The Impact of Science Shops on University Curricula and Research

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# Table of contents

Acknowledgement............................................................................................................... 3  
Summary........................................................................................................................ ...... 5  

1 Introduction.............................................................................................................. 7  
1.1 Science Shops..................................................................................................... 7  
1.2 The SCIPAS project............................................................................................. 8  
1.3 Impact on university curricula and research......................................................... 9  

2 Theoretical and methodological background .......................................................11  
2.1 Scope of the study ..............................................................................................11  
2.2 Methods for collection of data .............................................................................12  
2.3 Education and research: communities of practice and institutions ..............13  
2.3.1 Education and research: knowledge systems ..............................................13  
2.3.2 Education and research as institutions.........................................................15  
2.3.3 Directions for the analyses...........................................................................17  

3 Impact on curricula.................................................................................................19  
3.1 Introduction.........................................................................................................19  
3.2 The framework of science shop projects.............................................................19  
3.3 Competencies developed through science shop projects....................................21  
3.4 Mechanisms with impact on possibilities for projects ..........................................23  
3.4.1 Project work as part of established courses.................................................24  
3.4.2 Working together with citizen groups as part of the curricula .......................24  
3.4.3 Scientific staff improves possibilities for students........................................24  
3.4.4 Science shop services reduce scientific staffs workload................................25  
3.4.5 Accordance between community topics and scientific focus of faculty ........26  
3.4.6 Changes in curricula effects possibilities......................................................26  
3.4.7 Resources available for students to do science shop projects .....................27  
3.5 Ways of gaining impact on curricula....................................................................27  
3.5.1 Including community topics in existing teaching activities............................27  
3.5.2 Including science shop case studies in own teaching..................................28  
3.5.3 Co-operation with scientific staff about courses..........................................29  
3.5.4 Developing courses with methodology and theory....................................30  
3.5.5 Developing courses with topics raised by citizen groups..............................31  
3.5.6 Participation in restructuring of curriculum...................................................33  

4 Impact on research.................................................................................................35  
4.1 Science shop as incubator for new research area..............................................35  
4.2 Funding for science shop based research..........................................................38  
4.3 Developing new research topics from existing department..............................40  
4.4 Introduction participatory research methods......................................................43  
4.5 From science shop to centre for participatory research....................................43  

5 Conclusion and recommendations..........................................................................45  

6 References ..............................................................................................................47
Summary

Experience from science shops show that besides assisting citizen groups, science shops can also contribute to the development of university curricula and research. This work package has investigated the impact of science shops on university curricula and research through the SCIPAS questionnaire sent out to science shops and through follow-up interviews with employees from nine different university-based science shops. These science shops had indicated in the questionnaire that the science shop in one way or the other has had impact on university curricula and/or research. These case studies have been supplemented with a few articles and reports dealing with this topic.

The analysis has focused on the kind of impact which the science shops have reported and related the impact to the local history of the science shop. The analysis does not point to a certain science shop model as the best, but point at enabling factors and conditions that have been identified in the case studies.

Impact on curricula

One direct impact on the curricula is the competence students develop through science shop projects, where the students as part of their curricula work together with citizen groups on a topic proposed by the citizen group. The better the possibilities in the curricula for doing this kind of work the bigger is the potential impact from the science shop. At some universities the possibilities in the curricula are already there, while at other universities the science shop or scientific staff supporting the science shop develops the possibilities.

The following mechanisms with influence on the possibilities for doing science projects as part of the curricula have been identified in the case studies:

- A science shop develops the possibilities for doing project work as part of established courses;
- A science shop develops the possibilities for working together with citizen groups as part of the curricula;
- Scientific staff find the competence that science shop projects offer so relevant that they want to improve the possibilities for the students to do science shop projects;
- The degree of accordance between the topics in the requests from the citizen groups and the scientific focus of the faculty;
- The degree of accordance between the topics in the requests from the citizen groups and the scientific focus of the faculty;
- Scientific staff find that the science shop offers services that can minimise their own workload when they want to fulfil institutional or local aims;
- Changes in curricula improve or reduce indirectly and unintentionally the possibilities for working with science shop projects as part of the curricula.

Another type of impact on curricula is seen when this kind of competence is offered to students in other ways besides the direct work with science shop projects. The following ways have been identified:

- Science shop staff develop theoretical and methodological courses, where students can learn the competence that can be developed through science shop projects like science communication, academia-user dialogue etc.;
- Science shop staff supply case studies based on science shop projects to courses taught by the science shop staff itself and/or by other teachers;
• Science shop staff participate in the development of and the teaching at courses within topics emerged from problems raised by citizen groups;
• Science shop staff participates in restructuring of curricula in order to bring in methodological competence from science shop projects.

Impact on research

The impact on research is not understood as the single project carried out by graduates or researchers within a topic raised by a citizen group, but as changes in research agenda or research methodology based on or inspired by the work with projects in a science shop. The following mechanisms have been identified:
• A science shop acts as an incubator for a new research area and the science shop staff carries out research;
• A science shop is developed into a research centre for participatory research;
• Scientific staff and/or graduates develop a new research area or changes in focus within existing research area with science shop staff and sometimes also citizen groups as dialogue partners;
• Science shop staff introduces participatory research methods to scientific staff.

Enabling factors and conditions

A number of enabling factors and conditions have been identified:
• The science shop has influence on strategic decisions, either through participation in the decisions or through alliances with scientific staff or university management with influence on strategic decisions;
• Personal resources. This can be in terms of science shop staff with scientific qualifications, grants for scientific staff, Ph.D. grants, etc.;
• Science shop staff working also as teachers and/or researchers;
• Visibility of the achievements and the competence of the science shop;
• Changes in the societal discourse about the competence needs of academic candidates towards more practice or user oriented competence;
• Changes in the societal discourse about the relations between university and society towards more interactive relations.

It is not possible to point to a blueprint strategy on how to obtain most impact on curricula and research. Scientific staff as part of the science shop seems, however, to be the best basis for obtaining impact. Impact is then a question about utilising those occasions that show up and can be used for strengthening the role of the science shop and the role of community orientation and participatory methods at the university.
1 Introduction

1.1 Science Shops

In addition to the demands made on research and development by commerce and industry, ‘civil society’ organisations have their own research needs. Diffusion of knowledge often focuses on communication from researchers to society, but increasingly there is a demand for communication from society to researchers. This is the concept of ‘social demand’ for knowledge (Valenduc & Vendramin, 1995). Different types of interfaces exist between researchers and society, one of which are the ‘science shops’. Science shops are organisations created as mediators between citizen groups (trade unions, pressure groups, non-profit organisations, social groups, environmentalists, consumers, residents’ associations etc.) and research institutions (universities, independent research facilities). Science shops are important actors in community-based research (CBR). There are many differences in the way science shops are organised and operate, as well as some important parallels.

A science shop provides independent, participatory research support in response to concerns experienced by civil society.

In practice, contact is established between a civil society organisation and a science shop or CBR centre on a problem in which the civil society organisation is seeking research support. In this collective search for a solution new knowledge is generated, or at least existing knowledge is combined and adapted - again, in a true partnership without ‘science’ prevailing in any way. Through their contacts, science shops provide a unique antenna function for society’s current and future demands on science.

There is not one dominant organisational structure defining a science shop. How science shops are organised and operate is highly dependent on their context.

The above definition of a science shop might also include organisations that do not self-define as a science shop. Organisations that meet the definition of a science shop and do provide civil society with knowledge and skills through research and education on an affordable basis will be taken into account. The term ‘science’ is used in its broadest sense, incorporating social and human sciences, as well as natural, physical, engineering and technical sciences.

All science shops seek to:

- provide civil society with knowledge and skills through research and education;
- provide their services on an affordable basis;
- promote and support public access to and influence on science and technology;
- create equitable and supportive partnerships with civil society organisations;
- enhance understanding among policymakers and education and research institutions of the research and education needs of civil society;
- enhance the transferable skills and knowledge students, community representatives and researchers.

Science Shops in general have three criteria for accepting clients:

1. Clients should have no commercial objectives with their question, and the research results must become public (or ‘the question must be for the common good’);
2. Clients must be able to use the results of the research to achieve their mission (thus, scattered individual questions may not be accepted; but if necessary clients can also be assisted in applying the results);

3. Clients may not have the (full) financial means to acquire their research by other means (sometimes applicable questions from these clients are accepted as paid research or research at least subsidised by the client).

1.2 The SCIPAS project

The SCIPAS project ('Study and Conference on Improving Public Access to Science through science shops') led to seven reports and a scientific conference. SCIPAS was awarded financial support by the European Commission through the contract HPV1-CT-1999-00001 under the 5th Framework Programme of the European Community for Research, Technological Development and Demonstration Activities (1998 to 2002), and its specific programme "Improving the Human Research Potential and the Socio-Economic Knowledge Base" ("Strategic Analysis of Specific Political Issues").

The executive consortium of SCIPAS consisted of institutes from The Netherlands, Germany, Austria, Northern Ireland, Denmark, Israel, Romania, South Africa and the USA. The seven studies that were done in preparation to the conference are:

1. Compiling an inventory of different ways to organise and operate a science shop in different countries, including the participating countries. Identify best practices, and internal and external pros and cons of various operational options. Investigate the impact on the social and environmental conditions of citizen groups.

2. Compile a report on success and failure in starting new science shops and lessons to be learned to facilitate and support the creation of new science shops.

3. Make an inventory of needs and resources for training programs for science shop staff members. Identify mechanisms for matching science shop staff with training programs.

4. Describe the options for setting up an international science shop magazine or other means (e.g., an Internet archive) for publishing science shop research results and policy issues internationally.

5. Set up a free, publicly available Internet database of existing science shops and facilitate Internet contacts among science shops. Make an inventory of options for using automated translation facilities and interesting links.

6. Investigate the impact and develop strategies for how science shops can contribute, and are contributing, to the development of university education and research, i.e., their impact on curricula and research agenda's.

7. Investigate the potential benefits of, and the conditions for, transnational co-operation among science shops, including transnational research collaborations.

The conference 'Living Knowledge: building partnerships for public access to research', was held in Leuven, Belgium, from 25 - 27 January 2001. It was attended by 106 people from 19 different countries over 4 continents. Beyond its intrinsic value, the conference and the project documents are an indispensable milestone for laying the foundation of an international or European network of science shops, provisionally entitled 'Living Knowledge'. This network includes the four dozen science shops currently existing within the European Union and it will hopefully facilitate the creation of new science shops throughout Europe (including less-favoured regions). The network also includes science shop-like institutions.
and networks outside of Europe. Ultimately, the benefits to science and society interactions will be:

1. Increased visibility and accessibility: Science shops become more publicly visible, thus more accessible to potential client groups. It opens avenues for support from universities and citizens, as well as policy makers.

2. Improved documentation and evaluation: New participants (e.g., newly established science shops) get support more easily, by standardisation of documents, protocols, etc. without neglecting their regional context.

