policy assessment processes and that "the focus group is a promising tool to achieve such inclusion" (p. 341). The authors further explain that

> the strength of focus group research is to increase qualitative insights into specific topics, attitudes and behaviour, especially in fields about which people are not yet well informed and/or in which only limited social science research insights exist, and/or for which policy formation is in an early stage and could benefit from citizen participation (p. 343).

Some focus groups are conceived for an *instrumental research purpose* – i.e., to improve policy making by providing an opportunity for citizen acceptance. Other focus groups are designed with a *participatory purpose*– i.e., to include citizens in the process of policy formulation (Durrenberger et al., 1999, pp. 344-345). In the Netherlands, the Open Access movement has required little citizen acceptance or involvement so far; thus the focus groups for this study were developed with a *substantive research purpose* in mind – i.e., to acquire preliminary insight into citizen's perceptions, concerns, visions and judgements regarding this new public policy.

23 Dutch citizens were recruited to participate in four separate focus groups. Table 1 details the selection criteria used to assign the individuals to different groups. Of the 23 participants, 12 were females and 11 were males. The participants ranged in age between 21 and 60. Nine were university students at the undergraduate level and the other 14 were working professionals: e.g., a cameraman, social worker, hotel administrator, fireman, businessman, financial controller, part-time medical assistant, primary school teacher, policewoman, accountant, medical receptionist, artist/painter.

Table 1: Selection criteria for assigning individuals to different groups.

	Ages: 18-35	Ages 35+
University and College Education (*Hoger Beroeps Onderwijs, Wetenschappelijk Onderwijs*)	Group 1	Group 2
Some College Education (*Middelbaar Beroepsonderwijs*; *Hoger Beroeps Onderwijs; Wetenschappelijk Onderwijs*)	Group 4	Group 3

Below we list the study's primary research questions:

1. What do laypeople know about Open Access to scholarly/scientific literature?

2. What level of interest do laypeople have in reading peer-reviewed publications produced in different scholarly/scientific research areas (e.g., Health Sciences; Psychology; Agriculture; Food Sciences; Media Studies etc.)

3. Are laypeople aware of and do they agree with the notion that there are civic benefits associated with Open Access?

4. What types of situations are likely to motivate a layperson to look for Open Access research literature?

5. What would be the most significant barrier for laypeople when they look for and use Open Access research literature?

6. What types of mediation strategies would be most helpful to laypeople when they look for and use Open Access literature on the Web?

2.1 Pre-Group Questionnaire Results

A pre-group questionnaire was given to each focus group participant for identification purposes (e.g., name, address, e-mail) as well as a general assessment of each individual's literacy level pertaining to online search engines, information search strategies, scholarly databases and academic literatures (see Appendix A). Users of Open Access journals and institutional (academic) repositories need to know how to search for scholarly information via the Web and should be able to understand the nature of this information, including how it was originally produced and evaluated.

2.1.1 Use of the Internet and World Wide Web

Twenty-one of our 23 participants confirmed that they owned a computer at home and twenty-two confirmed that an Internet connection was available to them either at home or in their place of work. Amongst all participants, access to the Internet was expected. Across the Netherlands approximately 88.4% of the total population use the Internet : "14,544,400 Internet users as of August/07" according to the International Telecommunications Union (ITU); the leading United Nations agency for information and communication technologies (see Internet World Stats, 2008). The Netherlands is only second to Norway in the top 43 countries in the world with the highest internet penetration rate (see http://www.internetworldstats.com /top25.htm).

The focus group participants were familiar with using a search engine on the Web, and though all confirmed that they had used a search interface like Google or Yahoo! (n=23), only a few were familiar with Google Scholar (n=7). The students (n=8) and one professional participant indicated that they had used a university library catalog to search for information, and 9 participants (including 3 students) stated that they had used a public library catalogue. Only nine of the focus group participants indicated that they had searched for information at a known organisational, businesses or university website (see Figure 2 below).

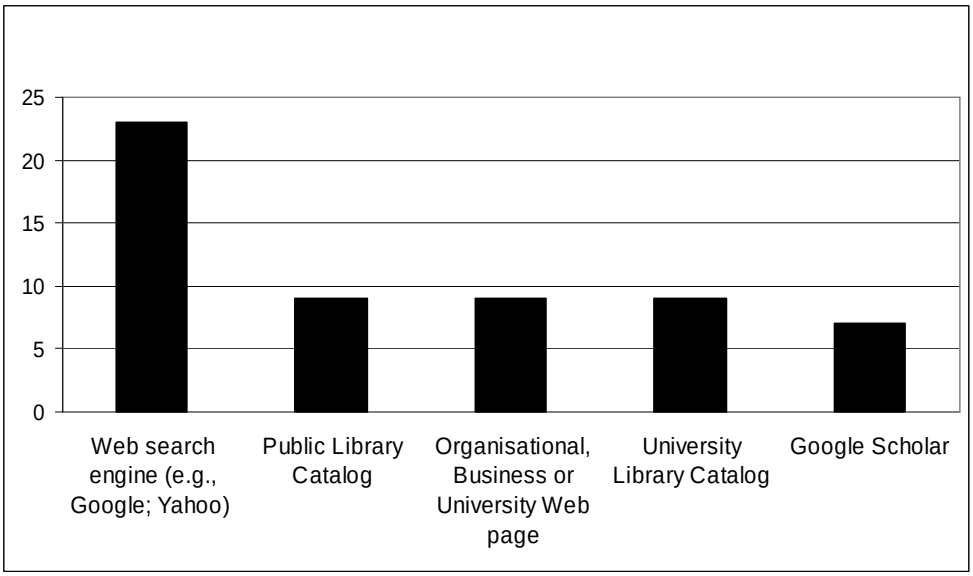


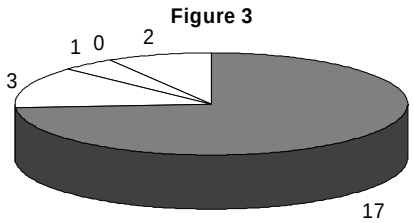
Figure 2. Focus group participants' use of 5 types of online information resources.

When we asked each member of the focus group to indicate how often they surfed the Web for information outside of regular work tasks or student assignments, 17 confirmed that they do so "*almost everyday*" and 6 confirmed that they do so "*about two times per week*".

2.1.2 Digital literacy and Information Literacy

Familiarity with the Internet and frequent use of the Web can be a supportive factor in the development of digital information literacy; however, people generally differ with respect to their online search habits. Some individuals have a better understanding of the type of information that they need than others, and some know how to locate information on the Web much better than others. People also vary with respect to their ability to evaluate the credibility of an information source.

Nine questions were administered to the focus group participants. Figures 3 to 11 below illustrate the results. The correct answer for each survey question is typed in bold font, including the number of participants who selected the answer.



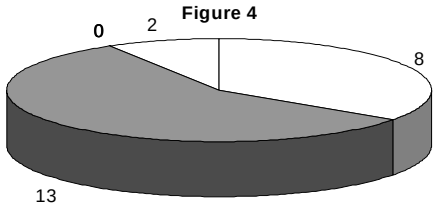
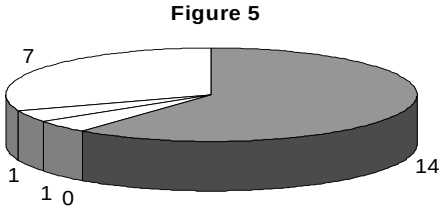


Figure 3. Google search to find vacation information associated with two different cities:

- vacation Budapest AND Vienna (17)
- **vacation Budapest OR Vienna (3)** ✓
- vacation Budapest * Vienna (1)
- vacation Budapest NOT Vienna (0)
- don't know (2)

Figure 4. Best Google Scholar search for documents on "The depletion of the ozone layer and impact on health":

- impact, depletion, ozone layer, health (8)
- **ozone layer, health (13)** ✓
- ozone layer (0)
- skin cancer, ozone layer (0)
- Other. Please specify _____. (0)
- don't know (2)



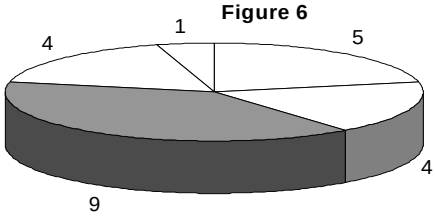
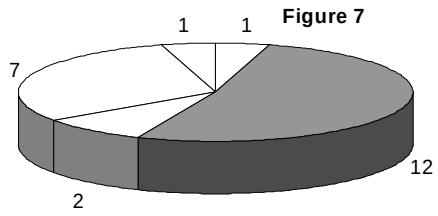


Figure 5. Using a search engine like Google/Yahoo! you would not find:

- **books that are available in a library (14)** ✓
- biographical information about famous people (0)
- information about companies (1)
- merchandise catalogues (1)
- don't know (7)

Figure 6. To find journal articles about "the effect that bullying behaviour has on school-aged young boys'" I would use:

- the library catalogue (5)
- **a bibliographic database (4)** ✓
- Google (9)
- the journals a library (4)
- don't know (1)



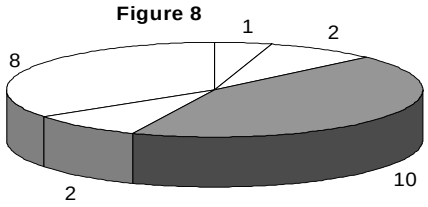
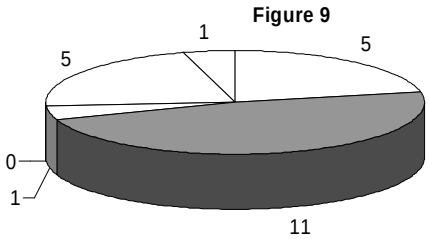


Figure 7. To become familiar with a subject about which I know very little, I would first consult:

- a journal (1)
- **an encyclopaedia or Wikipedia (12) ✓**
- a database (2)
- a book (7)
- don't know (1)

Figure 8. Which of the following is a citation to a journal article?

