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Science shops as university–community interfaces: an interactive approach in science communication

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In a nutshell

Science shops provide independent, participatory research support to civil society. They both *use* traditional science communication techniques to produce usable results, and they are *part* of an interactive science communication system. They work from the democratic motive for science and technology (S&T) communication, helping to articulate civil society issues, putting citizens' requests on the research agenda, and supporting citizens in the subsequent use of research results. The process includes more than two one-way flows of 'questions' and 'answers'. As an independent, trusted source, science shops can have a special position as facilitators in risk communication. Science shops benefit research, higher education and civil society simultaneously.

The EU supports science shops to help close the gap between science and society. Science shops have proved viable in different countries, provided there is demand for knowledge, a supply of researchers (such as students, working for course credits), willing hosts (like universities) and available paid staff. The science shop method is flexible and can be adapted to local circumstances. We see a mutual benefit from more interaction between science shop staff, and researchers and other professionals in science communication, to share experiences and reflect on our work.

Getting science and society together

With the start of the Science and Society Program in 2001, the European Commission (EC) began to look for ways to create a better interaction between science and society. One of the EC's focal points is the 'science shop', a Dutch invention from the 1970s that has now spread to a number of other countries. A science shop is a 'unit that provides independent, participatory research support in response to concerns experienced by civil society'. The shop is often part of a university, but is sometimes organized by an independent non-government organization (NGO). The word 'science' in the name is used in its broadest sense, so it includes the social sciences, the humanities and engineering. 'Science Shop' can be considered a brand name for all organizations with structural activities that fit the definition, even if they don't use precisely those words in their name.

The original motivation to form science shops in the Netherlands was the big gap that existed between science and society. The university was an ivory tower, and theoretical, monodisciplinary knowledge prevailed. There was no direct link to daily problems in society, where some of the side effects of technological development were becoming visible.

In the 1970s, some critical staff and students joined forces to help civil society groups with their knowledge (such as chemical knowledge, to solve environmental problems). They introduced project education in university as an addition to regular lecture-based classes. Their efforts coincided with a growing environmental awareness and the development of civil society organizations. Since there was both supply and demand, their (at first voluntary) work was successful. By the end of the 1970s, almost all Dutch universities had a science shop in which staff—now paid by university—worked on research requests from civil society groups. Science shops became a recognized intermediary between science (the universities) and society, working in an open and interaction-oriented way (Felt 2003).

So, by 1974, they were already working on the creation of a ‘mode 2’ science and society system (Nowotny et al. 2001), in which the context of the issue, the views and knowledge of civil society, and knowledge from other disciplines were taken into account in applying scientific knowledge to help solve societal problems. Moreover, in their research there was some mutual control over the development of knowledge.

Today’s science shop staff are still motivated to bring down barriers between science and society, and to support those who wouldn’t otherwise have access to scientific research capacity. Simultaneously, they hope to give students some valuable societal experience (Jørgensen et al. 2004).

The current attention of the EU coincides with a trend towards internationalization that has originated from the science shops (sharing best practices, and even doing joint projects, have created a sense of community over the previous decade). EU support allows the science shops to take some time away from the daily routine to reflect and report on their work, and interact more with the academic worlds of S&T studies and S&T communication studies.

In this paper, we’ll see how science shops are a tool for producing more interactive S&T communication. As an example, we’ll elaborate on the specific role that science shops can have in risk communication. We’ll discuss the portability of the science shop concept, and its current strengths and weaknesses.

Science shops: providing independent advice

In this section, we describe the way science shops operate, presenting two cases in more detail and concluding with some international developments.

Operation of a science shop

In a science shop, questions from civil society organizations are rephrased as scientific research projects. Students, under the supervision of a professor, then perform the research or a researcher does it. Students usually get credit points, counting towards their degrees, for their research. The research will lead to a report or another type of product that is useful to the client (see box). The student will gain valuable skills (problem definition, project-based working, communicating, planning), and the professor or researcher will have case material for future scientific publication or further theoretical analysis. Moreover, supervision is part of the teaching obligation, so all actors are doing what they’re supposed to do: teaching, learning and researching. This is why a science shop can be implemented in a university at relatively low additional cost, so universities can also serve the non-profit sector. Science shop staff solicit or receive new requests, manage the process, actively support clients in the use of the results, and formulate follow-up research.