3. Dissemination of results: Research results become more widely disseminated (including internationally). Successful research models can be replicated and further developed. Research themes can be distinguished; information on emerging subjects can be compiled and communicated to policy makers and (other) research institutes.

4. Collaboration: Collaboration yields synergy and helps utilise previous experience. More comprehensive studies can be done. Citizen group driven studies on transnational issues become more practicable. Science shop policy and strategies will also benefit from cooperation.

5. Quality control: A network enables standardisation in documenting, evaluating, archiving and retrieving science shop research results.

This report on impact on university curricula and research along with the reports of the other six workpackages and the conference, are milestones in achieving such a European network.

1.3 Impact on university curricula and research

This work report discusses the impact from university-based science shops on curricula and research. Experience from science shops show that besides assisting citizen groups, science shops can also contribute to the development of university curricula and research. This impact has been investigated through the SCIPAS questionnaire sent out to science shops and through follow-up interviews with employees from nine different university-based science shops and one university researcher. Not all the cases call themselves science shops, but in the report the term ‘science shop’ will be used most of the time, when the cases are referred to in general. When the single case study is discussed the precise name is used. The interviews have in most cases been supplemented with written material about the science shops. The chosen science shops had indicated in the questionnaire that the science shop in one way or the other has had impact on university curricula and/or research. The analysis and the case studies have theoretically been based on literature on universities and education and research as institutions and a few articles about the impact of science shops on education and research.

The analysis has focused on the kind of impact which the science shops have reported and related the impact to the local history of the science shop. The analysis does not point to a certain science shop model as the best, but point at enabling factors and conditions, which have been identified in the case studies.

The structure of the work report is as follows: Chapter 2 is the theoretical and methodological part of the report, describing the understanding of changes at universities that the analyses in the report have been based on.
Chapter 3 describes and analyses the impact on the curricula, while chapter 5 describes and analyses the impact on research.
Chapter 4 is the conclusion summarising the enabling factors and conditions, pointing to some ideas for further research and some recommendations.
Chapter 5 gives some recommendations for future studies and for measures which can enhance the impact of science shops and curricula.
2 Theoretical and methodological background

The arguments for establishing and running science shops (and other types of community-based research organisations) are multiple, however overall they seem to relate to two groups of interest: 1) community and citizens and 2) researchers and students. In the following a brief presentation is given of what interests these two groups of actors may have in the working of science shops (SCIPAS, 1999).

Citizens’ access to information and research resources and the linking of and mediating between academic spheres and ‘field’ spheres, and theoretical spheres with practical ones are key points to science shops and community-based research organisations whether they are related to a university or not. In addition to these perspectives, science shops at universities also deal with and involve students and researchers and the university as institution in general. By doing so, these science shops are not only influenced by the citizen groups they co-operate with, but also by the universities they are affiliated with and the researchers and students which engage in their activities. The science shops themselves can also have some influence and impact on the research agenda as well as the curricula at the universities. Together with the society related education and research, the renewal processes of education and research at the universities are described as central terms by these science shops (SCIPAS, 1999). In some cases, the activities at science shops have led to the establishment and development of new research areas and new topics in courses and curricula, as well as new research and teaching methods (SCIPAS, 1999).

From the students’ point of view a science shop can represent an opportunity to work with a real-life problem, together with real-life people who have real-life needs of finding practically applicable solutions to their problems. Another benefit may be that the methods of studying and solving problems in the science shop are different from what the university otherwise offers to teach the students. Seen from a societal point of view and a labour market point of view, science shops can provide students with valuable competence and qualifications that are not only vocationally but also socially relevant in later job situations. As such the science shops can provide a possibility of establishing more dynamic and direct beneficial relations between the academic world and practical life in that the two spheres can become more reflected in one another. Also the science shops can provide the opportunity of making teaching and research multidisciplinary (SCIPAS, 1999).

2.1 Scope of the study

The interest of this study is to investigate how science shops (and other university-based community research organisations) contribute to the development of research education at the universities. Hence the study will primarily focus on the role of science shops with respect to establishing processes where the knowledge needs put forward by citizen groups become a part of and rooted in different institutions at the university such as research and research programmes, and curricula in courses and teaching.

To do so, an overall question to answer in the study is:

What motivations do researchers and teachers have and what do they experience as relevant for the establishment and further integration of projects and subjects mediated by science shops, in research and education activities.
To uncover these processes, this study will try to grasp the relations between science shops, researchers, and teachers as well as these actors’ relations to the institutional environment in which they act and operate.

Entailed in the above question is the assumption that the performance of science shop projects is in fact capable of initiating processes of development in fields of research and education. The study also holds the view that researchers working with science shop projects and community-based research organisations not only are capable of initiating development processes – they also emphasise the establishment of a kind of development that most likely would not have been realised otherwise. As such the adoption of science shop and community-based research projects can contribute to the development of research and education on the base of what often are untraditional sources and methods.

To be able to deal with processes of development in fields of research and education, it is necessary to find out more about the frame and content of the work of researchers and teachers. This study will therefore also focus on the social and institutional relations that researchers and teachers establish and are part of, as well as how they themselves experience and interpret their own role, their work, the rules for interaction, the rules for their work, the communication of results, the options and limitations conceived etc. To be able to make successful action, the actors not only have to relate to other actors but also to the organisation in which they act. Hence, for the overall view of the study, it is also relevant to consider the mutual influence of the institutional frameworks and the actors of research and teaching.

2.2 Methods for collection of data

The project is built upon studies of existing literature about the workings of institutions dealing heavily with knowledge production. This literature makes up the more theoretical part of the project. The empirical part of the study consists of a number of questions in the overall SCIPAS questionnaire. These questions were focused on:

- whether the requests fit into existing curricula;
- whether curricula have changed to fit science shop projects;
- whether results from science shop projects have been included in courses;
- how experience from projects are accumulated;
- whether research methods at the university have changed due to the science shop;
- whether the research agenda has changed due to the science shop.

Based on the answers to the questionnaire, a number of science shops were selected for case studies. The study involves 14 cases about the impact of science shops and community-based research organisations on university research and curricula. The selection of science shops of more interest to the study has been based on the principle of diversity in terms of:

- countries and geographic regions – east, west;
- professional fields – the Humanities, social science, natural science;
- organisational framework/structures;
- the science shop concept applied;
- the role of students involved.

All of the science shops viewed are connected to one or more universities. Beyond this, the project also involved different literature and written information about the science shops and community-based research organisations that have been studied more in detail.
Besides the studies of literature and written material about the organisations and the science shops and their courses, the collection of information has also included qualitative interviews. Interviews were made with science shop employees and with two researchers whom have co-operated intensively with a Danish science shop. The Danish interview was carried out in person, whereas all the other interviews have been made by telephone. The interviewees have been given the opportunity to comment on the summary of the interview made with them.

2.3 Education and research: communities of practice and institutions

In this study higher education and research are considered as social systems or communities of practice where a fundamental characteristic is that its most important activity is to work up knowledge. This means that within these systems knowledge is discovered, extracted, preserved, communicated, and applied (Vught, 1997).

The aim of this section is to present the theoretical understanding of the role and working conditions of the teacher and researcher, which this report is based on. The section gives a presentation and discussion of the role and work as well as cognitive and institutional frames of teaching and research activities.

According to Pinch and Bijker, there is a widespread agreement among researchers that scientific knowledge is thoroughly socially constituted. Such an understanding of scientific knowledge being constituted by social factors implies “that there is nothing epistemologically special about the nature of scientific knowledge: it is merely one in a whole series of knowledge cultures” (Pinch and Bijker 1984, p. 401-2). This does not mean there is no need to explain why some knowledge cultures are and become more successful than others. It does, however, mean that it is reasonable to see the success of certain knowledge cultures as a sociological phenomenon and discuss different social elements that constitute it.

2.3.1 Education and research: knowledge systems

The production and communication of knowledge is one of many assignments that teachers and researchers deal with in their everyday work. It is interesting to discuss some of the functions that scientific knowledge has in the modern society as well as the institutions that are related to the development and application of this knowledge. It is possible to understand modern science as a knowledge system, which 1) is structured, which 2) has become institutionalised with research institutions and educational institutions, which 3) has a certain fairly limited content and certain functions in the society, and which 4) is determining for a particular form of rationality (Hefferlin, 1969, p. 14).

According to Jakobsen and Pedersen, knowledge systems consist of different components of knowledge. In modern knowledge systems one such obvious component is the theories, methods, and results dealt with in scientific literature. Apart from literature, other components may be religious or literary works or may be partial narratives that have not been written down and tradition (Hefferlin, 1969).

The knowledge in a knowledge system embraces more than theories, scientific results and narratives. In order to be able to deal with and understand different (scientific) arguments, it is necessary to be familiar with different assumptions, different types of assessments, and different types of coherence. For example, what is considered right and wrong, true and false has varied throughout history. This means that the meaning of an opinion or argument given has to be understood through an establishment of a link between the argument given and the context in which it has come into existence. That is, any knowledge system is based on a
more general frame of understanding, without which the theories, assumptions, and arguments in question would be ambiguous or incomprehensible (Hefferlin, 1969).

Knowledge can be understood as an expression of our conscious understanding of phenomena and processes in the world. Knowledge is then something that conscious people have on a theoretical structural level – as knowledge of and insight in basic connections, regularities and structures – and on a practical level – as the mastery of different skills. In order to connect these two levels, the researcher is said to have an – unspoken– tacit knowledge, which makes it possible for him/her to apply explicit knowledge (Hefferlin, 1969).

Beyond the three components mentioned above, another characteristic of knowledge systems is that specific understandings of what can be regarded as acceptable justifications for knowledge exist within the system. In the theoretical work within different subjects or scientific disciplines, different understandings develop of what differentiates sensible reasons from insensible ones, preferences for specific ways of arguing, for specific types of models describing the reality, as well as preferences for the type of results that the work aims at. The sort of justifications regarded as acceptable are, together with the preferences of arguments, models, and forms of descriptions, all a part of what can be called the type of rationality of the knowledge system (Hefferlin, 1969, p. 14).

It is important to bear in mind that specific types of rationality are opening up for some formulations of problems and certain questions that can be asked and are closing for others. All systems of knowledge are based on assumptions of a metaphysical character, i.e. assumption of how the nature works or of a world order. These assumptions are ahead of the justification. Where the connections of justifications end and where metaphysical assumptions are accepted vary from time to time (Hefferlin, 1969).

Functions of knowledge systems

Beyond the components, another common characteristic of knowledge systems is their different functions in the cultures in which they are developed, and that they are attached to social institutions. Firstly, knowledge systems have a metaphysical function in that they give reason to an understanding of the world. Secondly, they have an instrumental function since they tell us how important problems ought to be solved (Hefferlin, 1969).

To be able to become a representative for a knowledge system, a formal education is normally demanded. This is seen in the attachment of knowledge systems to social institutions, like research and education institutions. Also, the management of different functions often happens within a system of institutions. In some knowledge systems it happens with a high degree of specialisation in particular assignments and privileges. The knowledge systems and the institutions that are attached to these privileges are often justified through their instrumental and/or metaphysical functions. Furthermore, the knowledge systems are also justified in that they support a certain order in the society, meaning that they have a legitimating function (Hefferlin, 1969).