- Collier, M & Webb, R. H. (2002). Floods, droughts, and climate change. Tucson, AZ: University of Arizona Press. (1)
- J. Baert Wiener. (2002) Designing global climate regulation. In S. H. Schneider, A. Rosencranz, and J. O Niles (Eds.) Climate change policy: A survey (pp. 151-188). Washington: Island Press. (2)
- **Crowley, T. J. (2000). Causes of climate change over the past 1000 years. Science, 289 (5477), 270-277 (10). ✓**
- Sygna, L., Eriksen, S. O'Brien, K. & Otto Naess, L. (2004). Climate change in Norway: Analysis of economic and social impacts and adaptations (CICERO Report 2004:12). Oslo, Norway: Center for International Climate and Environmental Research. (2)
- don't know (8)



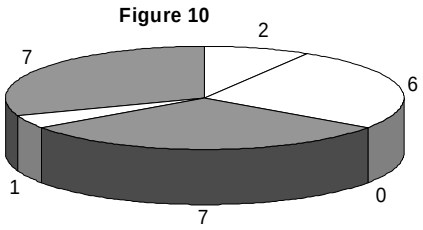


Figure 9. To find the most recent information concerning the use of marijuana and drug abuse, I would consult:

- a book (5)
- **a journal (11) ✓**
- an encyclopaedia (1)
- a dictionary (0)
- a magazine (5)
- don't know (1)

Figure 10. Which of the following best describes articles published in a scholarly journal?

- it includes a list of references (2)
- the research method used is described (6)
- the information is written for the layperson (0)
- **it has been evaluated by an editorial board before publication (7) ✓**
- none of the above (1)
- **don't know (7)**

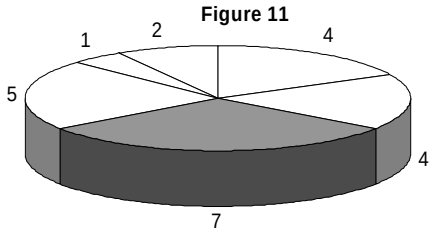


Figure 11. Which item below is an important criteria for evaluating an internet site?

- the date of publication is provided (4)
- the author is known in the field (4)
- **responsibility for the site is clearly indicated (7)** ✓
- the site is quickly accessible (5)
- none of the above (1)
- don't know (2)

2.2 Focus Group Exercises

In this section we present the outcome of the six focus group exercises outlined in Appendix B.

2.2.1 What do laypeople know about Open Access to scholarly/scientific literature?

At the start of a focus group session each participant was asked to note a few preliminary negative, neutral and/or positive ideas concerning Open Access and convey them to other members of the group. The ideas that they expressed are written below in the form of brief "sound bytes."

Positive ideas:

- "Interesting; I would like to find out what scholars/scientists are writing"
- "Interesting; I can following new developments – especially on illnesses, environmental issues, animal welfare"
- "people can get more scientific information about certain topics – e.g. disease information"
- "people will learn a lot from it"
- "knowledge sharing"
- "more cooperation and interaction is possible"
- "medical doctors can exchange information much quicker"
- "saves money for universities so that they can spend more on students"
- "accessible to everyone and not only through membership at a library"
- "stimulates people to be more critical of information"
- "you can find almost anything and most authors are written on the page"
- "knowledge and scientific information should be free for everyone"
- "it is democratic to know that the sites are available"
- "cutting-edge knowledge at my fingertips"

Negative ideas:

- "dangerous for some people, depending on the research"
- "you are not going to know if the research you find is legitimate"
- "harder to discern legitimate high quality research"
- "more difficult to distinguish between good and bad literature"
- "difficult to find out what to use or what is real"
- "plagiarism"
- "people will copy it and use it and make it look like it was their own thoughts"
- "more information means that you have to search harder for good information"
- "science is not neutral but value-driven and Open Access could lead to misinterpretation"
- "it could be used in the wrong way"
- "the language is too difficult to understand for "normal" people"
- "the information is for a small group of people"
- "people who publish don't get paid (?)"
- "too complicated and not that easy to find sometimes"
- "too much information and not all of it is correct and updated"

Summary:

- **Lay persons assume that scientific/scholarly information is not normally accessible to them because it is written at a high cognitive level, but they also have a sense that if they are free to access it, there is potential to learn from it and develop their ability to be more critical of information in general and how it is produced.**

- **Lay persons feel that there are potential dangers associated with openly accessible scholarly/scientific research, but find it difficult to express or identify specific ways in which it could be used in the wrong way.**

- **Civic scientific literacy in an Open Access context requires individuals to understand how they can benefit from scholarly/scientific information as well as recognize and identify specific contexts in which it may not be needed.**

2.2.2 What level of interest do laypeople have in reading peer-reviewed publications produced in different scholarly/scientific research areas?

Group participants were asked to think about different areas of scholarly/scientific research and identify, from a list of 14 discipline cards, which would be of primary reading interest to the lay public (see Appendix B). For discussion purposes they were invited to create a ranking system associated with the disciplines and to speak openly about their own personal interests.

Table 2. Ranking results from Cognitive Response Exercise C.

1. Health Sciences and Psychology	1. Health Sciences and Psychology	1A. Health Sciences and Psychology	1. Business and Economics
2a. Biology and Life Sciences	2. Earth and Environmental Sciences	1B. Business and Economics	2A. Earth and Environmental Sciences
2b. Earth and Environmental Sciences	3. Technology and Engineering	1C. Philosophy and Religion	2B. Agriculture and Food Sciences
3a. Philosophy and Religion	4. Agriculture and Food Sciences	2A. Agriculture and Food Sciences	3A. Health Sciences and Psychology
3b. History and Archaeology	5. Philosophy and Religion	2B. Technology and Engineering	3B. Sociology and Media Studies
4. Technology and Engineering	6. Business and Economics	2C. Physics and Astronomy	4A. Law and Political Science
5. Law and Political Science	7. Sociology and Media Studies	3A. Biology and Life Sciences	4B. Philosophy and Religion
6. Business and Economics	8. History and Archaeology	3B. Law and Political Science	5. Biology and Life Sciences
7. Agriculture and Food Sciences	9. Biology and Life Sciences	3C. History and Archaeology	6. History and Archaeology
8. Sociology and Media Studies	10. Arts and Architecture	4A. Earth and Environmental Sciences	7. Arts and Architecture
9. Arts and Architecture	11. Law and Political Science	4B. Mathematics and Statistics	8. Technology and Engineering
10. Physics and Astronomy	12. Physics and Astronomy	4C. Arts and Architecture	9. Physics and Astronomy
11a. Chemistry	13. Chemistry	5A. Chemistry	10. Mathematics and Statistics
11b. Mathematics and Statistics	14. Mathematics and Statistics	5B. Sociology and Media Studies	11. Chemistry

Table 2, above, indicates the rank results. Research produced in *Health Sciences and Psychology* was ranked quite high in terms of the public's interest, including *Business and Economics*, and *Earth and Environmental Sciences*. Most group participants considered *Mathematics and Statistics* and the field of *Chemistry* to be of little public interest.

During the group discussions, the following views were articulated.

F4CH: "... *you have a specific source of cancer in your family and you want to look at how that can affect you and what the chances are that you get it. You can look at biology and the life sciences. There is bound to be some articles that can interest you. And people want to have an opinion at parties [bit of laughter] about the Al Gore movie for instance.....and a lot of people say this [global warming] is [expletive] and that this is not happening*, *and a lot of people say no, it's scientifically proven*. *It's nice to be able to take a stand in that."*

F3MO: *"The health sciences – that gives people lots of hope. What can I do with my health? You go to the doctor and the doctor says "No, I'm sorry, there's no hope." You know then and you go to the Internet and look if there is hope"*

F3DO: "*people will always be interested in anything that has to do with people, and that can be health, history.. ehm.. social matters. I think for instance, chemistry – most people are far from it. It stands far from most people..."*

F3MZ: "*I think so too. Unless you study chemistry, then you are not interested...I think that most people will not look for chemistry [information] on the internet ..."*

F3MO: "*It has to do with milieu. If you look at it, you can split the questions into very personal things. Health and psychology – that has to do with your person [your most] private matters. And then you have things like, chemistry. That is not so much a personal thing but it has to do with general society..."*

F3DO: "*It also has to do with the time we live in... Perhaps a decade ago it would have been different. Now we read a lot about the earth and environment. Earth and environment is quite [a popular subject] now..."*

F4CH: "*I think business and economics would be popular."*

F4LI: "*I think people search [for information on] economics more, yeah.."*

F4CH: "*Money, it's popular!"*

F2NI: "*Agriculture and life sciences – this is something which we need, all of us. Everyday from the moment of birth till death... I think that without food and agriculture there will be no business and economics. So we have to put that first."*

F2PI: "*Maybe people don't realize how important agriculture is and that is why they might lack interest in it, and maybe [this is why] they have more interest in business and economics*."

F2AS: "*my opinion is that technology studies are important. This one is more important than agriculture, because, ehm... the development of technology makes, certain things happen and possible in agriculture. So, I think that technology is very important nowadays. I mean, everything is digital! We live in a digital world!* "

F2DA: "*but if you look at it in that way, then technology is the* ..."

F2NA: "*..the most important...."*

F2PI: "*maybe even more important than, for example, business and economics, which are greatly affected by technology. And the same goes for political science and law. I mean, how do you maintain the law without technology?"*

F2AS: "*It makes everything possible – technology..."*

F2AS: [Regarding Chemistry and Mathematics and Statistics]... "*Those are the more explicit studies. I mean, there are not a lot of people who are interested in mathematics or statistics."*

Moderator: "*Why?"*

F2AS: "*It's too explicit, too theoretical."*

F2AS: "*I think its logical that people are more interested in... ehm.."*

F2PI: "*The knowledge they need most in their daily life you mean?"*

F2AS: "*Yeah*"

F2PI: "*Indeed. I mean, many people don't have nothing to do with mathematics or statistics. And they're like, okay, as long as I can count, it's enough*."