Mediation process at university-based science shops

1. *Receive/solicit clients and new questions*. Clients find the science shop through websites or guides, by referral through other intermediaries, or even through the university switchboard. Targeted acquisition can be used to collect requests on certain topics at a suitable time (for example, based on supply of research capacity). The ‘unaware’ audience can also be approached actively.

2. *Map the real problem*. Together, the science shop and the client make a clear articulation of the problem, including its background, cause–effect relationships and involved stakeholders. This is essential for analysing the potential role of research in the issue. General options for research or advice for a different strategy are discussed with the client.

3. *Preliminary research or quick scan*. A short literature search and expert contacts frame the research, and the best feasible approach is selected. The client is involved in framing the project. It might also become clear that research isn’t the best solution to the client’s needs. At this stage, the initial question can be refused, be referred, result in a short advice, or be formulated into a draft research proposal with a scientific research question. If required, a funding proposal can be drawn up.

4. *Find a supervisor or co-supervisor*. To guarantee maximum scientific quality, science shop projects are always supervised or co-supervised by a member of academic staff in a relevant discipline. For academic staff, this counts as teaching load.

5. *Find a student/researcher*. The researcher (a student who is receiving course credits is normally preferred) makes a start with the formulation of a detailed research plan, in cooperation with the client and the supervisor and science shop

staff. Students can usually do projects in a practical period or for ‘optional’ course credits, or as their bachelors, masters or PhD thesis.

6. *Maintain communication*. The science shop staff usually manages the research process and communication with all involved, and safeguards the client’s interest. This is essential for commitment to the project and acceptance of the results.

7. *Facilitate usable presentation and publication of results*. The scientific results are usually for use by laypeople, so the science shop facilitates understandable and usable reporting. Apart from reports, media releases can be issued, or websites, brochures, CDs, advisory letters, etc. can be produced.

8. *Support implementation of results and follow-up actions*. If the client wishes it, a science shop can support activities to increase the impact of the results. Science shop staff, students or supervisors can be actively involved in seminars, meetings with stakeholders, public hearings or press conferences. They can even be expert witnesses in legal cases.

9. *Make inventory of follow-up research*. Clients might not always be aware of the broader scope or scientific implications of their research question. Options for follow-up research are discussed with all stakeholders. Sometimes the science shop or the research group involved continues the research because of societal or scientific interest in the subject, or a number of smaller questions are grouped together for more in-depth research (themes).

10. *Evaluation*. The project is evaluated (from the viewpoints of the student/researcher, the supervisor and the client). Client satisfaction, such as the feeling of empowerment, can be measured. Measuring the contribution of research to achieving their goals is less straightforward. An impact evaluation can be done later, but many societal factors play a role in ‘real life’.

The criteria that most science shops apply are that clients must have no commercial aim with the research, and the research results must become public (other interfaces and subsidies are available for industry and small or medium enterprises). Also, clients must be able to use the results of the research to achieve their mission, which means that the client should have some form of organization; for the science shop, this means that it must produce results that are clear, and applicable in context. Payment ranges from zero to full costs, depending on the client’s possibilities and the organization of the research. The client groups fit well in the EC’s definition of civil society organizations (EC 2001):

> organisations whose members have objectives and responsibilities that are of general interest and who also act as mediators between the public authorities and citizens. They may include trade unions and employers’ organisations (‘social partners’), NGOs, professional associations, charities, grassroots organisations, organisations that involve citizens in local municipal life; churches and religious communities.

Science shops both *use* traditional S&T communication techniques (producing understandable, usable products) and are *part* of the interactive S&T communication system. This is especially apparent at the start and end of the mediation process.