Crises in knowledge systems arise when a new order in the society is developed which cannot be justified on the base of the old knowledge system. They arise when the knowledge system is no longer capable of answering those questions that are asked or – in other words – because the metaphysical, instrumental, and legitimating functions of the systems are considered as insufficient (Hefferlin, 1969).

According to Jakobsen and Pedersen (Jakobsen and Petersen (ed.), 1990)), a knowledge system has a high degree of resistance towards perceptions and understandings that may lead to crises. Firstly, it is difficult to develop, to take in and to convince other people about
understandings that are in conflict with existing understandings within a knowledge system. The existing frame of understanding and type of rationality will have links to perceptions, which are difficult to go beyond. Furthermore, knowledge systems are capable of living with (limited) inconsistencies and conflicting understandings for long periods. Finally, the institutions that are attached to a knowledge system, will react against crises – and thereby also against any threats to their own existence and *raison d'être* (Hefferlin, 1969).

### 2.3.2 Education and research as institutions

According to Vught, the working up of knowledge within education and research systems is related to a number of basic principles. The first one of these concerns the *authority of the experts*, which among other things are occupied with decisions about the knowledge oriented academic activities such as research and teaching. Also, the decisions of what and how to research and what and how to teach are to a large extent overlooked by academic experts. Such a system emphasises the vocational autonomy of the experts (Vught, 1997).

Another basic principle within the institutions of further education is that the *fields of knowledge* are in focus. Understood in this way, the building units of the organisation of higher education consist of the fields of knowledge, and any organisation within the system will not be able to exist if not a certain institutionalisation of these units is made (Vught, 1997).

A third principle is that the *authority to make decisions* is spread out on many actors. Vught finds that decentralising the processes of decisions is an inevitable characteristic of an organisation dealing heavily with production and communication of knowledge (Vught, 1997).

The final principle is concerned with the *way in which authority is delegated within the institutions*. In the relations between the academic and the administrative groups of actors, the authority is traditionally exercised by the academic experts and to a lesser content by the administrative staff. Putting the relatively more limited ability to exercise influence of administrative groups together with the professional authority, systems of further education may appear as complex institutions containing a high degree of autonomy (Vught, 1997). On the other hand, more and more universities are managed by hired professionals (and not by managers elected among by and among their colleagues) at university level and at department level. This means that decisions about what to teach and research might become more centralised decisions.

### The actors at universities

The university as institution has been subject to large changes throughout the years. For instance, the role of the university has changed over time and the role also differs from country to country. Compared to earlier, many universities and the academics employed are today responsible for many types of assignments such as teaching, research, development and innovation, evaluation etc. Earlier, the assignments would be limited to research and teaching, and earlier again only to the task of teaching. The amount of students to be taught has also differed throughout the years starting from educating a very small academic elite to today’s education of large groups of professionals. The latter is synonymous with the so-called ‘mass university’. A division between research and teaching has also emerged in many universities in spite of the fact that these two activities earlier were regarded as very closely connected to each other (Rasmussen, 1997).

The different assignments are themselves also becoming still more differentiated (Rasmussen, 1997). For example, teaching assignments might be divided in teaching first
year students, teaching students between the bachelor and the master level, and teaching at
the level of Ph.D.'s. Also research assignments have become still more divided in what is
called basic research, applied research, innovation, experimental research and studies, and
evaluations. Apart from these things, the academic employed at universities today is also
making professional evaluations and (s)he may also find him-/herself not only in the role as
an employee but also as an employer, in that (s)he possesses leading functions in relation
to, for example, non-permanent staff. Furthermore, development, marketing, and fundraising
in relation to own projects and results are also elements of an academic's job description
today. Finally, they often participate in different forms of evaluation and quality development
within the university (Rasmussen, 1997).

According to the picture of the university academics drawn above, (s)he is a very busy
(wo)man who is engaged in many varied assignments of which many often have a close
relation to actual societal questions. In spite of this, the more ‘traditional' picture of the
professor being an actor who is totally engaged in a very special subject that has no or only
very little relevance to practice is still very prevalent. In order to be able to better understand
the choices and priorities that academics make in their every day work, it is necessary to
handle such traditional conceptions of academics and their work with care (Rasmussen,
1997).

Callon et al. support the picture drawn above and describe the behaviour of scientists as
conforming to the classical picture of the entrepreneur, in that they “attempt to obtain the use
of various kinds of resources, to make them fit together and to profit from the results” (Callon
et al, 1986, p. 9). Beyond the research itself, the control of resources, the scientific
environment, and the world that they create are also aspects of scientists' ‘entrepreneurial'
activities (Callon et al, 1986).

The students at universities can be seen as choosing their way through the universities
based on a mixture of considerations concerning scientific interests, career considerations,
social and political values, their economic conditions and personal relations to other students
and to teachers.

Innovations at universities

Vught finds universities have a low degree of formalisation, a low degree of centralisation, a
low degree of stratification of rewards, a high degree of complexity, put large emphasis on
quality in production, and stress the efficiency to a lower degree and the contentment in the
employment to a high degree (Vught, 1997). This points in the direction of a conclusion
saying that ‘higher education may as a whole be considered as showing low resistance
towards innovations'. However, Vught also points to another perception expressed by
Hefferlin, which is shared by many. According to this other perception, systems of higher
education work are conservative organisations by nature, which do not easily provide a basis
for new thinking. According to Vught, Hefferlin finds that new innovations will only appear in
systems of higher education insofar that these contain a high degree of instability. This
means when special circumstances happen, such as for example reorganisations of faculties
as a consequence of expansion or reduction of professional fields, low degree of permanent
employment, rotation in the management of the institution etc. (Vught, 1997) and (Hefferlin,
1969).

Clark is another author who supports that changes and innovations in university systems are
much more influential than is normally recognised. He finds that innovations and adaptations
are increasingly characterising these systems and that new formations and the diffusion of
these is happening in processes of institutionalising working methods within the institutes
and other similar units. Hence, changes happen at the practical level, since they take place
in the vocational activities in the different units within the system (Vught, 1997). Whether changes are viewed as frequent or not will also depend on the perspective of the actors. Seen from within, the universities have been undergoing enormous changes with respect to their many functions and the academic forces. However, seen from without, the universities are some of the institutions that have changed least compared to other organisations (Vught, 1997).

Insofar as the characteristics of higher education show that the actors and structures in education and research systems have a low degree of resistance towards innovations, these same characteristics will be the reason why it is difficult for the same actors to hold on to any new formations. Also, dissemination of new formations relies on the vocationally motivated conviction that the introduction of certain news is worth the trouble. According to Bok, members of a teacher college on a faculty will only approve new formations if they evaluate and assess that the new system will somehow be of benefit to their own existing activities (Vught, 1997).

Seen from this point of view, even the most promising new formation may not survive unless some action is taken to make it gain larger dissemination. In relation to this, Vught suggests that an effective action most likely will appear when colleagues view the new formation as an effective solution of a common problem (Vught, 1997).

Becher and Kogan argue that systems of higher education and research always will be local and specific in their character: “…we do not deal with a hierarchical system, where change can be decided from above, but on the contrary with a system of negotiation, where the individuals, the basic units, and the institutions each believe that they are entitled to decide what is best for themselves. Consequently, any suggestion of renewals ultimately has to be approved by those who have to implement them.” (Vught, 1997, p. 65).

Vught suggests the following characteristics as parameters for successful innovation (Vught, 1997):

1. **Compatibility** of the new thought: to what extent is a new formation considered as consistent with existing values, earlier experiences, and needs among the recipients;
2. **Relative advantages** of the new thought: to what extent is a new formation considered as more beneficial than the way of thinking it is going to displace;
3. **Complexity** of a new formation: to what extent an innovation is considered as relatively difficult to understand and apply;
4. ‘**Triability**’ of a new formation: to what extent a new formation can be tried out as a limited experiment;
5. ‘**Observability**’ of a new formation: to what extent the results of a new formation are visible to others.

According to Vught, the presence of a high degree of all of five characteristics, except the complexity, will influence the extent to which a new formation can be expected to be implemented positively. In the case of the complexity of a new formation, the degree of this will not have any influence on the extent of implementation (Vught, 1997).

### 2.3.3 Directions for the analyses

The analyses of the information from the questionnaire and the case studies concerning the impact of science shops on curricula and research are based on the understandings of universities presented in the previous paragraphs. Figure 1 shows the understanding in a graphical way.
The focus will be on the kind of changes and on the driving forces behind the changes:

- What kind of changes have taken place; including whether theories, methods and types of rationality of knowledge systems have changed;
- Whether the impact has taken place as institutional changes or as local changes based on initiatives of single researchers and teachers;
- What alliances have been created in order to carry through the changes and what arguments have been used to create the support for the changes;
- Why students have participated in science shop projects (e.g. for social, for competence oriented etc. reasons) and whether institutional changes have supported or hindered this involvement;
- Why researchers and teachers have taken part in science shop projects and in follow-up investigations to projects in science shops (e.g. for social, scientific etc. reasons) and whether they have experienced some kind of resistance from colleagues, management etc.;
- Whether changes in research have been institutionalised as new fields of knowledge or the changes have taken place within or across fields of knowledge.

*Figure 1: The understanding used in this report of the relations between society, university and science shop*
3 Impact on curricula

3.1 Introduction

This chapter presents the different type of impact on curricula science shops (and similar types of community-based research) might have. Furthermore it also discusses the competencies that can be gained by doing science shop projects as part of higher education curricula.

One direct impact on the curricula is the competence students develop through science shop projects, where the students as part of their curricula work together with citizen groups on a topic proposed by the citizen group. Around 70% of the science shops answering the SCIPAS questionnaire say that students work with science shop projects as part of their education. The better the possibilities in the curricula for doing this kind of work the bigger is the potential impact from the science shop. At some universities the possibilities in the curricula are already there, while at other universities the science shop or scientific staff supporting the science shop develops the possibilities. Around 40% of the science shops report that curricula have changed to fit science shop projects better, while 10% report that the possibilities have become worse.

Another type of impact on curricula is seen when competencies normally gained through science shop projects are offered to students in other ways besides the direct work with science shop projects. It is, however, only around one third of the science shops that report that. The following ways that science shop staff applies have been identified:

1. Scientific staff includes community topics in existing teaching activities;
2. Science shop staff includes science shop case studies in own teaching activities;
3. Science shop staff co-operates with scientific staff about the developing of and the teaching of courses within topics emerged from problems raised by citizen groups;
4. Science shop staff develops and runs its own courses within methodology and theory where students can learn competencies that can be developed through science shop projects;
5. Science shop staff develops courses within topics and problems raised by citizen groups;
6. Science shop staff participates in restructuring of curriculum through formal planning activities.

The impact will be assessed according to qualitative aspects, such as what kind of competencies the science shop can give the students, and quantitative aspects, such as how big a proportion of the students that actually work with science shops or follow courses developed on the basis of the science shop work.