Summary:

- **Lay persons are able to recognize the value of health and medical treatment research literature (e.g., "*It has to do with people*" and "*gives hope*") but many are less aware of and less able to discuss the value of other areas of scientific research and their impact on society (e.g., chemistry, physics, mathematics).**
- **Lay persons are apt to believe certain myths associated with research (e.g., "*technology makes everything possible*") and sometimes unable to recognize that advances in science and technology can also make the world more complicated and challenging.**
- **Science communication programs need to focus on ways to stimulate citizen's interest in the value of less cognitively accessible areas of scientific/scholarly research (Example below).**

- **Example: "During World Mathematical Year 2000, a sequence of posters designed at the Isaac Newton Institute for Mathematical Sciences (Cambridge, United Kingdom) was displayed month by month in the trains of the London Underground. The posters were designed to stimulate, fascinate - even infuriate! But most importantly ...bring maths to life, illustrating the wide applications of modern mathematics in all branches of science - physical, biological, technological and financial (see http://www.newton.ac.uk/ wmy2kposters/)**

2.2.3 Are laypeople aware of and do they agree with the notion that there are civic benefits associated with Open Access (OA)?

Group participants were asked to rank the most important Open Access benefit for laypeople (i.e., from a list of given benefits) and discuss their opinions. Table 3 presents the results of the second group ranking exercise.

Table 3. Open Access benefits. Ranking exercise D.

	Group 1	Group 2	Group 3	Group 4	Mode	Mean
Open Access will empower laypeople who want to read and use research literature for personal decision making and problem solving.	**1**	**1**	**1**	**1**	**1**	**1**
Open Access will allow people to satisfy their curiosity about what type of research is being done in certain fields and the latest findings.	**2**	**3**	**3**	**2**	**2**	**2.5**
Open Access literature will help to increase the level of understanding that people have of scientific research terms (e.g., DNA, stem cells, greenhouse effect), research processes, and findings.	**3**	**4**	**2**	**3**	**3**	**3**
Open Access will help people to see what scientific researchers are doing in their own country and acquire sufficient levels of accurate information on which to base their assessments of government policies so that their policy preferences best reflect their own interests.	**4**	**5**	**4**	**4**	**4**	**4.3**
Open Access will allow tax-paying citizens to see where and how money is being invested to support new scientific research.	**5**	**2**	**5**	**5**	**5**	**4.3**

During the group discussions, the following views were articulated.

F4LI: "*This* [card] *about personal decision making, I think that is the most important thing that people will look for."*

F4BA: "*Yeah, I agree with you*."

F4CH: "*Well, I think that for most people, it takes effort to find good literature and to read it all. It takes time and effort, and people will more likely do that if it's a personal problem. If it's something that is important to them [they will search for scientific and scholarly information], otherwise its just general interest*."

F4SR: "*I think that this* [points to card about laypeople satisfying curiosity] *is a good one. People get curious when they see something on television or in the news.* "

F4LI: "*Like the Al Gore movie, yeah. People were curious."*

F4SL: "*But I think that it's also important if you understand everything that is said in the news."*

F4CH: "*Yes, but most articles that I read don't explain the terms that they use*."

F4LI: "*Yeah, I get a dictionary*"

FSCH: "*Mostly the ones that I read just assume you have [some] knowledge of the subject and then they elaborate on the knowledge*"

F4CH: [Re: Informing taxpaying citizens] "*A lot of people won't understand because science is taking very very small steps. You have an entire research [project] that takes several years and then you find a tiny piece of the puzzle associated with a problem and people will think – well, that costs so much money and you have almost nothing to show for us. Well, that's the only way that science really advances.. And.. maybe lay people won't get that..."*

F4WO: "*I think that they're not really interested in the way that money is spent on universities."*

F4CH: "*Well, people are interested in the big results [of science] and in the final products and not in the tiny steps that it takes to get to the product. And ninety-nine-percent of the articles are just tiny, tiny steps. Well, you have to have the knowledge to place the steps in the whole picture, at the start…*"

F3JA: "*For personal problem solving. That's why people are..."*

F3DA: "*... using the Internet.*"

F3JA: "*Yes... go to the Internet."*

F3DA: "*It's what we talked about, you know, you're sick, or somebody else is sick and now you have the info you didn't have before*."

F3AN: "*If you find that information there."*

F3DA: "*Yeah, but this is, you know, this touches people's lives the most, I think."*

F3DA: "*Unfortunately, I think that a lot of people are not that curious, that scientific... They want to know where the money is going though. That's what I think."*

F3AN: "*How much are people going to learn about scientific terms in a scientific journal? They're not. Because a scientist is not going to explain what he's talking about. He assumes that his public already knows. So I think this should come as last."*

F3DA: "*I agree with you."*

F3AN: "*So we're not going to find out or understand things better"*

F3TA: "*I think the next one would be curiosity, because that's why you…. [that's] how you start to, you know, search for information. If your curiosity subsides you cannot go to this next level of understanding."*

Moderator: "*Does everyone agree?"*

F3AN: "*I don't know. I don't think that everybody is interested in research."*

F3TA: "*Who's interested in* [card: allowing taxpaying citizens to see how money is invested]*?* "

F3AN: "*I am. I think that this should come second."*

F3TA: "*Yeah, but you know, we're talking like probably one person or one percent of the Dutch population."*

F3DA: "*No, that's not true."*

F3AN: "*No, but it's important to know, I think. If you know what research is being done, you would like, you would want to invest in those kinds of research."*

F3AN: "*But do people really sit down in front of a computer to find out where their tax money is ...* "

F3DA: "*No no.. its sort of... Things change, because if you can find it, maybe you are going to use the information and think – hey, next time I'm going to vote, I'm not going to vote for this party, because I see that my tax money is not being spent right."*

F2NI: *"But nowadays all of the major things that are really related to the things that you would look for on the Internet. Where are they investing? What are they standing for? It's so international. Let's say, for the European community, you cannot look at the Netherlands alone anymore. In this kind of .. ehm... economical organisation, which is together, they are looking more generally. Not for each country, and what they are doing exactly. So, let's say cancer research – The Netherlands is such a small country. You don't have so much of an impact. Also financially. You have much better institutes next to Paris because they are bigger, and they can invest much more money."*

Summary:

- **Lay persons tend to be positive about the fact that free scientific / scholarly information has potential to empower them, especially in terms of personal choices and personal decision-making.**
- **Some lay people are convinced that individuals will not appreciate scholarly research unless they are highly curious about science, and others are convinced that curiosity is normally a function of having the ability to understand scientific texts and the language of science.**
- **Lay persons are more likely to link Open Access to personal benefits rather than the role it can play in helping them become more involved in government policies and tax dollar spending.**
- **Civic scientific literacy programs can focus on the skills that individuals need to appreciate, value, and make sense of science for personal benefit, but they also have to convince people to take their knowledge and understanding to another level of public engagement.**

2.2.4 What types of situations are likely to motivate a layperson to look for Open Access research literature?

The second exercise of each focus group session (Exercise E. Vignettes) was designed to encourage participants to discuss why it is that some people might choose to look for research literature as a personal problem solving aid or why they might choose other sources and types of information.

Vignettes 1 and 2 (below and in Appendix B) present two problems that are personal in nature. The problem described in Vignette 1 is relevant to research from the fields of Health Sciences and Psychology. The problem described in Vignette 2 relates to the fields of Developmental Psychology and Media Studies. Vignette 3 describes an environmental issue that is relevant to all humans, yet presented in terms of an educational framework.

VIGNETTE 1: A 28 year old woman has a child who is two years old and she has just discovered from a paediatrician that the child may be autistic. The doctor tells her that he will arrange a visit to a specialist, and explains that the cause of autism is still not specifically known.

F1NA: "*I think a study could be useful, because I think...I am also a mother, and most mothers when there is something wrong with their child, they think it has to do with them. When you read a study and you see that… ehm… the cause of all this is not yet to be found, it can give you some kind of... yeah, how do you say, a feeling that oh, it doesn't have to do with you, because there has been a lot of research about it. And that's why I think a study can help*"

Moderator: "*A study can help. Yes*"

F1PI: "*Yeah, I mean, for example, in my family there is a disease and there is no medicine yet, but every time that research is being published, then I am the first one to read it. Just to know, well, is there a medicine? You want to keep your knowledge up to date, maybe even your hope – You want to keep it up to date."*

F1NA: "*I think [research] literature gives you the facts. If you use other information, it's all,… it's often based on people's opinions or people's feelings, things like that. And when you read literature, you know it's based on facts."*

Moderator: "*Why do you think it would be useful to have Open Access research information, or why do you think other forms of information would be beneficial?"*

F1AS: "*[It is good] to get in contact with other mothers who had this [problem]. I don't want to specify it as a problem, but other mothers who have had a child also born with autism, they can.. ehm... the [case woman] can get some feedback from those people because they're experienced and I think that on the Internet for example there are some forums where people put their opinion and experience so that other people can learn from it*."

VIGNETTE 2: A 42 year old father notices that his 10 year-old son enjoys playing violent video games, and has said that he would rather do this than go outside and play football. The father is becoming more and more concerned about it and what this means for his son's social and emotional development.