When dealing with clients, science shops may be confronted with some citizens' unrealistic expectations of science. Or, to phrase it differently, the public sometimes expects a magic bullet that will instantly solve all its problems. When this expectation is not met, some citizens might turn away.

The other extreme occurs when public awareness of S&T is low. Farkas (2002) showed that some organizations of disabled people knew how to ask questions about health care, but never thought of applying to a technical university for modified technical tools they could use. In this case, citizens can be said to be unaware of what S&T could do for them. Science shops can play an active role in such cases.

After the research project, science shops help to define interesting follow-up research. An example of this 'antenna' function is the way that individual questions on side effects of prescription drugs on pregnant women led first to a four-year project and then to a regular research field in the Department of Pharmaceutics of Groningen University. At the Danish Technical University, the science shop acted as an incubator for research on ecological food production (Hende and Jørgensen 2001).

Case examples

The following two examples give further insight into the communication side of science shop work, with an emphasis on risk communication.

Steenwijk: health risks from carpet factories

In 1998, citizens of the city of Steenwijk approached the Chemistry Shop Groningen. They were looking for experts to help them assess the health risks from two local carpet factories. The science shops were recommended to them by Monitoring Network Environment and Health, a nationwide NGO.

During the articulation phase, the citizens described the problem as 'toxic emissions that cause cancer, smell ugly, and cause visible water pollution'. The cancer risk was considered dreadful and involuntary, the source was industrial, and the victims were identifiable (neighbours, relatives). The outrage caused by authorities' unresponsiveness to these fears was in line with the results produced by Slovic over the years (Slovic 2000). The fact that the three issues were considered together as one big problem had made it impossible to discuss them individually with the other stakeholders (local authorities and companies). The only communication had been through newspaper interviews (and especially headlines). In fact, the problem was at least partly a problem of communication.

To find a way out, we decided to take three separate research tracks: cancer (past emissions, current emissions), smell, and water pollution (which proved to be a small problem and easy to handle with some sewerage system renovations). We supported citizens in their discussions with the other stakeholders. Because the science shop is independent, and paid only by the university, we were a trustworthy source. We made our explanation very personal, including tales from our own families and friends, thereby showing the citizens that we understood. Thus, the citizens believed our explanation that the cancer occurrence that they'd noted did not differ from the average. They also accepted our explanation that current emissions were a factor of 1000 below the strictest limits. However, because there were no data on past emissions, the regional health authorities set up a cancer monitoring programme. Previously, the local authorities had given only the bare figures of the emissions, without a clear explanation—one of the first few of nine steps in risk communication that Fischhof (1995) says should be taken. Our separation of the three problems opened the way for research and debate on the smells, which we calculated to be above the legal limits in this case (Van der Werf and Mulder 1999).

We conducted some methodological work to find the right assessment frame for the odour. This was complicated, because two companies were involved and they had fluctuating emissions. We listened carefully to the citizens, who mentioned 'peak emissions' (occurring during product changes, which had never been investigated before). The local authorities then agreed to set up a steering committee to supervise smell mitigation research. The committee included representatives of all stakeholders: local authorities, including the regional health inspectorate and environmental inspectorate; both companies, with their technical consultants (and lawyers, at the beginning); and the citizens, assisted by two science shops (chemistry and medicine). In this way, the citizens became 'partners' instead of merely receivers of expert results, in a partnership consistent with current recommendations for risk communication (Fischhof 1995).

Finally, a production change in the largest company and some changes in wastewater treatment in the other reduced the emissions to just below the limit. However, in odour analyses there's an allowed error margin of a factor of two. This meant that the companies couldn't be fined (they were not proven to have exceeded the limits), but neither could one say that there was no problem. We managed to explain this scientific uncertainty and its consequences to all stakeholders. This avoided possible further outrage, which in our view would have arisen if the authorities (again) claimed that there was 'no problem'. However, it also meant that no technical solutions could be implemented—the companies couldn't be compelled.