3.2 The framework of science shop projects

The majority of the science shops (around 70%) answering the SCIPAS questionnaire answer that students do project work in the science shop as part of their curricula (course, diploma work, thesis etc.). That is, it is a widespread concept among science shops that students work with at least some of the requests coming to the science shop.
The case studies included in this study cover a range of learning and research situations. These are seen in relation to the participation of the citizen groups in the research process and in relation to the project set-up. The citizen participation seems to vary depending on:

- The topic (whether citizen participation is necessary – for example in projects about citizen participation in local waste segregation);
- The personnel resources of the citizen group;
- The concept of the science shop.

The Chemistry Shop at University of Groningen in the Netherlands characterises the concept applied as ‘research for community’, while the Policy Research Action Group, PRAG, in USA (a network of 4 universities and 15 community organisations in the Chicago metropolitan area) is based on participatory action research and characterises their concept as ‘research with community’ (Nyden et al, 1997, p.7).

The students seem to be involved in science shop activities or activities similar to these mainly in two different ways:

- Through placement and internship in the citizen group;
- Through project work carried out in co-operation with the citizen group.

In general, the European science shops seem to use project work in co-operation with the citizen group as their concept for student involvement. Brunel University in the UK uses placements and internships as their concept. The same goes for PRAG, which also seems to use placements and internships as the concept for their participatory action research. University of Toronto in Canada uses both the placement and the project approach.

Hall et al (2000) say that community-based learning can be understood as a very broad and inexact term including any and every aspect of student learning in higher education, which takes place outside the classroom in the surrounding local environment. In this perspective it would include, for example, work-based learning, voluntary activities, field studies and visits, internships and work placements, pure and applied research with community respondents, and participatory action research.

Hall et al (2000) mention in the UK context a recent collection of articles edited by Sue Buckingham-Hatfield for Community Service Volunteers exemplifying the range of community-based learning in the UK. This includes opportunities for volunteering, for independent study, for relating academic theory to community examples, and for community-based research projects across a range of disciplines. Such a range of practice is loosely co-ordinated through the network of the Council for Citizenship. In the USA, there is a tradition of ‘service learning’ involving students in their local community. Another strand of community-based learning, with rather more emphasis upon the effects on the community as well as on the students, comes from participatory action research (Nyden et al, 1997). In both UK and USA we see therefore a very broad perception of the term being applied when talking about and practicing community-based learning.

The CoBaLT project (Community Based Learning Teamwork) in community-based learning in sociology has, according to Hall et al, narrowed the term ‘community-based learning’ to:

- Include student work and activity outside the classroom which is formally assessed as part of the student’s degree;
- Include course modules which require students to involve themselves in some way with the local community;
• Exclude off-campus activities which are not formally assessed towards the degree, such as some forms of work placement and voluntary action.

Among the cases studied, this understanding of the term can be recognised in many of the (continental) European science shops’ way of describing and valuing the community-based learning activities they established together with communities and students at universities.

Both perspectives on the term appear in the cases and since impact on university curricula and research can happen within both of them, this report will not try apply it in either a narrow or a broader form. What is important to bear in mind in relation to this is that different ways of understanding and practicing the term may result in different possibilities for making an impact on curricula and research.

3.3 Competencies developed through science shop projects

When students as a part of their education make science shop projects in co-operation with citizen groups it can be seen as what is also called community-based learning, where students undertake research with local third sector organisations (Hall et al, 2000, p.2).

According to Hall, proponents of community-based learning claim the following advantages:

• It makes connections between abstract concepts learned in the classroom and real applications in the world outside;
• As a form of experiential learning it promotes learning through a cycle of action and reflection (cited from Hall et al, 2000);
• Through the engagement of students and interaction with others, it fosters a deep rather than a surface approach to learning (cited from Hall et al, 2000);
• It develops general skills that are useful in other contexts, particularly the world of work.

These four aspects of community-based learning all show up in the case studies analysed as can be seen in the following examples. Beyond these, the cases have also shown another dimension of community-based learning, which deals with developing new perspectives or new ways of looking at the community groups worked with.

In an in-depth interview with a former student who had carried out a project in the University of Groningen Science Shop for Medicines in the Netherlands, the student interviewed emphasised the ability to connect abstract concepts in form of theory with practical application as well as general communication skills as competencies she has gained by participating in a science shop project. As a former student, her experience is that the competencies she has gained have been valuable in her present professional work. In the interview made three years after the project the student said – based on her present practice as a graduate – that she had learned the following from the project (interview with Evelyn Schaafsma, 30 Nov 2000):

• Translating from practice to theory and from theory back to practice. For example, a question from a patient or a patient organisation needs to be translated towards the scientific literature and research. The results then afterwards need to be translated back to practice and be explained to the target group;
• Writing skills, especially an ability to explain concepts clearly to people not scientifically educated;
• Communication skills: the student has to deal with people outside the university, talk with them about what they want and what they need and what their aims are. This is supported by dialogue methods like different types of interviews.
This understanding of the relationship between the student and the citizen group is very much like the doctor-patient relationship since it represents one of more perspectives that pharmacists use in their relations to patients. In the science shop project, the co-ordinator guides the students toward a more interactive approach as the approach to apply in the relationship between the student (later on the graduated pharmacist) and the patient or the patient organisation. The background for this is the view that all pharmacists are aware that they should ‘treat the patient decently and take them seriously’, but they are not all aware that the patients hold a kind of expertise themselves and that this expertise is very valuable in trying to find a proper solution of the patient’s problem. The science shop co-ordinator has herself learned this perspective from her work in the science shop: The patient should be seen as an equal partner in the dialogue having her or his own expertise (the co-ordinator is furthermore also bringing this concept into the courses she is teaching at the department – more about this aspect later).

Similar competencies are reported from undergraduate students at the Centre for Urban Research and Learning (CURL) at Loyola University in Chicago, USA, who have reflected their experience from the Urban Life and Policy Studies programme. A change in the students’ perspective can be seen in both the Dutch case dealt with above and in this American case. One of the students of Loyola University said (Report on Accomplishment and New Initiatives, 1999, p.2):

“…I have learned so much about policy work and myself. I knew some of the numbers and rates for different poverty issues, but to be able to put a face with the statistics can really empower a person to want to make a difference. In other cases, it was not the fact that I was taking an interest in government services the people were or were not receiving, it was the fact that I was willing to listen to them and talk to them as another human being…”

Also, according to the co-ordinator in the Physics Science Shop at Utrecht University in the Netherlands, the science shop gives students competencies in doing fieldwork by giving them the possibility to work in real-life situations outside the laboratory. The competencies focused on here are that the students gain a better understanding of real-life work and become better to solve professional problems. Though focusing on the development of later working competencies, the pedagogical point by giving the possibility to do fieldwork is to give – as a part of the education – the students an experience of working not only in a laboratory, where everything is well prepared and under control, but also in real life situations where there is always something unexpected happening and to get a sense of what one can do in such situations (interview with Patricia Huisman-Kleinherenbrink, 08 Dec 2000).

Interviews with students at the evaluation of science shop projects at the Technical University of Denmark highlight problem orientation, practice orientation and usefulness as attractive to the students. Furthermore, there may also be a wish among these students to influence and have an impact on their own educational curriculum as well as a will to take a responsibility of formulating parts of this by themselves. This is based on the interviews where the students have given expression to the view that there are two major aspects that they find interesting in science shop projects; working with a project, where the problem is not well defined from the beginning and working with a problem where the results are going to be used by somebody.

The statements below have been found in interviews among Romanian students at the Technical University of Iasi. These show the students’ experience of the competencies gained through participation in science shop projects as being useful for them in a later work context. Apart from the very technical skills the projects also provide them with other more general types of social skills, which are considered useful in order to be able to put the first ones in practical use. Furthermore the projects also provide the students with better abilities
to apply more bottom-up oriented strategies involving relevant actors in the solution of professional problems. The students think science shop projects can complete their university education by providing the following possibilities to (interview with Carmen Teodosiu, 06 Nov 2000):

- Get a better understanding of environmental problems
- Work in groups and apply technical knowledge to practical situations
- Have contacts with citizens’ groups
- Learn about project and task management
- Engage in international student co-operation
- Improve communication and language skills
- Develop pedagogical skills

In the Romanian context, the education of environmental engineers is viewed as having an important role in the development of democratic processes. In relation to the community, the role of the Environmental Science Shop at Iasi is among others to offer civil society information, consultancy in environmental protection, increase environmental awareness, and a scientific basis for public participation in environmental policymaking. Another role of the science shop here is to educate future engineers with competencies that are considered useful for a democracy. These are competencies such as the ability to work independently, make research plans, make surveys and evaluate activities, disseminate results, apply a practical approach to environmental problems etc.

### 3.4 Mechanisms with impact on possibilities for projects

The direct impact of science shops on curricula depends on the amount of students that work on science shop projects and the amount of students depends – besides their interests – on their possibilities to do this kind of project work as part of the curricula. Around 40% of the science shops answering the SCIPAS questionnaire report that the curricula have changed so the possibilities to fit in science shop projects have become better. Around 10% report the possibilities have become worse and around 25% report that the possibilities have not changed. The following mechanisms with influence on the possibilities for doing and establishing/integrating science shop projects as part of the curricula have been identified in the case studies:

- A science shop develops the possibilities for doing project work as part of established courses;
- A science shop develops the possibilities for working together with citizen groups as part of the curricula;
- Scientific staff finds the competence that science shop projects offer so relevant that they want to improve the possibilities for the students to do science shop projects;
- Scientific staff finds that the science shop offer services that can minimise their own workload, when they want to fulfil institutional or local aims;
- The degree of accordance between the topics in the requests from the citizen groups and the scientific focus of the faculty;
- Changes in curricula improve or reduce indirectly and unintentionally the possibilities for working with science shop projects as part of the curricula;
- Resources available for the actors involved in science shop projects.

These mechanisms run – to some extent – across the ways of introducing changes mentioned earlier. The content of the seven mechanisms will be elaborated below, while the ways of gaining impact on curricula are analysed in paragraph 3.5.
3.4.1 Project work as part of established courses

In some cases, for example Eastern European universities, a science shop might be among the first possibilities for establishing project-based learning. This is the case in the Environmental Science Shop at the Technical University of Iasi, Romania. The science shop co-ordinator, who is also a teacher at the Faculty of Industrial Chemistry, uses case studies from the science shop in her own regular courses. In this case, the co-ordinator not only applies the science shop material in her regular teaching. She also asks the students to prepare small reports on specific subjects that will later be used for different environmental education programs, on which the science shop co-operate with the schools in the city of Iasi. The impact can hence be understood as going in two ways (interview with Carmen Teodosiu, 06 Nov 2000).