F3RE: "*I don't think about scientific information. I think it's too deep for the father, as he has to go to the university or so. It's very difficult. Everyone can have such a child, but yes, to look what the information is, I don't think it's good."*

Moderator: "*So you don't think it's worth looking at the information?"*

F3RE: "*No. No."*

F3DO: "*I don't think so. Indeed as I may say something as the only one here without children. It's.. I think it's very difficult to know that research will help, because every situation with a child is unique. And, it's very hard to do, you'll never do okay for the child. No solution will be a hundred percent the best one. You won't find this, ehm, on the Web, in the research I think. It's all about how to deal with a child."*

F3DA: "*I would look just about anywhere if I was a father. I mean, it's such a pressing problem. So, I mean, if you can find information and it's available and reliable, I would use it.*"
F3JA: "*There are magazines for education. There are [many more] parents [who] read those magazines."*

F3AN: "*I think he would best first go to see his doctor and ask his doctor for information."*

F3JA: "*I don't think so."*

F3AN: "*It's the health.. it's the child's health!"*

F3DA: "*Yeah but it's a psychological thing."*

F3AN: "*Well, a doctor is also there for psychological problems*."

F3DA: "*Not my doctor!" [Group laughter]."*

F3AN: "*If [the father] doesn't know where to look, [the doctor] could direct the father in a certain direction."*

Moderator: "*What would be the motivation to look for another source of information versus research information?"*

F3MA: "*Well, the research is probably more reliable."*

Moderator: "*How so? How is it more reliable?"*

F3MA: "*Because they did research on it.*"

F3DA: "*Well, I disagree, because research for example, showed that all the sex we see on TV – what we see nowadays has not really changed our attitude towards sex. You know, one would assume that everybody is having his or her way and its not true, so we have to... I think the research will be interesting to, for example, to show a relation between children being aggressive – yes or no – and the video games they're playing. I would want to know the truth, so to say.*"

VIGNETTE 3: A 37 year old high school teacher has been educating her students on the topic of global climate change. In class she must respond to a question from a 17 year old student, who says: "my uncle has told me that humans are not really the major cause of global warming and that there is not much that we can do now to change it.

Moderator: "*If you were this thirty-seven year old teacher and you were trying to educate your students, why would it be useful to look for research information, and what other forms of information would be useful?*"

F3MZ: "*To answer the question from the child, you have to come with proof. The child asked you something. He's gonna ask why it isn't [or] why it ain't like that [and you've got have some proof. It's like that. It is probably the cause of humans or whatever the answer is. I think that's what the student expects. So [the teacher] has to go and look for research why it is like that.*"

F3DO: "*And give examples of how we can change it. That we can change it*."

F3MO: *"[The teacher] would also have to show examples that we have already changed something.*"

F3DO: "*And therefore for all those things, you can do research indeed on the Internet*."

Moderator: "*Yeah, so why would it be useful to find research information versus another form of information?*"

F3MO: "*I think [the teacher] should look for both. That sort of information [research] should work together with other information because there is... because one of the most dangerous things at this moment is the manipulation. It's very easy. Look at what Al Gore did. I mean, I very much agree with this guy, but he also did something overpower.. over.. overdone.. to manipulate the people to think the direction [is something] that we can change. We can if we take some decisions. So that's aggressive. It's a combination [of two things], from manipulation so that people really want to change [and] to give some hope that it is possible. And at the same time science, that is an important thing, because it's practical. Science is very practical.*"

Moderator: *"Science is practical."*

F3MO: "*It's very practical, yes."*

Moderator: *"What else is science?"*

F3MO: "*It's proof, science really proves things. Yeah, it can make things [more visible]*

Summary:

- **The discussions associated with Vignettes 1 and 2 were primarily associated with the discovery of "facts" – i.e. "*reliable facts"*. Group participants did not question the reliability of research, though some individuals expressed a concern regarding the average person's ability to interpret the presentation of research "*facts*". Most participants agreed that research would provide a person with information that was "*up to date*".**

- **Individuals who were not certain about using scholarly research for personal problem-solving emphasized a preference for human sources of information, either to direct them towards another information source or to provide new information. Some persons said that parent groups (e.g. online or off), medical or health associations and doctors would be more useful to them than research.**

- **Group discussions associated with Vignette 3 were oriented towards using research literature as "*proof*". Participants agreed that research literature should be used in conjunction with other types of information – e.g., lay oriented films, magazines and news reports –to find key points that will help the person move closer to the truth. Emphasis was placed on the importance of using different information types so that people can more easily make up their mind about what to believe and what not to believe.**

2.2.5 What would be the most significant barrier for laypeople when they look for and use Open Access research literature?

Group participants were asked to rank the most significant barriers associated with Open Access research literature (from a list of given barriers) and discuss their opinions. Table 4 presents the results of the third group ranking exercise.

Table 4. Barriers associated with Open Access literature. Ranking exercise F.

	Group 1	Group 2	Group 3	Group 4	Mode	Mean
Not being able to understand some of the scientific terms used in the research or the research methods used by the scientists.	**1**	**1**	**1**	**1**	**1**	**1**
Not being able to recognize what the research means within the context of a specific research field or related fields and how it compares to other research that has been done.	**4**	**3**	**2**	**3**	**3**	**3**
Feeling uncertain about the scientific results and what they mean in the context of everyday life.	**5**	**2**	**4**	**6**	**4**	**4.3**
Finding two or more research papers that give contradictory information and not being able to decide which information is correct or most useful.	**6**	**5**	**5**	**2**	**5**	**4.5**
Not being able to find scientific literature that is written in a preferred language (Note: a language other than English).	**2**	**6**	**6**	**4**	**6**	**4.5**
Not being able to judge whether or not the research is of high quality.	**7**	**4**	**3**	**7**	**7**	**5.3**
Not knowing how to search the Web effectively to find the scientific literature in open access databases and journals.	**3**	**7**	**7**	**5**	**7**	**5.5**

During the group discussions, the following views were articulated.

F3DO: "*I think that if you really want to know something, you will find a way to get there in any way, [that is] finding it yourself [or] asking others*."

F3MO: "*Okay.. but you also have to know the right terms to find it."*

F3MZ: "*But even if you misspell the word, it's still going to go to the right place."*

F3MO: "*Yeah, that's the truth. Yeah, yeah, you're right."*

F3DO: "*Yeah [the search engine will say] – are you looking for this perhaps?*"

F3MZ: "*Yeah, that's what it says. As you put in Google. So it doesn't matter. If you want to know about, let's say, headache... you type in 'head' not even 'ache' and you find everything ... including headache, so I don't think that this is the most important thing anymore.*"

F4BA: "*I think that this* [points to card] *'not being able to understand the terms' is very, very important.*"

F4BA: "*Yeah, that's a very important one.* "

F4WO: "*It has a relationship with this one* [card about judging the quality of the research]"

F4CH: "*Yeah, as well..."*

F4WO: "*.. because if you don't understand the terms, you're not able to judge..."*

F4BA: "*Yeah, the quality..."*

F4CH: "*And you can't compare [research articles]"*

F4LI: "*Yeah, but the quality would be high if it's in the database."*

F4MA: "*I think this one is second. The language one is on the same level as not knowing how to search."*

F4BA: "*Yeah, but all the literature is almost in English, all the important ones. So I don't think so*."

F4LI: "*Yeah, but it will be a big problem for, let's say, ehm, Dutch people or Italian people that don't speak English very well."*

F4CH: "*On the other hand, most people that are likely to search the database also speak English."*

F4LI: "*And there are a lot of online dictionaries."*

F4MA: "*Yeah, but still, you won't read an article if your English isn't that good*."

Moderator: "*Do you think people will understand scholarly literature written in the field of Media and Communication studies?"*

F3AN: "*I think so. It's the kind of people. Well, maybe I'm biased, but I think people of a certain level are interested in research. And if they have that level, they are capable of understanding English as well."*

F3DA: "*Probably so.. yeah."*

F3TA: "*I think for the Dutch it's not so difficult. I think that people who live here have less problems..."*

F3AN: "*No, it has nothing to do with the Dutch. It has to do with ... if you are academically schooled, and if you're capable of understanding the English."*

F3DA: "*Well, it depends. Suppose you're looking at research developments regarding your own health, then you might not be able to understand it. Say you are a historian, looking for new historical evidence, then you might. So it depends, I think."*

F3DA: "*Research is not just research in general. I mean, for example the global warming thing. I saw this program on TV, National Geographic, about several guys saying 'global warming is just a lot of, you know, nonsense. And they were sponsored by an oil company. So gee, I mean, I want to know the quality [of the research behind this statement].*"

Moderator: "*So that influences the quality*."

F3TA: "*Sponsorship is not quality*."

F3DA: "*If [a researcher] is sponsored by a certain company who wants you to have certain results, then*..."

F3AN: "*It could be of high quality, although it's biased*."

Moderator: "*Maybe Open Access will tell you who is sponsoring who.*"

F3DA: "*That would be terrific. If it's really totally open, like... this is, you know, about smoking and smoking is ok. But [the research] is sponsored by [a tobacco company]*"

Moderator: "*Okay, finding two or more research articles that are contradictory [in their results and conclusions]. Is this a barrier?"*

F2RE: "*It can be, but you have to go through with finding more information."*

F2MZ: "*If it is life threatening... like one [article] says that you are going to die from it and the other says you're not going to die from it. Yeah, then it's contradictory. You're going to be like, okay, I want to hear the real story now!"*

F2DO: "*Yeah, it makes you want to go further."*

F2MZ: "*It depends on the consequences."*

F2MO: "*If you don't accept this, then you do this. Then you become a slave...*"

Summary:

- **Lay persons are primarily concerned about the fact that scientific / scholarly literature is not cognitively accessible.**
- **Lay persons are not particularly concerned about whether or not they have their skills are adequate for searching scientific information on the Web as long as they know how to type keywords into a Google search engine.**
- **Lay persons assume that if scientific research information is available from a "*recognized database*" then it will normally be of high quality.**
- **When more than one piece of scientific / scholarly information is found on the Web, and the information is contradictory, some individuals believe that the contradictory evidence is most confusing or problematic if the underlying consequences are serious (e.g., a medical disease and medical treatment).**
- **Civic scientifically literacy is as much about individuals and their preferences and motivations as it is about the physical or cognitive barriers surrounding the accessibility of scientific information.**

2.2.6 What types of mediation strategies would be most helpful to laypeople when they look for and use Open Access literature on the Web?