Therefore, we suggested making a complaints telephone line available 24 hours a day, 7 days a week (the city's general service phone line was only available from 9 to 5). The citizens had complained about peak emissions and felt they weren't taken seriously, so we saw a 24/7 line as a solution to mitigate their stress—which mainly occurs when people can neither escape nor influence the source of stress. The phone line, and the subsequent action and feedback of the regulators, would again give citizens some control over the situation. The provincial authorities helped to implement this solution.

In an external evaluation by Neubauer (2002), all stakeholders stated that the involvement of the science shop started the communication process that led to the resolution of a lot of the annoyance and fear in the neighbourhood. In fact, this could be described as a case of scientific mediation (as in conflict resolution). For the citizens, it meant that they were able to discuss the issues on equal terms with the other stakeholders.

We also reported our findings in the Platform for Odour, a working group for research and policy advice of the Dutch Association of Environmental Professionals, and managed to get the experience of the citizens a prominent place at the association's biannual national conference. Some of our technical concerns have also been also taken up in the long-term planning of this platform, which is an example of communicating science from citizens to research (the antenna function of science shops).

Zijpe: pesticides in the bulb trade

The use of pesticides for crop protection and bulb disinfection is extensive in bulb farming. The bulb-growing sector has expanded considerably in some areas in the Netherlands during the past decade. In Zijpe, a Dutch community in the bulb production area, residents were concerned about possible health effects caused by exposure to pesticides. A local neighbourhood organization asked the regional health inspectorate to prove a relationship between bronchial problems and exposure to the pesticides, but without success. The residents then approached Utrecht University's Science Shop for Biology. The science shop began a research project in cooperation with the Institute of Risk Assessment Sciences at the university. Eventually, all stakeholders (the local neighbourhood organization, the regional health inspectorate, the bulb farmers and the university) were involved in the research.

First, the neighbourhood organization, the science shop and the research institute discussed the options for the research and agreed on a research proposal (the residents' initial focus on proving a causal relationship was not a research option for the research institute at this stage). The science shop mediated the discussion on research focus and research options. Research processes in general and epidemiological research in particular were discussed, but also the background of the citizens' concerns. All stakeholders concluded that the concerns were realistic but that the research could not focus on the initial research question at that time, and should instead assess the possibility of residential exposure to pesticides. This research was conducted by a graduate student as part of her masters curriculum.

House dust samples were collected in 27 residences in Zijpe (12 bulb farmers, 15 non-farmers) in March and April 2002. The active ingredients of seven commonly used pesticides were analysed. Except for one, all the ingredients could be detected in the house dust. Pesticides were found less frequently in non-farmers' homes than in farmers' homes (three different pesticides versus six). The results were based on a single observation in time and a small dataset, which limited the statistical power of the test. The differences between farmer and non-farmer residences couldn't be explained by potential confounding factors such as presence of animals, type of floor covering, etc. Therefore, the most plausible explanation for the presence of these pesticides in farmers' homes seemed to be that farmers (and possibly their family members) bring pesticides into their homes more frequently or in higher quantities than do non-farmers. The distance of a residence from pesticide-treated farmland also appeared to be important (Hogenkamp 2002).

The research didn't answer the initial research question of the residents, but they were satisfied with the results. The clear articulation of the problem and the framing of the research at the beginning of the project were essential for their acceptance of the research results.

The research increased their understanding of the role of scientific research in problem solving. It also reopened a positive discussion among the local stakeholders on future activities to solve the problem and the role of research in those activities.

The results of the project were used in formal discussions with members of the Dutch parliament, and preparations were made for a large-scale study in cooperation with residents, bulb farmers and the regional health inspectorate. A large-scale epidemiological study might reveal a relationship between exposure to pesticide residues in the home and bronchial health effects. In such a study, measurements should be taken over a longer period to obtain information about the variability of exposure over time, and include environmental compartments other than floor dust to be able to obtain dose estimates. Research involving blood and/or urine samples could be very useful in determining whether any health risks arise from the exposure.