3.4.2 Working together with citizen groups as part of the curricula

An example of this mechanism can, among others, be found in the American context. The earlier mentioned PRAG network in the Chicago metro has since 1993 been able to attract additional external funding to support several hundred projects with interns and research assistants working in community organisations and government agencies and apprentices from community organisations working together with the involved universities. One of the involved universities, Loyola University Chicago, has developed a Center for Urban Research and Learning (CURL), which operates parallel to PRAG and at the same time as the fiscal agent for PRAG by letting PRAG use the existing university organisational structure at Loyola University Chicago. CURL operates in many ways as PRAG and has in parallel to PRAG’s apprenticeship programme a community fellowship programme supporting community leaders’ training and/or research.

The same mechanism can be seen in the Canadian case. At University of Toronto, three courses have been created to act as framework for students’ co-operation with community groups. One of the courses is an Environmental Research Seminar, where the purpose is “to give students experience in working as a group of “consultants” who jointly undertake secondary and primary environmental policy research and report preparation on behalf of a “client” in a non-academic context” (Environmental Research Seminar 1999-2000). These possibilities have now been strengthened through funding of the so-called Community University Research Alliance, CURA. The clients are not only community groups, but also city governmental agencies.

3.4.3 Scientific staff improves possibilities for students

With regard to the third mechanism – that scientific staff finds the competence that science shop projects offer so relevant they want to improve the possibilities for the students to do science shop projects – a lecturer at the Queens University of Belfast, Northern Ireland has taken the initiative to establish a course where students are required to work on a project that has come into the science shop and to produce for example a policy briefing paper for a community organisation. The lecturer who took the initiative had already been involved with the science shop and supervision of science shop projects earlier, and was keen for his students to get some practical experience and use their social policy training in some kind of practical way. This science shop itself is not in a position to propose such a thing by itself but depends on that the academic staff sees the point of taking such actions. One barrier at this university for realising such ideas is the inertia that is incorporated in the system in that establishing a new course module means that an existing one has to be closed down (interview with Eileen Martin, 05 Dec 2000).
Besides this, the science shop co-ordinator from Twente University also finds that another motivation among the scientific staff is based on the information that the science shop at this university has found out that the students learn more when they work with real customers than when they work with theoretical formulated questions and assignments.

### 3.4 Science shop services reduce scientific staffs workload

The fourth mechanism – scientific staff finds that the science shop offer services that can minimise their own workload when they want to fulfil institutional or local aims – can be illustrated by the following three examples showing how scientific staff has been motivated to getting involved in and supervise students’ projects carried out in the frame of science shops.

As can be seen in the three case studies below, time seems to be a central factor in the considerations scientific staff may have about whether to involve as supervisor in science shop projects or not. Teachers’ and researchers’ practical motivation is therefore to a large extent based on resources spent in relation to sending and achieving students from the science shop.

Twente University, the Netherlands is a rather young university from the 1960’s, founded because “the people here in this region were very eager to get the university here. So… from the start there have been strong ties between the university and the society around.” (interview with Dick Schlüter, 06 Dec 2000). The regional organisations and industry and the university have contact with each other. The science shop offers the scientific personnel an easy way to send out students to do practical oriented research work as part of their educational curriculum. “The scientists are really pleased that we come with that research, because they can send out students easily.” (interview with Dick Schlüter, 06 Dec 2000). The science shop takes part in the projects and cares about the students and how the research proceeds. There is less work for the researchers to do, which also is a reason for them to like the science shop. This case shows how changes in the societal discourse determine what role the university shall have and that how curricula are considered can impact on the possibilities for doing science shop projects.

A professor at Technical University of Denmark, who has supervised many student projects coming via the science shop, characterises the culture of his institute as containing an openness towards working with many and small (research and student) projects covering many different aspects. He finds that this has had some positive impact on his and the institute’s attitude towards working with science shop projects. Two incentives leading to this openness have been the ‘interesting projects’ the science shop offers together with the time the teachers save. The latter is due to that the science shop acts as a supplementary resource taking over some of the administrative work related to doing the courses, including taking care of the setting up of the projects and following up on how the projects are proceeding (interview with Mogens Henze, 25 Oct 2000).

At the University Centre for Pharmacy at University of Groningen in the Netherlands the science shop co-ordinator is also teaching regular courses. As described already, members of the scientific staff use the science shop co-ordinator to get examples on patients’ perspectives on pharmaceuticals and pharmaceutical care. On the other hand it has not been possible for the science shop staff to get the other scientific staff to supervise the science shop projects, though this was the intention originally. The reason given by the scientific staff is that they do not have the time available to supervise these projects. That is, the science shop staff has to supervise all the projects themselves while at the same time it has not been possible to get more resources from the Faculty to the science shop (interview with Evelyn Schaafsma, 30 Nov 2000)
3.4.5 Accordance between community topics and scientific focus of faculty

When it comes to the degree of accordance between the topics in the requests from the citizen groups and the scientific focus of the Faculty – the fifth mechanism mentioned above – this can be illustrated by the Physics Science Shop at Utrecht University in the Netherlands, which participates in two regular courses. The participation is organised so that the students can work with science shop projects as a part of the course. Firstly, there is an optional three-week practical training course module where the students can substitute a part of the course by doing some measurements for the science shop on a topic proposed by citizen groups. Secondly, there is an eight-week course with the possibility to work only on a science shop project. This course has never been given, because it has never been possible to find a proper project. One characteristic of this science shop is that: “The questions we get from our clients are hardly ever on subjects that are investigated in the Faculty. Ordinary citizens are not interested in quantum physics or elementary particle physics – at least not on a scientific level that is sufficiently high for the research staff. So… there are hardly any contacts with the Faculty with regard to the subjects”. However, even though there is this gap the Faculty still consider the science shop to have some value to add to parts of the curriculum. The situation seems to be the same for other physics science shops in the Netherlands as well (interview with Patricia Huisman-Kleinherenbrink, 08 Dec 2000).

At the Science Shop for Medicines at University of Groningen, also in the Netherlands, the science shop co-ordinator asks the students before doing larger science shop projects (for example thesis work) to follow courses at the department, where the science shop is affiliated, in order to learn other research methods than laboratory work. The reason for this is that laboratory work based on experiments with rats and analytical chemistry is the dominant way of working at the Faculty. Furthermore, the science shop co-ordinator thinks it is good that all thesis work at the Faculty has to start with a four-week introduction to research, where research is presented from a social science point of view, because it adds some values to their research approach that she finds important (interview with Evelyn Schaafsma, 30 Nov 2000).

3.4.6 Changes in curricula effects possibilities

Introduction of (more) project-based learning in the curriculum can improve the possibilities for working with science shop projects. This has been the case at the Technical University of Denmark, where the introduction of two mandatory project courses in the first part and the middle part of the curriculum has made it easier for the science shop to recruit students for their projects, since all students now have to formulate and carry out more projects during their education. On the other hand, changes in the economic conditions for Dutch students seem to have made it less attractive for some students to do projects (like science shop projects), which are not seen by the students as part of a mainstream curriculum. One problem with non-mainstream courses and projects are that they often are more time consuming for the students to make than the regular courses are to attend.

Changes in curricula that have improved or reduced indirectly and unintended the possibilities for working with science shop projects as part of the curricula can be found at the Technical University of Iasi, Romania. Here recent changes within the environmental engineering and management profiles have created an opportunity for making practical social research. This includes a new course on ‘technique of social inquiry’, which is seen as being an important basis for the projects carried out by the students in the recently founded Environmental Science Shop. Some of these projects include interviewing citizens about their knowledge about environmental problems and their sources (interview with Carmen Teodosiu, 06 Nov 2000).
3.4.7 Resources available for students to do science shop projects

With regard to the resources available – the eighth mechanism – PRAG’s and CURL’s internship programmes pay graduate students a research grant as a kind of living stipend and coverage of their university tuition in order to make it possible for them to do their graduate studies. Among other things, this is done in order to make access formally equal for all groups of students. It is common that “a fairly decent percent of graduate students in graduate programmes at American universities are supported either with a research internship like…here, or a teaching assistance-ship, where they would be teaching undergraduate classes” (interview with Philip Nyden, 11 Dec 2000 and Maureen Hellwig, 18 Dec 2000).

3.5 Ways of gaining impact on curricula

The content of this section refers back to the six ways of gaining impact identified in section 4.1. In the following paragraphs other types of impact on the curricula, apart from the direct impact when students work with science shop project as part of their education, will be described and analysed. It is only around one third of the science shops (around 15), which report that science shop research has been included in courses or modules. Only one science shop reports that the inclusion has not been successful. One third of the science shops report that there has been no inclusion of research and another third do not answer the question, which probably also should be seen as no inclusion has taken place. There may be several reasons why only one third of the science shops report that science shop research has been included in courses and modules. One reason might be that the science shop does not have the embedding of methods and topics as part of its aims and focus. Another reason might be that a science shop has tried to contribute to changes, but has not been successful.

3.5.1 Including community topics in existing teaching activities

Scientific staff includes own initiative community topics and develops these from ‘within’ in the professional fields they are already working with.

Driving forces for including community initiated topics in the curriculum has, in one of the following two cases, been a personal professional interest combined with a consideration of what knowledge and competencies the professor finds the students will need in their future work as professional engineers within the field of water treatment. In the other case, a driving force is related to a move or a change in the focus within the education that affected how the relevance of the science shop’s contributions is considered and makes them more visible.

A study from the mid-1980s of the impact on research from ten years’ work in the Amsterdam science shops also showed impact on the curricula. Out of 162 science shop projects done by researchers, materials from the study were incorporated in educational material (Zaal & Leydesdorff, 1987).

The following describes cases found in the SCIPAS project. The co-ordinator of the Science Shop for Medicines at the University of Groningen in the Netherlands tells that other scientific staffs often consult her when they need to make new projects about patients’ perspectives in their own teaching activities. They consult her because they know the science shop has worked with that perspective for many years. Knowing that the science shop has been dealing with this issue and that the co-ordinator has concrete examples of how this particular perspective on how to perform as pharmacist can be taught to students constitute good reasons for consulting her. In combination with this, a related reason is also the fact that
pharmacy education in general is heading towards a more and more patient oriented approach. The science shop co-ordinator is also consulted very often in relation to a new field called ‘pharmaceutical care’, because she holds knowledge about what patients want and what patients need (interview with Evelyn Schaafsma, 30 Nov 2000).

At the Technical University of Denmark, what could be called ‘development from within’ has been practiced in an established area. Here scientific staff from a department embeds topics from science shop projects into their own teaching activities together with the science shop as a dialogue partner. The professor of the department has supervised several student projects in the science shop at the university.

The professor at the department for environmental technology has made a gradual introduction of elements and issues of the projects into his courses. It is his interest for water treatment together with his interest of dealing with problems of how to treat (waste-)water in order to reach a wanted quality that has led him to other areas, such as collection and (re-)use of rainwater. He did not immediately introduce problems of rainwater or green wastewater in the ordinary courses, because he thinks the focus of what he teaches has to correspond to the focus of the students’ later working situation. In this case, the scale of alternative technologies (such as green wastewater treatment and (re-)use of rainwater) did not correspond with the scale of the technology traditionally implemented, since the alternative technology were often small plants used on the household level, whereas the type of the plants that the students were going to deal with in future jobs would be large facilities. Such large-scale facilities are typically owned by the local authorities.