Group participants were asked to rank a set of Open Access mediation strategies on the Web (i.e., from a list of given strategies) and discuss their opinion concerning what would be most helpful to laypeople. Figure 15 presents the results of the fourth group ranking exercise.

During the group discussions, the following views were articulated.

F3MO: "*You can start at Wikipedia*"

F3MZ: "*It's an easy access.*"

F3MO: "*Yeah, it's an easy access*."

F3DO: "*That's important, yeah.*"

F3MO: "*It's an easy access for everybody as a start. And then.. ..then you can find out if there is a blog or something where you can discuss with people the matter.. the subject*."

F3DO: "*But I think a discussion is perhaps for later."*

F3RE: "*You can get your information directly, with a blog, a discussion blog. And this other…* [points to card regarding journalist news reports] *…you can only find on paper, but you can't talk to others."*

Table 5. Mediating and Interpreting Open Access literature. Ranking exercise G.

	Group 1	Group 2	Group 3	Group 4	Mode	Mean
Web news reports or articles written by journalists (e.g., New York Times Science page; BBC Science page; Scientific American) with links to Open Access research articles.	**5**	**1**	**5**	**1**	**1**	**3**
A Web page or site prepared by a scientist or scientific research team explaining the importance of their research, with links to Open Access research articles.	**3**	**2**	**2**	**5**	**2**	**3**
A blog written by a scientist or scientific research team, providing weekly reports on the progress of their work, and links to Open Access research papers.	**2**	**3**	**3**	**6**	**3**	**3.5**
A Wikipedia entry on the Web, which describes a subject in science and provides links to related Open Access research papers.	**6**	**5**	**1**	**2**	**4**	**3.5**
A Web page or site posted by an institute or university providing interpretive information concerning new research done by the institute or university's scientists, including links to Open Access research articles.	**4**	**4**	**4**	**4**	**4**	**4**
A discussion blog or Internet newsgroup where individuals interested in scientific issues can contribute their opinions regularly and post links to Open Access research papers.	**1**	**6**	**6**	**3**	**6**	**4**

F3MZ: "*Yeah, I understand, but not everybody wants to openly discuss their search with everybody. I want to do it for myself. So that's personal, I don't want to share what I'm looking for – a terrible disease or something! That's why I want to look [for information] about it for myself first. If I really cannot find it out, then I go to an open discussion with somebody*."

F3MO: "*That is a decision. If you find something on Wikipedia, then you can make a choice. If you want to find a blog written by a scientist, or you... This has to do with all the choices. [It is] which [ever] way you want*."

F3DO: "*I think that once it is a journalist who writes about [a research-related issue]*], *it's more coloured*."

F3MZ: "*Yeah – journalist – the name says... You don't always trust it*."

Moderator: "*But it is a respected source*."

F3MZ: "*Yeah, ok, but you know, they still can throw their own opinion in there too."*

Moderator: "*You think they throw in their own opinion."*

F3MZ: "*Yeah, I don't know."*

F3RE: "*I think they will know more about [a scientific research subject] than the discussion blog."*

F3MO: "*You don't trust journalists so much anymore."*

F3MZ: "*No*" [Laughter amongst the group]

F3RE: "*When they have to write something, they have to look for information before. They have to!*"

Moderator: "*And what about the way they present it*?"

F3MZ: "*I think it's more in a clear language than what the scientist would do*."

F1NA: "*For me personally, it's a news reporter, because most of the time they try to explain things in just simple language without using too many terms. And if I get interested in the subject that the news reporter [presents], I can always search further by the links that they give, so for me personally, the first one is the news reporter."*

F1DA: "*The problem with [journalists or news reporters] is that they show you the things they want to show; the thing you want to see.*"

F1NA: "*But you get that with everyone, everything, because that's also what the researcher himself does, or what Wikipedia does, they all do that.* "

F1AS: "*Yeah it's all subjective."*

F1PI: "*In the end it's all... but I think that the media have*…."

F1NA: *"the biggest power"*

F1PI: "*The [media/journalists] have the tendency indeed to decide what subject we discuss. And also what subjects to ignore. So, let's say that health care is a very hot topic, then you'll find every link about that, but let's say that .. ehm.. crime rates are not a hot topic or something, they would ignore that probably*."

F4LI: "*Wikipedia is not very trustworthy. I mean, you can add stuff that's not true, to Wikipedia."*

F4WO: "*It's a good starting point*."

F4LI: "*But it's not really reliable*."

F4CH: "*Well, it's more reliable than a blog or a discussion. At least these are about the same, because on Wikipedia you have a.... Behind the scenes of Wikipedia there's a huge discussion board [for people] to rage on and on and on about [whether or not] there should be a comma in the text or not. And if that's done behind the scenes, then the general public can just see the result of that discussion. Instead of having to read the entire discussion on blogs and on, ehm, yeah well, different people giving their opinions.*"

F4WO: "*If this links to the research, then people will start probably. If you Google any word now, you get Wikipedia very high on the list. So, if you click on this and then below on the Wikipedia page you see the link to the article, I think it's very useful."*

F4MA: "*Yeah, because Wikipedia is really easy to enter."*

F4CH: "*If you really want to dive into the subject, you can go to the research paper. But I doubt many people will...People who go to Wikipedia probably won't follow the links that are at the bottom of the text. They'll just take the information as granted.* "

F4MA: "*If I want information I get a real encyclopaedia, and not Wikipedia."*

F4BA: "*But lay people who are not university students, they go to Wikipedia. They will, and they can get linked through."*

F4BA: "*University students go as well. Yeah, they go as well. Me too, but..."*

F4LI: "*But I think... Yeah, the university site is more."*

F4MA: "*It's more trustworthy."*

F4WO: "*But most of the people don't know [about what's happening] in a university."*

F4LI: "*Yeah, ok, that's true."*

F4MA: "*It's a bigger barrier. And most people don't know that Wikipedia isn't reliable."*

F4LI: "*I think that for the more educated people, they will probably go to the website based on a university topic. Because you have found an article about [Professor X], you want to know more and then you go to his page, and then you go to the Open Access research."*

F4CH: "*It won't be objective, because [Professor X] will just praise his own research."*

F4LI: "*Yeah, but then there's more about the topic."*

F4BA: "*But how do you get to the website of [Professor x] in the first place*?"

F4CH: "*Exactly. That's something you are not going to find."*

F4SI: "*I think it is better to go to a university page.*"

Moderator: "*So you think that the universities should do more front work?*"

F4WO: "*They should, yeah, in their homepage.*"

Summary:

- **Some lay persons recognize that journalists and newspapers can be trustworthy in their interpretation of new science and technology information, but others believe that this information should be related to the public more often by scientists themselves.**
- **Lay persons suggest that Wikipedia might be a good starting point for obtaining information about science ("*like looking in an encyclopaedia*") but question the credibility of this Web resource because the pages can be altered by many Internet users.**
- **Lay persons tend to be wary about using blogs to discuss new science and technology research information, particularly if the discussion requires an individual to relate personal details about him/her self.**
- **Civic scientific literacy cannot be nurtured without the use of forums for discussion because issues and problems associated with science are rarely static, nor can problems related to science be solved or introduced into societal contexts simply because the public has access to scientific facts.**

3 Conclusions

This study was organised around a small (but varied) sample of Dutch citizens; therefore our focus groups should not be used to make substantial inferences about the information seeking and use habits of all people living in The Netherlands. The results produce a preliminary look at how laypeople currently perceive Open Access and we hope that the opinions expressed by our participants may be used for discussion purposes in an educational policy context.

Here we will highlight six relevant issues:

1. Lay conceptions associated with scientific/scholarly knowledge and the accessibility of scholarly research literature online (*focus group outcomes*).
2. The concept of civic scientific literacy and why it matters,
3. Methods for evaluating civic scientific literacy
4. The current debate concerning civic scientific literacy
5. Policies and programmes for increasing civic scientific literacy.
6. Open Access and civic scientific literacy.

1. **Lay conceptions associated with scientific/scholarly knowledge and the accessibility of scholarly research literature online (focus group outcomes).** Members of the lay public are expected to have a different view of scholarly/scientific research than scholars themselves. The focus group sessions highlight a few lay conceptions:

- Citizens recognize the value of health and medical treatment research (e.g., "*It has to do with people*" and "*gives hope*") but seem to be less aware of and less able to discuss the value of other scholarly/scientific areas of research and their impact on society (e.g., chemistry, physics, mathematics).
- Citizens are aware of the fact that advancements in science are slow and that science is "*taking very very small steps."*
- Citizens are less concerned about the skills they need to locate research information on the Web and more concerned about interpreting the scientific and methodological jargon used in the research, as well as understanding what it means in the context of a research field.
- Citizens are wary of the fact that there is too much information on the Web, but assume that Open Access will stimulate people to be more critical of information because it will be difficult to determine what constitutes useful and credible literature.
- Citizens appreciate research literature that provides them with information for personal decision making and problem solving, but recognize that research outcomes are not necessarily useful in all situations.
- Citizens do not seem to agree that openly accessible research information can help them to assess government policies that best reflect their personal interests.
- Citizens generally trust journalists to interpret science for them in lay terms, but believe that journalists are apt to insert their own opinion; hence information coming directly from a university source is more trustworthy.

2. Why should we care about civic scientific literacy?

Hazen (2002) states that "we live in an age of constant scientific discovery – a world shaped by revolutionary new technologies" and "as a consumer and as a citizen [an individual] has to form an opinion about .. science-based issues if [he or she] is to participate fully in modern society."

A scientifically literate individual is "someone who possesses some knowledge and understanding of scientific concepts and processes required for participation in a Digital Age society and can identify scientific issues underlying national and local decisions and express a position that is scientifically and technologically informed" (North Central Regional Educational Laboratory, 2004).