A new technique for collecting samples was relevant to the research group as a research tool, as well as being relevant to the residents for this study.

International developments

The science shops originated in the Netherlands in the 1970s, and there are now science shops at more than two-thirds of Dutch universities, which fully fund their shops. Publications on science shops by Ades in *Nature* in 1979, Dickson in *Science* in 1984 and others triggered a lot of attention abroad, and the method was imported and adapted by many other countries. A publication by Sclove (1995) in the *Chronicle of Higher Education* linked the European developments to those of the Community Based Research Centers in the US. The Dutch began actively exporting their method in 1998, when the Dutch Ministry of Foreign Affairs funded its implementation at Romanian universities. Since 2000, over 30 Community–University Research Alliances have been started in Canada, based on the Dutch example but adapted to the Canadian context. The alliances are funded by the Canadian Research Councils. Recent EU support has delivered documentation on science shops (the *SCIPAS* reports and the *InterActs* reports; www.scienceshops.org).

Science shops across Europe got to know each other, and their network, 'Living Knowledge', is constantly enlarging. They now produce their own newsletter and magazine, have an active email discussion list and have piloted with international cooperation projects. Two international Living Knowledge conferences were held to exchange ideas and experiences (Louvain 2001 and Seville 2005). The third conference will be in 2007 in Paris. The EU-funded project ISSNET (Improving Science Shop

Networking) brought together science shop experiences and created a structure for networking the shops.

In 2005, science shops were active in the Netherlands, Denmark, Norway, Germany, Austria, the UK, Belgium, France, Spain, Romania, Canada, the US, Australia, Malaysia and South Korea, and initiatives to start them were under way in Iceland, Ireland, Latvia, Estonia, Finland, Greece, Turkey and Japan. Despite working regionally, the shops share many features and challenges.

To support new science shop initiatives, the EU has funded the TRAMS (Training and Mentoring of Science Shops) project. TRAMS will offer new science shops and similar organizations a toolbox with training materials, a summer school on the science shop concept, and an individual mentoring programme for practical advice and support.

Training and mentoring are important services of the international network. Most science shops deal with research questions at a local level, but many such questions also arise elsewhere and are not as local as they seem at first. Through research cooperation, science shops are a tool for citizens to break out of the local. By initiating and facilitating such cooperation, the network gives citizens better access to scientific knowledge and expertise, thus improving public participation in research.

Bringing education, research and outreach together

EU support has allowed science shops to network and exchange information. The Dutch science shop model has proven to be portable, including to quite different contexts. However, there is no single ‘best way’ to operate a science shop; local circumstances play a large role. Mulder et al. (2001) demonstrate that the active support of four actors is necessary:

- clients (societal demand for research support)
- scientists (a supply or source of research support, such as students who can obtain credits or research staff who are allowed to spend time)
- institutions (hosts or supportive structures, such as universities)
- science shop staff (paid individuals doing the mediation work).

Clearly, these four actors exist within specific historical, sociopolitical, cultural and scientific environments or contexts, which means that they can differ from time to time and place to place. By assessing the actors in a country were there aren’t yet any science shops, one can find the best format to start a science shop there.

If any of the four actors is not able to participate, initiatives will fail. In the mid-1980s, there were 16 science shops in France, but they couldn’t make use of the research potential of students. French civil society’s expectations of science were too high and it wasn’t willing to wait long for research, and staff had to divide time between doing projects and raising funds. The science shops failed.

In Romania, civil society was not as strongly organized as in the Netherlands, but clients still came from NGOs, and non-profit institutes, small business and local authorities as well. Scientists were available, students were allowed to do projects as part of their curriculum, and NGOs were supported to obtain funds. The introduction of science shops was successful, and there’s currently a network of ten shops.

The tide might be turning in France. The Ecole Normale Supérieure Cachan started a novel ‘Boutique des Sciences’ in 2003, involving both students and staff. Projects are under way, so there may be a successful reintroduction in France.