Today, teaching in green wastewater treatment plants has become a part of the curriculum in two regular courses due to a change in users’ requests; implementation of green wastewater treatment plants is no longer only taking place in individual households. Today groups of households are also making requests of these plants, and the plants needed are no longer just the large scale ones which engineers traditionally worked with. At the same time these groups of households possess economic resources that enable them to actually hire a consultant. So, as the type and requirements of potential users of the plants have changed, so has the relevance of taking these issues into the courses (Jørgensen, 1999).

### 3.5.2 Including science shop case studies in own teaching

In this case the science shop staff supplies existing courses with case study material based on science shop projects. The courses can be taught both by the science shop staff itself and/or by other teachers.

According to one Dutch science shop co-ordinator, examples of science shop keepers in the Netherlands who also teach in university courses are mostly found where the science shops are affiliated with and a part of a faculty – that is to say in decentralised science shops. In opposition to this, staff will often mediate and organise projects for all the faculties at universities where the science shop is positioned centrally. Then the scientific staff can use the projects in their own teaching if they want to (interview with Dick Schlüter, 06 Dec 2000).

In the examples given by the case studies, the possibility to integrate case material from science shop projects in regular courses is heavily related to the fact that all of the science shop co-ordinators stay in positions where they can act in roles of both science shop co-ordinator and as teacher. Being in these two roles gives them (easy) insight and access both to materials and examples of science shop cases and a group of students that can work with these cases as a part of their regular curriculum. A precondition of this is that the teachers are free to choose how they want to organise their teaching. Within these universities, these
co-ordinators’ positions and acting in these two roles has hence become important in the practical process of integrating science shop activities more in curriculum.

At University of Groningen in the Netherlands, the science shop staff both in the Chemistry Science Shop and in the Science Shop for Medicines are also teachers at the Faculty. The Chemistry Science Shop has for a number of years given a course on ‘chemistry and society’, which it was asked to take over when the Faculty closed the department on science and society. Furthermore, one of the science shop staff members has also developed a course on ‘industrial innovation for environment’ based on his own research interest. The science shop staff uses cases from the science shop in both courses as part of their empirical base (interview with Henk Mulder, 06 Nov 2000).

The co-ordinator of the Science Shop for Medicines teaches communication skills and counselling training. She bases her teaching on experience from the work in the science shop and organises it very much from a patient perspective. In the course on counselling training, where the students have to practice with pharmacist patients, the science shop co-ordinator tries to make the students give a feedback to the patients that involves the perspective she knows herself from patients via the science shop.

3.5.3 Co-operation with scientific staff about courses

Here the science shop staff co-operates with scientific staff about the developing and teaching of courses. The courses deal with topics that have emerged from problems initially raised by citizen groups.

The following cases show three aspects that have acted as motivation factors for co-operation between science shop staff and scientific staff. Firstly, there have been good personal relationships between the two groups, secondly, they are interested in and work within the same topics, and thirdly, they all find that perspectives contributed by the science shops are beneficial for the students.

The Centre for Urban Research and Learning, CURL, at Loyola University in the USA, has in co-operation with the Graduate School at the university developed an interdisciplinary educational program – “Urban Life and Learning: Chicago”. Students attending this can get a master’s degree or a certificate. The two have also developed a certificate programme on “Philanthropy and Non-Profit Sector Graduate Certificate Program”. This programme includes three courses on non-profit organisations, on philanthropy, policy and community change and an internship with local philanthropic organisations.

The Science Shop for Biology at Utrecht University in the Netherlands co-operates with the ‘department on science and society’ on a mandatory one-week course on ‘science and community’. While the science shop uses cases from the science shop as bottom-up cases, the department on science and society uses more top-down cases related to policy-making. In this way different perspectives are presented to the students on how professional problems can be approached. The co-ordinator thinks that the co-operation has been established because both units work on topics that are relevant for community groups. Besides this, the science shop staff also has very good personal contact with the staff members of the department it is affiliated with. Hence one reason why the science shop has been asked to take part in this course has to do with both personal contacts and the expertise of the science shop. Another reason has to do with a general change in the attitude among scientific staff towards those skills that the science shop staff work with and train the students in. For example, some faculties are now beginning to realise that not all students will become researchers, and that those students who will become policy makers instead...
need competencies other than the traditional ones and that some of these competencies are reflected in the science shop approach (interview with Caspar de Bok, 08 Dec 2000).

At the Queen’s University of Belfast, Northern Ireland the science shop is invited every year to teach students at a post-graduate course in science communication. Furthermore, the science shop helps with preparing post-graduate students for their dissertation through a research module, where the students – through working on a science shop project – learn about science communication. The co-ordinator will not say that the science shop is integrated into that course, but rather that it contributes to it each year. One reason why the science shop is considered relevant to this course is that it is involved in the area of science communication and the area of communicating scientific ideas to a particular public. Furthermore, the science shop also has a good working relationship with the other members of staff involved in the course, and they are happy with the contribution that the science shop makes and feel that the students benefit from their contribution. The co-ordinator finds that their presence basically renews the course offer in that they are not actually written into the course programme, but are still being approached for permission every year (interview with Eileen Martin 05 Dec 2000).

3.5.4 Developing courses with methodology and theory

The science shop staff develops and runs their own courses where students can learn competencies that can be further developed later on through science shop projects (like science communication, academia-user dialogue etc.). In this case, the courses deal with theory and methodology.

Several of the case studies show science shops that teach students in the general qualifications that can be obtained from science shop projects. This will happen in courses that are not directly related to science shop projects. The courses mean the science shop also has a methodological impact on the curricula besides the direct project work with the science shop projects.

At Utrecht University in the Netherlands, the Science Shop for Biology has developed and run a course in community-based research, where the students learn general qualifications needed in community-based research. The course lasts 14 weeks (2 hours every week) and the students end the course by writing a paper related to general topics about the interaction between science, scientists and community. Some of the topics covered by the course are: oral communication, researchers as external advisors, information sources, desk research, research planning, and science communication to lay people. The science shop uses finished project cases from the science shop as part of the empirical basis of the course. Having done this course, the next step for the students can be to make a project in the science shop.

Traditionally, the Science Shop for Biology staff has not been allowed to develop and run its own courses. But by making a so-called ‘zero-appointment’ (each science shop staff is on the staff list of each department but not paid by this) between the science shop and the departments, this has become possible. Science shop staff is academic staff with a teaching competence. Besides getting the possibility to reach a larger group of students through the allowance to establish regular science shop courses, this zero-appointment arrangement has also been good for the contact between the science shop staff and the scientific staff members at the departments of the Faculty (interview with Caspar de Bok, 08 Dec 2000).

At the Technical University of Denmark the science shop developed in 1986 an optional course on ‘co-operation with user groups’. The students learn about theories about co-operation between academic experts and so-called ‘experience experts’ (citizen groups,
employees etc.) in the course. They also learn different methods like future-creating workshops, which can be used in co-operation with user groups. In the last part of the course, the students do a project where they evaluate a project with co-operation between academia and citizens (some of the cases might be science shop projects or research projects based on earlier requests form citizen groups to the science shop). Also in this case, a larger outreach of methodologies of the science shop has been possible via the establishment of the course. Hence the course does not only fulfil the aim about giving potential, present, and earlier students in the science shop the possibility for making theoretical and methodological reflections upon this kind of activity. It also works as a space where other students can get a chance to ‘sniff’ at the ideas underlying science shop projects without necessarily also having to try them in practice themselves.

### 3.5.5 Developing courses with topics raised by citizen groups

Science shop staff develops new courses that deal with topics originally emerged from problems raised by citizen groups.

A number of the science shops have academic staff also employed as teachers and/or researchers. This gives these science shop staff members the possibility to develop and teach regular courses too. Some of these science shops have developed new courses and curricula within topics originally emerged from problems and strategies raised by citizen groups. The courses have been made either within the science shop or in co-operation with other departments.

The first Dutch example shows how a science shop staff member, who has done research in science shop projects herself, later on based on that insight and seeing the need, has been able to establish a new course bringing up science shop topics. The three Danish examples on urban ecology, cleaner production and organic food production show three different science shop strategies for the embedding of topics from science shop projects in curriculum:

1. the science shop co-operates with departments in the development phase of new areas;
2. the science shop makes a more permanent involvement in co-operation with departments;
3. the science shop acts as an incubator for a new area, until it is possible to involve scientific staff from departments close to the area.

The Chemistry Shop at University of Groningen in the Netherlands has developed a course in Environmental Chemistry based on the need for more people holding professional knowledge in this field that science shop projects had shown. The science shop co-ordinates the course and invites a number of external speakers. The basis for the establishment of the course has been that the science shop co-ordinator has a strong chemical background. The concept of this science shop is that the science shop staff carries out a number of the projects themselves. And in this case the co-ordinator has been able to use this in a way so that she can use some of the projects, which she has carried out herself in science shop, as part of the empirical case material applied in the course.

The Science Shop at the Technical University of Denmark has three main goals:

1. to help groups outside the university;
2. to give the students possibilities for qualifying through co-operation with user groups on real-life topics;
3. to contribute to the renewal of the education and research at the university.

The aim of the renewing activities is to give the knowledge needs of the user groups of the science shops more permanent impact on curricula and research. One of the ways the Science Shop has contributed to the renewal is through new research programmes and new courses within areas, where a number of science shop projects have been carried through.
Even during the first years of the Science Shop, this type of renewing activities became part of the plan for the permanent science shop at the university. Visits to a number of Dutch science shops had shown that it was necessary to have research and teaching programmes based on the science shop projects if a more long-term and permanent impact should be gained by science shop activities on the research and education at a university. The visits also showed the need for having permanent academic resources in a science shop. In order to secure continuity in the work of the science shop it was therefore also important to consider how these science shop positions could be made attractive to academia.

The Science Shop has initiated and been involved in a number of renewing activities within urban ecology, cleaner technology and organic food production during the years through the Interdisciplinary Centre. An important vehicle for these renewing activities within the curricula was the creation of two so-called optional ‘frame courses’ given the broad title ‘holistic technological development’. By establishing frame courses, the science shop and the centre got the opportunity to develop and offer new courses dealing with different areas based on a number of requests that had been received in the Science Shop. These courses were therefore developed in order to be able to offer these types of new topics to as many students as possible.

In practice there has been a close connection between what was taught in the new frame courses and the research activities undertaken in the science shop and the Interdisciplinary Centre. The following tells how the three fields mentioned above have developed; what were the aims and what was done to reach these.

Within urban ecology, the science shop and the Interdisciplinary Centre invited already in 1987 the department for urban planning to jointly plan and teach a course in urban ecology. The course was based on experience from an on-going research project on urban ecology affiliated to the interdisciplinary centre. The culture of research in the urban ecology group has always been that a lot of their work was based on a participatory approach. Later on, the course was taken over by the department for urban planning and it is still one of the course modules offered by the group for urban ecology at this department. Project proposals to the science shop from community groups are from time to time are used as cases in the course.