We should care about civic scientific literacy because it helps individuals to:

- understand issues that they come across daily in news stories and government debates
- appreciate how the natural laws of science influence daily life
- gain perspective on the intellectual climate of our time
- appreciate the world around them
- make informed personal choices (Hazen, 2002).

3. Evaluating civic scientific literacy.

Jon D. Miller (2006), director of the International Center for the Advancement of Scientific Literacy (Chicago, US), notes that "it is important to construct a measure of civic scientific literacy that will be useful over a period of years and that will be sufficiently sensitive to capture changes in the structure of composition of public understanding" (p. 6).

In the 1980s and 1990s Miller and a number of other researchers determined two dimensions of scientific literacy – 1) a basic vocabulary of scientific terms and concepts, and 2) an understanding of the process or methods of science. Over time national surveys conducted both in Europe and the United States have indicated "that the vocabulary and process dimensions [are] empirically inseparable." By 2003 and 2004 the two factors (dimensions) were correlated at the .94 level or higher.." (pp. 3-4).

The emergence of an unidimensional scientific literacy construct has led Miller and his associates to develop a "durable set of measures" which may be "continually enriched to reflect the growth of science and technology" (p. 4). Recent studies carried out with the American public in 2003, 2004, and 2005, "have included new open-ended and closed-ended measures of civic scientific literacy, which provide "significantly better estimates of public understanding than had been collected in any prior national study" (p. 4).

The methodology, termed "Item-Response-Theory (IRT)", allows researchers from any country to incorporate changes and continually enrich the composition of items in the survey to reflect the growth of science and technology. Individual scores on the new IRT Index may range from approximately zero to 100, and a score of 70 or higher is "indicative of a level of understanding sufficient to read science and technology stories written at the level of the *New York Times* section or an article in *Science et Vie*." (p. 6)

In 2005, new national studies carried out in America and 25 member states of the European Union indicated that “35% of Swedish adults and 28% of American adults qualified as being civic scientific literate. Using the same metric, 24% of Dutch adults and 22% of adults in Norway, Finland, and Denmark were classified as civic scientific literate” (p. 6).

4. The current debate concerning civic scientific literacy.

The clash of opinions concerning civic scientific literacy is rooted in the differences between scholars who favour the public communication perspective, versus those who are now promoting the public engagement perspective.

Traditional science literacy models normally place emphasis on informing the public or communicating facts and figures about science to the public. Individual’s who prefer the public engagement perspective assert that

> scientific institutions and scientists need to focus less on programs designed to inform the public about the facts of science, and should instead focus on programs that get citizens involved in science-related decision-making, with a goal of promoting public trust (Nisbet, 2003).

In a 2003 column published in *The Guardian* (April 10, 2003) Susan Greenfield argued that the only way for members of the general public “to evaluate the implications of science is, of course, to be scientifically literate, and one can only be scientifically literate if one is willing to have an open mind and stop expecting scientists alone to be the conscience of the nation.” Greenfield suggests that we “imagine a society where to talk about science was as natural as talking about football.. [O]nly then will we be truly empowered as a society to harness science for what we want in life.”

Jon Turney’s (2003) counterarguement, is that is that it is wrong to focus on scientific literacy if the aim is to “abolish ignorance.” Turney states that

> many folk are indifferent to science, and likely to remain so. Others won’t make the effort to surmount barriers of jargon and methodology because they are too busy. If they did, it is still not clear that their opinions about the implications of science would be welcomed... If large numbers of people fail to achieve some idea of scientific literacy, this may be because they have got the message that they have no real purchase on scientific decision making, not because they are incapable of mastering technicalities (*The Guardian*, April 17, 2003).

Wilsdon, Wynne and Stilgoe (2005) have written extensively about the notion of ‘upstream’ public engagement and explain that it is

> not about members of the public standing over the shoulders of scientists in the laboratory, taking votes or holding referendums on what they should or should not be doing.... This agenda is not about imposing cumbersome bureaucratic structures on science, or forcing lay people onto every research funding committee....

> Rather, upstream engagement – at a point where research trajectories are still open and undetermined – should be the start of a process of ongoing deliberation and social assessment, that embeds dialogue between scientists, stakeholders and lay publics within all stages of the R&D process..." (pp. 35-38).

5. Policies and programs for increasing scientific literacy.
The Dutch Ministry of Economic Affairs' 2006 *Science, Technology and Innovation* report on *Policies, Facts and Figures* has given attention to the following science policy issues:

- Focus and mass (i.e., the concentration of research funds on national priorities).
- Rewarding excellent research
- The utilisation of research results
- Human resources
- Public awareness

Public awareness was described as follows:

> Realising the Dutch ambition within Europe requires not only investments in research and innovation, but also calls for changes in the education system and an adequate strategy in terms of communicating science and technology. The problem is that relatively few pupils in secondary education choose a profile in science and technology, and the same is also the case for students in higher education. Public communication policy on science and technology is intended to motivate the general public, especially young persons, and to raise their interest in science and technology (p. 29).

In lieu of this issue, the Dutch government has launched a National Action Plan on Science and Technology (2004) termed the "Delta Plan." The purpose of the Delta Plan is to "increase enrolment into (15% more) progression through and graduation from (15% more) science and technology subjects." A "Science and Technology Platform was established to put this ambition into practice... and the platform has developed programmes throughout the educational chain...tailored to various sectors" of the education system (p. 53).

Final outcomes, including the impact of the Delta Plan are not yet known, but there is evidence that education and scientific literacy are inextricably linked. In the United States research has shown that "independent of age and gender, level of educational attainment was positively related to civic scientific literacy" (Miller, 2004, p. 289). Miller (2001) has also found that an "individual's use of informal science education resources," for example, "science magazines, news magazines, science books, science museums, home computer, science websites and the public library" also bears a positive relationship to civic scientific literacy" (p. 290).

Clearly, one of the best strategies for increasing civic scientific literacy is to focus on improvements to the science education system. In nations outside the Netherlands emphasis has also been placed on education reform. For example, Canada's science learning outcomes (Kindergarten age to Grade 12) are based on four foundation statements (Council of Ministers of Education, Canada, 1997):

- Foundation 1. Science, technology, society, and the environment
- Foundation 2. Skills
- Foundation 3. Knowledge
- Foundation 4. Attitudes

Foundation 4 in the Canadian policy context encourages students "to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society, and the environment." The Canadian Council of Ministers of Education state that "attitudes are not acquired in the same way as skills and knowledge;" yet there are certain indicators which may be developed over time in the home, at school, within the student's community and in society:

- Appreciation of science: encourage students to appreciate the role and contributions of science in their lives, and to be aware of its limits and impacts.
- Interest in science: encourage students to develop enthusiasm and continuing interest in the study of science.
- Scientific inquiry: encourage students to develop attitudes that support active inquiry, problem solving, and decision making.
- Collaboration: provide students with opportunities to work in group situations and on real-life problems.
- Stewardship: encourage students to develop responsibility in the application of science and technology in relation to society and the natural environment.
- Safety: encourage students to demonstrate a concern for safety in science and technology contexts (Council of Ministers of Education, Canada, 1997).

Since it is the Dutch government's policy to promote public awareness and motivate young students to enrol in science and technology subjects, policymakers are urged to consider how information-based technologies, including Open Access, can play a role in stimulating attitudes of appreciation, interest, inquiry, etc.

6. Open Access and civic scientific literacy.

In a research article titled "*Public Understanding Of, and Attitudes Toward Scientific Research: What We Know and What We Need to Know*" Miller (2004) states that

> it is critically important to monitor the impact of the information technology revolution on the development of scientific literacy....and on the public understanding of research" (p. 291).

It is well known, particularly in the US, that although television is still the main source of information about science and technology, the Internet is becoming a strong competitor:

> When people get information about science from television, they tend to do so inadvertently... In contrast, obtaining science information from the Internet is more likely to be purposive. For example, the number of people [in the US] naming the Internet as the place they would go to learn more about a scientific issue such as global warming or biotechnology rose from 44% in 2001 to 52% in 2004 (National Science Foundation. Division of Science Resources Statistics, 2006)

At present, little is known about the role that Open Access will play to support civic scientific literacy, except that the results of scholarly/scientific research is and will continue to be more visible to the lay public on the Internet, in its original academic form.

With Open Access, scholarly research literature may be used online to create a new kind of public awareness; whereby the traditional networks of popular science (i.e., journalists and popular magazines, newspapers and observatories) and academic science need not exist in parallel anymore. As science proper becomes more available on the Web we might begin to see more network interaction or cross-linkages between the two sides.

In an Open Access era, the best approach to civic scientific literacy is not to focus on the information provider's point of view, but to focus on ways to stimulate the public's engagement with problems and issues related to science. This puts the public's understanding of science "closer to a perspective on behavioural processes [because] it starts by taking the public's point of view (e.g., the information consumer's—but not solely as a communication receiver)" (Kim, 2007).

Open Access has potential to benefit the lay public because it respects the individual's ability to make choices as an information consumer:

> Audiences do not simply expose themselves to information randomly; rather, they actively choose different media channels and types of information purposively, depending on their particular goals and their expectations about how well the media channels and information types will meet those goals (Triese et al., 2003, p. 315).

In a previous Rathenau Institute report, titled *Digital Vaardigheden: Geletterdheid in de Informatiesamenleving* (Digital skills: Literacy in the Information Society) Jan Steyaert (2000) examined the digital skills that citizens need in order to deal with technological developments in the information society. Steyaert distinguished between instrumental skills (i.e., new structures in which information is contained) and strategic skills (i.e., the readiness to proactively look for information, take decisions based on information, and scan the environment for relevant information) and concluded that the government and other parties throughout The Netherlands were focusing too much on one dimension – the physical infrastructure – and neglecting the skills that citizens would need to use new technologies.

To reap the benefits of Open Access, young Dutch citizens are in need of strategic e-learning programmes designed to promote and further develop their capacity as online information consumers. E-learning programmes focused on civic scientific literacy can help prepare young citizens to:

1. Recognize when scholarly or scientific research information is needed for problem-solving,
2. Know where to look for scholarly/scientific research information online and evaluate its credibility,
3. Understand how scholarly/scientific research information is socially situated and produced, and
4. Understand what this information means in the context of a scientific communication network and society as a whole.