Weaknesses of science shops in their current settings reflect weaknesses among the four actors. If society is not well organized, or public awareness of science is low, a lot of emphasis has to be put on soliciting new research requests. In such a situation, although scientists engage the public and strive for partnership, science can take an inappropriately dominant role in finding research topics.

If scientists aren’t able to work on science shop projects, the supply of knowledge stops. Currently, academic tenure criteria stress peer-reviewed articles, with only a minor focus on teaching and none on outreach. Only when the research project is part of the curriculum (part of a practical period, course or a thesis) can students and staff work on it without additional cost. In some countries, working with students can mean delays because of rigid study programmes. And, although students usually do good work, some don’t, and their results can’t be published unless there is staff time for editing. Because of their small size, another barrier that many science shops face is lack of visibility, both to the public and to researchers, students and decision makers at the university and in national research planning (Jørgensen et al. 2004).

Not all scientific research institutions favour science shops. If one is lucky, a university pays a lot of attention to its ‘third mission’ (after research and education), and sees science shops as a way to promote a positive regional image, the social awareness of students and interesting research themes. There’s a big problem if the institute focuses on large, basic research projects, which can only be solved by allocating separate, external funding sources for science shop projects.

Finally, as well as having an overview on a scientific discipline, science shop staff need to have many additional skills, such as communication and management skills. From the experience of existing science shops, but also from initiatives that have failed, there’s a need for clear lines of responsibility for project coordination. Designated science shop staff have to take responsibility for the mediation process. This shouldn’t be an ‘add-on’ task, but a clearly recognized structural activity. Science shop staff are the continuing actors in science shop projects, whereas researchers, scientific supervisors and community organizations vary from project to project.

As reasons for supporting the science shop concept, Rainer Gerold, former EU Director for Science and Society, mentions the restoration of citizens' trust in science, the need to raise public awareness of science and science's awareness of the public, and the close fit between many themes of research and European social ideals. We can already see this happening on regional scales. The EU also hopes to create shorter lines from civil society to European research agendas (Gerold 2001).

On a local scale, there are examples (as described above) of good communication between citizens and research, giving citizens some upstream involvement in research planning. The route to influence on European research policy is still very long, but, on a small scale, the Science and Society Program of the European Commission is paving the way. There is now a clause in all research contracts under the commission's 6th Framework Program that requires researchers to disseminate the results of their community-funded research to the public. It's hoped that the inclusion of this condition will help to bring science closer to citizens, stimulate the public's debate on science, and draw wider attention to such issues as scientific culture, ethics, governance and women in science. The EU recently opened its research budget to science-shop types of research by launching a call for research questions from local civil society organizations. The European Commission's high-level expert group on university-based research recently made a recommendation to 'promote the creation and advancement of science shops at universities' (Forum on University-based Research 2005).

Science shops play a special role in S&T communication. They interact with citizens to articulate problems and potential research support, and make sure that research results are fit for the context and presented in a usable way. This is clearly a two-way, interactive approach, raising both public awareness of science and scientists' awareness of the public. Science shops can also have a special, trusted position in risk communication processes, were they can help make the public a partner. They understand both the expert and the public, are independent, and can act as facilitators (as in the case examples above).

Science shop projects are mostly done on a regional or local scale. Although the scientists involved of course reflect on their own work, they aren't required (and don't have the time) to describe their science shop activities on a meta-level in scientific papers. Describing the interesting and valuable communication processes that occur during science shop projects will require scholars in S&T studies and communication scientists.

Some interaction between science shops and professionals and researchers in S&T communication is now beginning. The EC-funded CIPAST project includes Excite (the network of science centres) and the science shop network (Living Knowledge, represented by Wissenschaftsladen Bonn). In the universities of Groningen and Utrecht, science shops teach classes on community-based research and on risk communication. We feel that this interaction between science shops and those involved in other forms of S&T communication is very fruitful. The work of science shops would benefit from more interaction with researchers in science communication. Not only would it generate visibility, but it would also be possible to mutually learn from analysis and reflection, to strengthen this model of interactive science communication.