The science shop also participated together with the Interdisciplinary Centre in the planning of courses within cleaner technology, environmental management and life-cycle assessments together with departments for working environment, ecology and environmental sciences, chemical engineering and manufacturing engineering at the Technical University. Based on inspiration from requests to the Science Shop and on experiences from earlier research, the Interdisciplinary Centre took as much as possible a citizens’ and employees’ perspective in their contributions to the courses. Today the science shop co-ordinator participates in the teaching at permanent courses on ‘management of environment and working environment’ and ‘life cycle assessments of products and systems’.

Within organic food production, the science shop and the Interdisciplinary Centre tried back in 1989 to involve the department for food technology in a research project on organic food production. The project was planned together with a number of community organisations involved in activities related to the development of the agriculture and the food sector. The department for food technology was not interested at that time (although they had supervised some science shop student projects within organic food products), so the science shop and the Interdisciplinary Centre decided to apply themselves. Since then there has been a small research group with three researchers researching in the field of organic food production at the Technical University. Two of the researchers have been almost fully financed by external funding. The presence of the group gives the science shop good possibilities for finding supervisors for the students making science shop projects within this topic. Besides
researching, the group has also offered a course module in organic food production for five years and has given a single lecture on organic food processing at the department for food technology. Today the research group co-operates with the department for food technology on a project on organic food processing. This co-operation is the background for the establishment of a new long-term vision, which is to develop a common permanent course on organic food processing (Jørgensen, 1999).

3.5.6 Participation in restructuring of curriculum

Some science shop staff participate in formal curriculum planning activities in order to bring in more focus on competencies from science shop projects.

Hall et al (Hall et al, 2000) point to the Dearing Report on higher education in the UK, where it is argued that students need more than just books and lectures:

“They also need practical experiences that rehearse them in the professional or scholarly skills of their field, and the opportunity to develop their own understanding and point of view in an environment that gives constructive feedback”(Section 8.3).

The report concludes that:

“All the evidence we have reviewed endorses the value of some exposure of the student to the wider world as part of a programme of study. This may be achieved through work experience, involvement in student union activities, or work in community or voluntary settings.”(Section 9.26) (citations from (Hall et al, 2000)).

The examples below show how some science shops can gain more support at the universities because they offer qualifications that fit with a recent practice-orientation of higher education.

In the Netherlands, changes are being introduced in natural science-based curricula like biology, chemistry, pharmacy and physics. The curricula of the bachelor and the master programme have recently been under investigation and changed. According to one science shop co-ordinator, the changes have come — among other reasons — because the science shops have been able to show good results both with students doing practical research and with the motivation of the students. At the same time it has been discussed whether four years to get a degree in Master of Science was too short or if the curricula for these higher educations needed to be extended to five years instead. In effect, the Ministry of Education agreed to finance curricula that last five years instead of four years on the condition that the new curricula become more practice oriented and include societal issues. This means that the education in those five years, according to the Ministry of Education, shall not only be a science oriented education but that students also shall face societal problems as a part of the last year in their study (interview with Evelyn Schaafsma, 30 Nov 2000).

At Twente University, courses where the students have to carry out a piece of practical work in the region have already been established. This is rather new in the curriculum and one of more of the consequences of the change and the more openness towards practical research with the real customer. One problem with these courses is that the different faculties give them and they are only running in a part of the year since they follow the academic calendar. The science shop does, for their part, get customers the whole year round. Making such courses therefore requires the science shop to organise the integration of projects in the curriculum in a different way than it is used to do. This problem is faced by more of the science shop and internship programmes.
At the University Centre for Pharmacy, University of Groningen, the department where the science shop is affiliated has recently changed the curriculum, so the students now use one day a week to make integrated projects. It is the idea that the project work shall act as the *leitmotif* during the year of study. As a part of the process of setting up these integrated projects, the scientific staff at the department has discussed with the science shop co-ordinator what type of examples would be suitable for such kind of interdisciplinary projects. This involvement of the science shop co-ordinator in this process is due to her educational background as one of the few pharmacists at the department and the fact that she has been working there for some years so that the other scientific staff knows her expertise in the field.

Despite these close relations to the scientific staff and experience in teaching in practice oriented competencies, the science shop staff has not been invited to take part in the planning of the newly introduced fifth year of the curriculum at the Faculty level. This is because the Ministry of Education feels that the students should work with more society-oriented topics in this last year of the new curriculum. Hence the role of the science shop at this Faculty has not changed due to the change in curriculum even though the focus of the new curriculum makes the benefits of involving the science shop in the planning of regular teaching activities more obvious (interview with Evelyn Schaafsma, 30 Nov 2000).

At the Biology Faculty at Utrecht University the change in the view on the length of the curricula has led to the development of three different profiles, directed towards research, communication and education, and management and policymaking, respectively. The Biology Shop has been invited to participate in the planning of the profile on management and policy making, probably because the Faculty sees that the science shop offers the students some relevant qualifications in the course the science shop teaches on ‘science and community’ and on ‘community-based research’. The co-ordinator believes that one reason why the science shop has been asked by the board of their Faculty to become a partner in the discussion of the development of these profiles is that it has a certain expertise in this field (interview with Caspar de Bok, 08 Dec 2000).
4 Impact on research

This chapter presents the different types of impact on research science shops (and similar types of community-based research) might have.

The impact on research is not understood as the single project carried out by graduates or researchers within a topic raised by a citizen group, but as more permanent changes in research agenda or research methodology that are based on or inspired by the work with the requests coming to the science shop and the projects carried out. It is only a few science shops answering the SCIPAS questionnaire that report changes in research. 20% of the science shops report changes in research methods, while 60% report no changes and 20% do not answer the question. In relation to changes in research agenda around 20-25% of the science shops answer each of the following options: ‘a little’, ‘hardly at all’ and ‘not at all’. Another 20-25% gives no answer. Only one out of around 45 science shops report that the research agenda has changed a lot. There can of course be different interpretations of what a little influence is and what a lot of influence is. But putting these two categories together, it is only around 30% of the science shops that report that the research agenda has changed due to the science shop. One science shop mentions explicitly that the science shop always has worked rather separately from the rest of the university. Another science shop reports that the research agenda at the university has changed a lot towards more community orientation, but that the science shop has had only a small degree of influence on this change.

The following mechanisms leading to impact on research have been identified in the case studies:

- A science shop acts as an incubator for a new research area and the science shop staff carries out research;
- University funding for science shop based research;
- Researchers integrate science shop themes in their research;
- Science shop staff introduces participatory research methods to scientific staff;
- A science shop is developed into a research centre for participatory research.

4.1 Science shop as incubator for new research area

If a science shop has scientific staff as described in the previous paragraph it gives possibilities to develop new areas, although there might not be interest among the scientists at the departments. In chapter 3, it was described how physics science shops don’t get questions from citizen groups within areas that are researched in the faculties (interview with Patricia Huisman-Kleinherenbrink, 08 Dec 2000). This paragraph gives two examples of science shops as incubators for new areas.

At the CURL, a grant from the U.S. Department of Education has allowed CURL to establish a participatory evaluation research collaborative in response to needs identified by CURL’s community-based partners. Central among community interests has been routine involvement of community residents in research. In this initiative the participatory approach is needed to document successful models of community programmes that can be strengthened and shared with regional or national other groups. Another example is CURL’s team-based model of participatory evaluation research that has been used for around 5 years. Faculty, graduate students, undergraduates, community fellows and community organisation staff are
involved in shaping and completing all stages of research from conceptualisation of the issues to be studied to the writing of the final report. The model was developed as an alternative to the traditional evaluation research model, where the people, whose daily life or programmes are being evaluated, do not play an active role in the research process. They only give information by filling out questionnaires or giving interviews (Report on Accomplishment and New Initiatives, 1999, p.14).

The role as incubator for activities on organic food production carried out by the Interdisciplinary Centre at the Technical University of Denmark was introduced in paragraph 3.5 on the renewing activities at the universities. The focus now is to show that building such a new area as an area for research and education might take 5-10 years. It is not a process that can be planned in detail from the beginning, because the development is an interaction between the societal discourse on the subject, the activities the changes in discourse allow the science shop to do, and the development in the established researchers' interest. The established researchers are those being challenged by the new research area or the modifications of their existing area. Table 1 illustrates this interaction.
<table>
<thead>
<tr>
<th>Period</th>
<th>Development in societal discourse related to organic food production</th>
<th>The activities undertaken by the science shop and the affiliated community research centre</th>
<th>The interests of the 'established' researchers at the university</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985 - 1990</td>
<td>Organic agriculture starts growing on the initiative of city people moving into the countryside. Focus more on agriculture than on food processing.</td>
<td>The science shop receives questions from organic agriculture organisation. Projects done as student projects. Research centre decides to make organic food production an area that should be embedded at the university. Apply for funding for research project on organic food production and invites food researchers and community organisations.</td>
<td>Food researchers and environmental researchers as supervisors on science shop projects done by students. Food researchers do not want to participate in research project on organic food processing since they were not lacking resources, due to many resources from biotechnology research.</td>
</tr>
<tr>
<td>1990 - 1998</td>
<td>Organic agriculture grows faster due to problems with pesticides in ground water. Conventional farmers start to convert to organic agriculture in bigger numbers. Some regions see organic agriculture as a business strategy and others as an environmental strategy. Retail chains start using organic food as competition parameter to attract consumers.</td>
<td>Research capacity on food processing has to be found outside the university due to the lack of interest from the food researchers at the university. Regional strategies for organic food production and organic food in public catering as new research topics in research centre. Receives university money to plan course on organic food production. The teaching at the course financed by overhead in the research centre from other projects. Research group as supervisors on science shop projects on organic food production.</td>
<td>Food researchers invite science shop researcher to give lectures at food technology course.</td>
</tr>
<tr>
<td>1998 -</td>
<td>The number of processed organic food products increase.</td>
<td>Has to cancel course on organic food production due to lack of resources. Apply for funding from the national food research programme. Invites food researchers to co-operate. Suggests consumer organisation to plan research project on consumer policy.</td>
<td>Food researchers agree to co-operate with organic food research group on project on care in food processing. Interest due to growing societal importance of organic agriculture.</td>
</tr>
</tbody>
</table>

Table 1: The embedding of organic food production at Technical University of Denmark as interaction between the societal discourse, the activities in the science shop and the affiliated research centre and the interest of the food researchers.
4.2 Funding for science shop based research

One way of impacting on the research agenda is access to funding for science shop based research. It has not been possible within the project to investigate systematically the impact on the research agenda based on this funding. However, some data have been available about the impact of research at University of Amsterdam in the 1980’s. Some of the first experience getting more permanent influence on the research agenda via science shops was done at University of Amsterdam in the 1980’s. It was the experience of the science shops at the university that only through long-term research programmes was it possible to get influence. The science shops convinced the council of the university about this research strategy and an agreement about a research fund was made between the university and the biggest national confederation of trade unions. The fund was around 15 person-years of research. The conditions to get money from the fund was that community organisations should participate in the planning of the project, that it was not possible to get other kind of funding and that the project should be interdisciplinary. Several projects were done with this funding, for example a project about the pollution of a big river and about the use of medicine at shift-work. It was, however, the experience that these projects only had limited long-term influence on the research agenda at the participating departments. It was the feeling from the science shops that the departments saw this money as a possibility to get projects funded that the department did not prioritise that highly itself. The balancing of different political interests seemed also to be a potential problem. In one case was the publishing of the results delayed, because the researcher became a member of a governmental working group within the same topic (river pollution). This implied that the environmental organisation that had participated in the planning of the project had to delay their plans for activities based on the project (Jørgensen, 1995, p. 69). Based on the experience with this fund, the university developed another strategy for community influence on the research agenda. The idea was to make ‘programme studies’, where science shops, researchers and community organisations together could plan more long-term research programmes. A programme study would typically include:

• An overview of the requests to the science shops within the area and of the experience from the projects;
• An overview of research and education within the area;
• An assessment of the future development within the area;
• Development of a plan for future research, including plans for the financing and the organisation of the research.