4 References

Association of College & Research Libraries (ACRL). (2000). Information literacy competency standards for higher education. Retrieved June 20, 2008 from http://www.ala.org/ala/acrl/acrlstandards/informationliteracycompetency.cfm.

Bauer, M. W., Allum, N. & Miller, S. (2007). What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda. *Public Understanding of Science, 16(1)*, 79-95.

Bensaude-Vincent, B. (2001). A genealogy of the increasing gap between science and the public. *Public Understanding of Science, 10(1),* 99-113.

Berg, B. L. (1998). Qualitative research methods for the social sciences (Third edition). Needham Heights, MA: Allyn & Bacon.

Bloor, M., Frankland, J., Thomas, M. & Robson, K. (2001). *Focus groups in social research*. London: SAGE Publications Ltd.

Budapest Open Access Initiative. (2002, February 14). Retrieved June 20, 2008, from http://www.soros.org/openaccess/read.shtml.

Callon, M. (1999). The role of laypeople in the production dissemination of scientific knowledge. *Science Technology & Society, 4(1),* 81-94.

Chatman, E. A. (1991). Life in a small world: applicability of gratification theory to information-seeking behavior. *Journal of the American Society for Information Science 42(6)*, 438-449.

Cole, C. (1997). Information as process. The difference between corroborating evidence and “information” in humanistic research domains. *Information Processing and Management, 33(1)*, 55-67.

Council of Ministers of Education, Canada. (1997). K to 12 common framework of science learning outcomes. Pan-Canadian protocol for collaboration on school curriculum. Retrieved July 15, 2008 from http://www.cmec.ca/science/framework/.

Dervin, B. (1992). From the mind's eye of the user: the sense-making qualitative-quantitative methodology. In J. Glazier and R. L. Powell (Eds.), *Qualitative research in information management* (pp. 61-83). Englewood, Colo.: Libraries Unlimited.

Dijkstra, M., Buijtels, H. E. J. J. M., & van Raaij, W. F. (2005). Separate and joint effects of medium type on consumer responses: a comparison of television, print, and the Internet. *Journal of Business Research, 58(3),* 377-386.

Durrentberger, G., Kastenholz, H. & Behringer, J. (1999). Integrated assessment focus groups: bridging the gap between science and policy? *Science and Public Policy, 26(5)*, 341-349.

Ellis, D. (1989). A behavioural approach to information retrieval design. Journal of *Documentation, 45(3),* 171-212.

Ellis, D., Cox, D. & Hall, K. (1993). A comparison of the information seeking patterns of researchers in the physical and social sciences. *Journal of Documentation, 49(4),* 356-369.

Fogg, B. J. & Tseng, H. (1999). *The elements of computer credibility*. Paper presented at the Conference on Human Factors and Computing Systems, Pittsburgh, PA, May 15-20, 1999.

Greenburg, S. (2003, April 10). A new kind of literacy. *The Guardian*. Retrieved July 11, 2008 from http://education.guardian.co.uk/higher/sciences/story/0,,933156,00.html.

Hazen, R. M. (2008). *Why should you be scientifically literate?* Retrieved June 24, 2006 from http://www.actionbioscience.org/newfrontiers/hazen.html.

Hilgartner, S. (1990). The dominant view of popularization: Conceptual problems, political uses. *Social Studies of Science, 20(3),* 519-539.

Illinois Mathematics and Science Academy (2002). *21st century information fluency project. Digital information fluency model*. Retrieved June 20, 2008 from http://21cif.imsa.edu/resources/difcore/index.html.

Jacobs, N. (Ed.). (2006). Open Access: Key strategic, technical and economic aspects. Oxford, UK: Chandos Publishing Ltd.

Jasanoff, S. (2000). The 'science wars' and American politics. In M. Dierkes and C. von Grote (Eds.), *Between understanding and trust: The public, science and technology* (pp. 39-60). Amsterdam: Harwood Academic Publishers.

Jurdant, B. (1969). Vulgarisation scientifique et idéologie. *Communications, 14*, 150-161.

Kim, H.-S. (2007). PEP/IS: A new model for communicative effectiveness of science. *Science Communication, 28(3),* 287-313.

Koolstra, C. M., Boss, M. J. W., & Vermeulen, I. E. (2006). Through which medium should science information professionals communicate with the public: television or the internet? *Journal of Science Communication, 5(3),* 1-8.

Kuhlthau, C. C. (1991). Inside the search process: Information seeking from the user's perspective. *Journal of the American Society for Information Science, 42(5)*, 361-367.

Kuhlthau, C. C. (1997). The influence of uncertainty on the information seeking behaviour of a securities analyst. In P. Vakkari, R. Savolainen, and B. Dervin (Eds.), *Information seeking in context: Proceedings of an international conference on research in information needs, seeking and use in different contexts, 14-16 Tampere, Finland* (pp. 268-275). London: Taylor Graham.

laity. (2008). In *Merriam-Webster Online Dictionary*. Retrieved June 20, 2008 from http://www.merriam-webster.com/dictionary/Laity.

Latour, B. (1987). *Science in action*. Cambridge, MA., Harvard University Press.

Leydesdorff, L. & van den Besselaar P. (1987). What have we learned from the Amsterdam science shop. In S. Blume, J. Bunders, L. Leydesdorff & R. Whitley (Eds.), *The social direction of the public sciences: Vol. XI. Sociology of the sciences yearbook* (pp. 135-160). Dordrecht: Reidel Publishing Company.

Leydesdorff, L. & Ward, J. (2005). Science shops: a kaleidoscope of science-society collaborations in Europe. *Public Understanding of Science, 14(4),* 353-372.

Liu, Z. (2004). Perceptions of credibility of scholarly information on the web. *Information Processing and Management, 40(6),* 1027-1038.

Miller, J.D. (1998). The measurement of civic scientific literacy. *Public Understanding of Science, 7*, 203-223.

Miller, J. D. (2001). The acquisition and retention of scientific information by American adults. In J. H. Faulk (Ed.) *Free-choice science education: How we learn outside of school* (pp. 93-114). New York: Teachers College Press.

Miller, J. D. (2004). Public understanding of, and attitudes toward, scientific research: What we know and what we need to know. *Public Understanding of Science, 13*, 273-294.

Miller, J. D. (2006). Civic scientific literacy in Europe and the United States. A paper presented to the Annual Meeting of the World Association for Public Opinion Research, Montreal, Canada. Retrieved July 8, 2008 from http://www.arcsfoundation.org/Pittsburgh/JMiller.pdf

NARCIS*. The gateway to Dutch Scientific Information*. (2008). Retrieved June 23, 2008 from http://www.narcis.info/?wicket:interface=:13.

National Science Foundation. Division of Science Resources Statistics. (2006). *Science and Engineering Indicators 2006* (NSB 06-01). Retrieved July 24, 2008 from http://www.nsf.gov/statistics/seind06/pdfstart.htm.

Nisbet, M. (2003, June 9). Who's getting it right and who's getting it wrong in the debate about science literacy? *The Committee for Skeptical Inquiry. Science and The Media*. Retrieved July 11, 2008 from http://www.csicop.org/scienceandmedia/literacy/.

North Central Regional Educational Laboratory. (2004). *21st century skills. Scientific literacy*. Retrieved November 28, 2007 from http://www.ncrel.org/engauge/skills/scilit.htm.

Rieh, S. Y. (2002). Judgement of information quality and cognitive authority in the Web. *Journal of the American Society for Information Science and Technology, 53(2),* 145-161.

Science, Technology and Innovation in the Netherlands. Policies, facts and figures, 2006. Retrieved February 3, 2009 from http://www.minocw.nl/documenten/Science-Technology-Innovation-brochure-2006.pdf

Self, C. S. (1996). Crediblity. In M. Salwen & D. Stacks (Eds.), *An Integrated Approach to Communication Theory and Research* (pp. 421-444). Mahwah, NJ. Erlbaum.

Spink A. & Cole C. (2001). Information and poverty: Information-seeking channels used by African American low-income households. Library and Information Science Research 23(1), 45-65.

Steyaert, J. (2000). Digital vaardigheden: geletterdheid in de informatiesamenleving. . (Rathenau Instituut Werkdocument 76). Den Haag: The Netherlands.

Sturgis, P. & Allum, N. (2004). Science in society: Re-evaluating the deficit model of public attitudes. *Public Understanding of Science, 13*, 55-74.

Surf Foundation (2007, March 1). *Support growing for Open Access to scientific publications*. Retrieved June 20, 2008 from http://www.surffoundation.nl/smartsite.dws?ch=ENG&id=12876.

Taylor, R. S. (1991). Information use environments. In B. Dervin & M. J. Voigt (Eds.) Progress in communication sciences (Vol. 10, pp. 217-2550. Norwood, NJ:Ablex.

Treise, D. Walsh-Childers, K., Weigold, M. F. & Friedman, M. (2003). Cultivating the science internet audience: Impact of brand and domain on source credibility for science information. *Science Communication, 24(3),* 309-332.

Turney, J. (2003, April 17). How Greenfield got it wrong. *The Guardian*. Retrieved July 11, 2008 from http://education.guardian.co.uk/higher/research/story/0,,938049,00.html.

Wathen, C. N. & Burkell, J. (2002). Believe it or not: factors influencing credibility on the Web. *Journal of the American Society for Information Science and Technology, 53(2)*, 134-144.

Willinsky, J. (2006). *The access principle: the case for Open Access to research and scholarship*. Cambridge, MA: Massachusetts Institute of Technology Press.

Wilson, P. (1983). *Second-hand knowledge. An inquiry into cognitive authority*. Westport, CN: Greenwood Press.