Science shops combine all three missions of the university: education, research and outreach. They have an impact on scientific research (finding interesting research topics, raising science's awareness of the public), on education (giving valuable skills in communication and project work, raising the social awareness of students, curriculum reform) and on civil society (media attention, policy influence, empowerment of civil organizations to better shape their own living environment). The science shop model is flexible enough to be applied in different contexts, provided there is a way to unlock demand and supply, and provided each has a host institute and staff. It would also be good to have overviews and studies of the situation in countries without science shops.

Science shops have a role in S&T communication, and especially in promoting its democratic aspect. They take the science communication role of universities from the traditional PR office (communication for cultural and accountability reasons) to a more interactive form, without becoming an instrument in commercial knowledge transfer (communication from an economic motive), for which many facilities and subsidies already exist.

Science shops demonstrate partnerships of science and society. From the examples given in this chapter, it's clear that interaction is more than the sum of two one-way flows, and isn't a simple matter of questions and answers. Science shop practice includes interactive articulation, research and dissemination phases. The many small steps that are made in regional projects make a big step in science communication: citizens are given some upstream involvement in science.

In these ways, science shops give new meaning to Article 27(1) of the United Nations Declaration of Human Rights: 'Everyone has the right to … share in scientific advancement and its benefits.'

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References

Ades T (1979). Holland science shops for 'made to measure' research. *Nature* 281(5729):519-520.

Dickson D (1984). Science shops flourish in Europe. *Science* 223:1158–1160

EC (European Commission) (2001). *Science and Society Action Plan*. EC, Brussels.

Farkas N (2002). Bread, cheese and expertise: Dutch Science Shops and democratic institutions. PhD thesis, Rensselaer Polytechnic Institute, Troy NY.

Felt U (ed) (2003). *OPUS: Optimising Public Understanding of Science and Technology. Final report*. University of Vienna.

Fischhof B (1995). Risk perception and communication unplugged: twenty years of process. *Risk Analysis* 15(2):137–145.

Forum on University-based Research (2005). *European Universities: Enhancing Europe's Research Base*. European Commission, Luxembourg.

Gerold R (2001). European Union support for science shops. *Wetenschapswinkel Courant* 3(6):1.

Hende M and Jørgensen MS (2001). *The Impact of Science Shops on University Curricula and Research*. SCIPAS Report No. 6, Utrecht University.

Hogenkamp A (2002). *Bloembollen, bestrijdingsmiddelen en bewoners.* Wetenschapswinkel Biologie, Universiteit Utrecht.

Jørgensen MS, Hall I, Hall D, Gnaiger A, Schroffenegger G, Brodersen S, von der Heiden K, Reimer R, Strähle M, Urban C, Endler W, Teodosiu C, Rojo T and Leydesdorff L (2004). *Democratic Governance through Interaction between NGOs, Universities and Science Shops: Experiences, Expectations, Recommendations. Final report of INTERACTS.* Science Shop, Danish Technical University, Lyngby.

Mulder HAJ, Auf Der Heyde T, Goffer R and Teodosiu C (2001). *Success and Failure in Starting Science Shops*. SCIPAS Report No. 2, Utrecht University.

Neubauer C (2002). *Quelques réflexions autour de la notion de « science citoyenne— l'exemple des boutiques de sciences aux Pays-Bas*. Université Paris 7 – Jussieu, Paris.

Nowotny H, Scott P and Gibbons M (2001). *Re-thinking Science*. Polity, Cambridge.

Sclove RE (1995). Putting science to work in communities. *Chronicle of Higher Education* 41(29):B1–B3.

Slovic P (2000). *The Perception of Risk*. Earthscan, London.

Van der Werf PL and Mulder HAJ (1999). *Geur en gezondheid rond tapijtfabrieken in Steenwijk.* Chemiewinkel Rijksuniversiteit Groningen, Groningen.

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