Wilson, T. D. (1981). On user studies and information needs. *Journal of Documentation, 37(1)*, 3-15.

Wilson, T. D. (1999). Models in information behaviour research. *Journal of Documentation, 55(3)*, 249-270.

Wynne, B. (1992). Public understanding of science research: new horizons or hall of mirrors? *Public Understanding of Science, 1(1),* 37.

5 Appendices

5.1 Appendix A. Questionnaire [1]

1. Last Name: _____ First Name: _____

2. E-mail Address: _____

3. Gender: Male ( ) Female ( )

4. Age: _____

5. City and Province of Residence: _____

6. Country of Residence: _____

7. Country of Citizenship: _____

8. Highest level of education completed or current level of enrolment:

( ) University Post Graduate (Masters Degree or Ph.D.)
( ) University Undergraduate
( ) College Degree
( ) High School

9. Current Occupation/Profession _____

10. Do you own a computer at home and a connection to the Internet? Yes ( ) No ( )

11. Do you have access to a computer and the Internet at your workplace?
Yes ( ) No ( )

12. Place a check beside one or more of the following resources if it is something that you have used to search for information:

( ) A Web search engine, like Google, AltaVista, Yahoo, etc.
( ) A Public Library Catalogue
( ) A University Library Catalogue
( ) A search engine dedicated to academic information, like Google Scholar
( ) An Organisational, Business or University Web page

[1] Questions 15-22 were adapted from the Monash University Library Information Literacy Questionnaire, Monash, Australia (Available at: http://www.lib.monash.edu.au/reports/infolit-evaluation-2005/questionnaire-pretest.pdf) and from the questionnaire in Mittermeyer, D. & Quirion, D. (2003). Information literacy: study of incoming first-year undergraduates in Quebec. *Conferences des recteurs et des principaus des universités du Québec. Montréal, 2003* (Available at: http://www.crepuq.qc.ca/documents/bibl/formation/studies_Ang.pdf).

13. How often do you surf the Web for information outside of regular work tasks or student assignments (check one item below)? :

( ) Almost everyday
( ) About two times per week
( ) A few times each month
( ) Only once per month
( ) Once every few months
( ) I don't search the Web for info information

14. You want to carry out a Google search to find vacation information associated with two different cities. Which of the following search strategies would you use?

( ) vacation Budapest AND Vienna
( ) vacation Budapest OR Vienna
( ) vacation Budapest * Vienna
( ) vacation Budapest NOT Vienna
( ) don't know

15. Using a search engine such as Google Scholar to search for documents on "The depletion of the ozone layer and the impact on health," you would use the words:

( ) impact, depletion, ozone layer, health
( ) ozone layer, health
( ) ozone layer
( ) skin cancer, ozone layer
( ) other. Please specify _____.
( ) don't know

16. Using a search engine such as Google or Yahoo, you would not find:
(Circle ONE answer)

a) books that are available in a library
b) biographical information about famous people
c) information about companies
d) merchandise catalogues
e) don't know

17. If you want to find journal articles about "the effect that bullying behaviour in school has on the development of young boys" you would search in:
(Circle ONE answer)

a) the library catalogue
b) a bibliographic database
c) Google
d) the journals a library
e) don't know

18. To become familiar with a subject about which you know very little, first you consult:
(Circle ONE answer)

a) a journal
b) an encyclopaedia or Wikipedia
c) a database
d) a book
e) don't know

19. Which of the following is a citation to a journal article? (Circle ONE answer)

a) Collier, M & Webb, R. H. (2002). *Floods, droughts, and climate change*. Tucson, AZ: University of Arizona Press.

b) J. Baert Wiener. (2002) Designing global climate regulation. In S. H. Schneider, A. Rosencranz, and J. O Niles (Eds.) *Climate change policy: A survey (pp. 151-188)*. Washington: Island Press.

c) Crowley, T. J. (2000). Causes of climate change over the past 1000 years. *Science, 289 (5477),* 270-277.

d) Sygna, L., Eriksen, S. O'Brien, K. & Otto Naess, L. (2004). Climate change in Norway: Analysis of economic and social impacts and adaptations (CICERO Report2004:12). Oslo, Norway: Center for International Climate and Environmental Research.

e) don't know

20. To find the most recent information concerning the use of marijuana and drug abuse, you would consult: (Circle ONE answer)

a) a book
b) a journal
c) an encyclopaedia
d) a dictionary
e) a magazine
f) don't know

21. Which of the following best describes articles published in a scholarly journal? (Circle ONE answer)

a) it includes a list of references
b) the research method used is described
c) the information is written for the layperson
d) it has been evaluated by an editorial board before publication
e) none of the above
f) don't know

22. Which item below is an important criteria for evaluating an internet site? (Circle ONE answer)

a) the date of publication is provided
b) the author is known in the field
c) responsibility for the site is clearly indicated
d) the site is quickly accessible
e) none of the above
f) don't know

5.2 Appendix B. Focus Group Exercises

A. Cognitive Response Exercise: On the following paper, write down the first thoughts or ideas that come to your mind about Open Access research literature located on the Web. (Note: *Exercise is designed to determine what people know or do not know about Open Access and what they think of this subject prior to the influence of the group discussions*).

Negative ideas	Neutral ideas	Positive ideas

B. Debriefing: After the first exercise we provided participants with the following written explanation:

What is Open Access? Open Access is an internet scholarly communication movement dedicated to facilitating the work of scholars and scientists and increase the citation impact, quality and value of new research.

By Open Access to scholarly and scientific research..."we mean its free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles .....or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself" (Budapest Open Access Initiative, 2002).

For the international research community to achieve Open Access two strategies are recommended:

1) Self Archiving: scholars deposit their refereed journal articles in open electronic archives or digital repositories created at their Universities or research institutes.

2) Open Access Journals: a new generation of journals on the Web that no longer invoke copyright to restrict access to and use of the material they publish, but make literature freely available to anyone who wants to download and read it.

Show the group printed pages of different Open Access repositories on the Web. Place example copies of Open Access articles on the table.

C. Cognitive Response Question: Each card names an area of scholarly or scientific study. Sort the cards according to the level of interest laypeople might have in reading research produced in these areas, and explain what their motivations may be. You may share personal experiences. (*Note: Exercise is designed to encourage participants to think about which areas of research would be of interest to the lay public and would be most readable. Here we want individuals to speak about their own personal interests*).

Agriculture & Food Sciences	Arts & Architecture	Chemistry	Health Sciences and Psychology	Mathematics & Statistics	Physics & Astronomy
Biology & Life Sciences	Business & Economics	Earth & Environmental Sciences	History & Archaeology	Law & Political Science	Technology & Engineering
Sociology & Media Studies	Philosophy & Religion				

D. Ranking Exercise: What is the most important Open Access benefit for laypeople? Discuss the points below, rank in order of importance, and indicate other possible benefits:

- Open Access literature will help to increase the level of understanding that people have of scientific research terms (e.g., *DNA, stem cells, greenhouse effect*), research processes, and findings.
- Open Access will allow people to satisfy their curiosity about what type of research is being done in certain fields and the latest findings.
- Open Access will empower laypeople who want to read and use research literature for personal decision making and problem solving.
- Open Access will allow tax-paying citizens to see where and how money is being invested to support new scientific research.
- Open Access will help people to see what scientific researchers are doing in their own country and acquire sufficient levels of accurate information on which to base their assessments of government policies so that their policy preferences best reflect their own interests.

E. Vignettes Exercise: With each case described below, explain why you think that it would be useful to look for Open Access research information or why you think other forms of information would be beneficial?

- A 28 year old woman has a child who is two years old and she has just discovered from a paediatrician that the child may be autistic. The doctor tells her that he will arrange a visit to a specialist, and explains that the cause of autism is still not specifically known.

- A 42 year old father notices that his 10 year-old son enjoys playing violent video games, and has said that he would rather do this than go outside and play football. The father is becoming more and more concerned about it and what this means for his son's social and emotional development.

- A 37 year old high school teacher has been educating her students on the topic of global climate change. In class she must respond to a question from a 17 year old student, who says: "my uncle has told me that humans are not really the major cause of global warming and that there is not much that we can do now to change it.

F. Ranking Exercise: What would be the most significant barrier for laypeople when they look for and use Open Access research literature? Discuss the points below, rank in order of importance, and indicate other possible barriers:

- Not knowing how to search the Web effectively to find the scientific literature in Open Access databases and journals.
- Not being able to find scientific literature that is written in a preferred language (Note: a language other than English).
- Not being able to understand some of the scientific terms used in the research or the research methods used by the scientists.
- Feeling uncertain about the scientific results and what they mean in the context of everyday life.
- Not being able to judge whether or not the research is of high quality.
- Not being able to recognize what the research means within the context of a specific research field or related fields and how it compares to other research that has been done.
- Finding two or more research papers that give contradictory information and not being able to decide which information is correct or most useful.

G. Ranking Exercise: What types of open-access mediation strategies would be most helpful to laypeople on the Web? Discuss the points below, rank in order of importance, and indicate other possible mediation strategies [Show the group printed examples of a Blog, Wikipedia entry etc.]:

- A Web page or site prepared by a scientist or scientific research team explaining the importance of their research, with links to Open Access research articles.
- A blog written by a scientist or scientific research team, providing weekly reports on the progress of their work, and links to Open Access research papers.
- A discussion blog or internet newsgroup where individuals interested in scientific issues can contribute their opinions regularly and post links to Open Access research papers.
- Web news reports or articles written by journalists (e.g., New York Times Science page; BBC Science page; Scientific American) with links to research articles.
- A Web page or site posted by an institute or university providing interpretive information concerning new research done by the institute or university's scientists, including links to research articles.
- A Wikipedia entry on the Web, which describes a subject in science and provides links to related Open Access research papers.

H. Follow-up Question: Thank you for your participation. We have discussed a number of issues concerning Open Access to research literature and the use of this literature by laypeople. Is there anything in this focus group discussion that you would like to add?