At the University of Amsterdam, program studies were made in co-operation with the trade union movement and with the environmental movement. Together with trade unions a programme was designed on occupational health and safety, financed by the university and some ministries. The programme included:

• A research programme;
• Advising of community organisations in part of the researchers working time;
• Postgraduate education on occupational health and safety;
• Training of trade union members in occupational health and safety.

One result of the programme was the formation of an interdisciplinary research group at the university on occupational health and safety. The science shops were aware that it could be difficult for local community groups to set aside resources to participate in such programmes, which implied that it would mostly be national organisations that took part in the programmes. The science shops were therefore aware that these studies should not take too many of the science shop resources, because it might take too many resources away from the daily work with short-term advising. (Jørgensen, 1995, p. 70)
The experience from three science shops in Leiden, Delft and Rotterdam from a programme study on soil pollution, which should formulate some of the topics to a national research programme on soil pollution, is that the environmental organisations lack experience with discussions of more long-term research needs. They are more focused on here-and-now knowledge production. On the other hand, it was the experience from the programme study that the organisations developed expertise in discussing research needs through the participation in the programme. One of the science shops summarised their experience with programme studies as:

- It is important early in the programme study to start co-operating with the departments where the science shops hope to start research;
- The topic should not be too broadly defined;
- The work is complicated if too many departments are involved;
- The interest of the departments of participating is greater if the programme study has links to earlier research;
- It is a challenge to balance the wishes of the community organisations and the involved researchers;
- It is often possible to get programme studies financed by the university and/or the relevant ministries with 3-6 month of research. This is often not enough, which means that the programme study often takes time from the day-to-day work in the science shop (Jørgensen, 1995, p. 71).

This last experience about the difficulties balancing the day-to-day activities and the more long-term research and educational activities is also the experience from the science shop at the Technical University of Denmark.

Also today, some Dutch science shops have the possibility to get research financing based on topics raised through the science shop. One of the schemes that seems to have existed for quite a long time is at Tilburg University. In May 1984 it was decided that the university would make funds available for the Science Shop of Tilburg University, which would enable the Science Shop to finance long-term research projects. These projects should make scientific research at Tilburg University more committed to the needs of society. In the first years after 1984 the Science Shop allotted most money to projects which had a duration of one or two years. Since the end of the Eighties, most of the money has been spent on the co-investment in Ph.D. projects. Also some money goes to 6-month preliminary investigations that should lead to proposals for Ph.D. projects. Nowadays all our Ph.D. projects are co-financed on a matched funding basis. Other partners in these projects are mainly the departments of Tilburg University, but other institutes, municipalities and other parties outside of the university also take part.

The university makes available 135,000 Euro for these projects on a yearly basis. Some of the projects also make use of external funds. At this moment 8 Ph.D. projects and 1 preliminary investigation are running. Themes that are covered include: multiculturalism, the role of environmental groups in environmental law, intercultural management and the sustainable use of water.

Proposals for these projects are, on the one hand, made by the Science Shop to departments, or on the other hand by members of departments of our university to the Science Shop. These proposals should be approved of by the board of the Science Shop and by the board of the department involved in the project. All proposals should be both relevant to society and should be of a high scientific level. All projects show that it is indeed possible to make these conditions meet.

Each Ph.D. project that is co-funded by the Science Shop has its own steering committee, which consists of members from societal organisations, such as environmental groups, civil
servants of municipalities or departments, representatives of minority groups, etc. In this way Ph.D. researchers get their input from society on the one hand and the members of these committees get the latest results from scientific research on the other hand. These interactions turn out to be extremely useful and are highly valued by both parties. There is also some interaction between some of these Ph.D. projects and the research questions from groups and organisations in society that are mediated by the Science Shop and that are researched by Master students of our university. This kind of cross-fertilisation is beneficial to both our Ph.D. projects and to the research questions from groups and organisations in society (Tim van der Avoird, 28 March 2001).

At the University of Groningen the science shops have received about three Ph.D.-grants during the last 10 years or so. The university has a central fund for some Ph.D. grants. When the science shop gets a grant they are invited to describe a project, which then is affiliated with one of the departments at the university.

At University of Utrecht risk communication is a topic, where the Science Shop for Biology is discussing the planning of a Ph.D. project together with some of the departments. The science shop has many questions about the health effect from certain types of pollution and has realised that a major problem is the communication about effects.

At the University of Utrecht, the board of the university has asked the science shops to do a project for small and medium sized enterprises, because they think the science shops might be a bridge between the university and these enterprises and their organisations. This can add a further dimension to the work of the science shops or it can change the position of the science shops. The idea is that the enterprises are going to pay for the services they get. The science shops are aware that they must not depend on this funding, because it might lead the university to reduce the basic funding to the science shops.

4.3 Developing new research topics from existing department

Researchers at the scientific departments can also be actors – without funding – embedding science shop topics in research. An investigation from the mid 1980’s of the spin-off from 10 years of science shop projects in the Amsterdam science shops analysed the impact from science shop projects on the research agenda and showed that this impact was bigger than from ‘traditional’ research activities (Zaal and Leydesdorff, 1987). The investigation analysed the impact from 162 science shop projects that had been done by researchers. 22 cases had led to 33 scientific publications or congress papers and 21 cases had resulted in follow-up investigations independent of the original questions. The reasons for the researchers to go into the science shop projects in the first place was in most cases either for social (71 cases out of 162) or scientific reasons (30 cases out of 162). For those not pursuing follow-up activities the reasons found were:

- the problem does not match with the focus of the researcher;
- the problem was too narrow;
- the problem was too familiar (and therefore did not give new scientific challenges);
- lack of time for doing follow-up activities;
- the problem is more of an applied research question (that is, not a more basic research question).

Among researchers taking up projects for scientific reasons, the motivation was in some cases the possibility to get access to data that normally would not be accessible, like studying personal dossiers or doing participant observation.
In a few cases (10 out of 162) the researchers had reformulated the question as part of taking up the science shop project. These cases showed the highest relative number of publications and follow-up investigations.

The development of research on so-called green water management (local waste-water treatment and on (re-)use of rain water) at the Technical University of Denmark is a recent example showing how a researcher (and teacher) within an established field of research and teaching at a university develops a new field of research and teaching in co-operation with a science shop, but is carried by a combination of scientific and social interest of the researcher. (The development of teaching within this area was described in paragraph 3.5.1).

In relation to the field of rainwater, the involved professor has participated in building up a coherent network by combining different relevant groups or social units that operated within the field. He believes that building up a very large contact network is important in the beginning of establishing a new research field.

The means of building a network has been the arrangement of a number of seminars held by the science shop and two departments (on environmental technology and on urban planning) in co-operation. As a part of an attempt of establishing a new research field, the seminars were intended as the creation of a forum, where desultory/sporadic experiences held by different social groups could be brought together already knowing something about the alternative technology. The professor’s contribution to the seminars includes, among other things, pointing out what he finds to be critical areas and formulate topics that need further research. This was done in student projects supervised by the professor or some of his colleagues. Later on the students presented their results from projects relevant for the issue of a certain seminar.

By being critical and formulating questions that are based on academic thinking instead of practical problem solving, the professor not only contributes to a reformulation of what problems are related to rainwater technology and how these problems should be solved, he also participates and contributes to a process where this field becomes a part of research undertaken by the institute.

Today the network consists of users, authorities, companies, and researchers who are somehow related to these technologies.

The building of a network and the activities related to this is an example of how a field can develop from within an institute at a university. As such the interests in rainwater technology are going from firstly being held by actors outside the university (the citizen groups) to another actor inside the university (the science shop) to a third actor, which also acts within the university community (two departments). The issue is being ‘carried’ by different social actors into different communities of practice. In this way, the network both works towards the world and internally at the university.

Dealing with alternative technology, the professor’s own field of research has been widespread and holistic not only in the research themes, but also in the approach applied in the research. Whereas he used to deal with treatment of wastewater, he now works only with waste from households in general. Including more mass streams in his research, he applies a more overall view on household waste (interview with Mogens Henze, 25 Oct 2000). The co-operation with the group on urban ecology at another department has also strengthened their co-operation.

One incentive for researching in alternative technologies is that the professor finds the ‘mainstream’ research too uninteresting to deal with alone. Besides this, it is also possible for
him to apply his knowledge and experiences from one of the fields to the other. Seen in this light, his engagement in science shop projects is also closely related to the fact that his interest for environmental issues has been congruent with themes of the projects offered by the science shop.

Being able to make enough publications on the base of his mainstream research and models developed here, the professor is not obliged to publicise articles within this new research area. He has, however, experienced several problems with academic profiling within the alternative fields. There is no tradition of scientific documentation and publicising within the fields of rainwater and green wastewater treatment and periodicals are lacking within the alternative field. Among traditional periodicals the attitude is that the (alternative) research is not well enough documented and that there is great insecurity about the reliability of the results, and finally that an increasing number of articles for publishing makes the competition harder. This means that not only have the conditions of publishing changed in general and it has become harder to get a chance, the researchers who research in alternative fields also face a number of additional barriers in their efforts to publicise (interview with Mogens Henze, 25 Oct 2000). Table 2 shows the interaction between the societal discourse, the science shop activities and the role of the university teachers and researchers:

<table>
<thead>
<tr>
<th>Period</th>
<th>Development in societal discourse related to green water management</th>
<th>The activities undertaken by the science shop and the affiliated community research centre</th>
<th>The interests of the ‘established’ researchers at the university</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985 – 1990</td>
<td>- Focus on low-tech wastewater treatment.</td>
<td>- The science shop receives questions. Projects done as student projects.</td>
<td>- Teacher finds science shop projects time saving and interesting.</td>
</tr>
<tr>
<td></td>
<td>- Focus on reuse of rainwater.</td>
<td></td>
<td>- Topics are not included in existing courses.</td>
</tr>
<tr>
<td>1990 –</td>
<td>- Strengthened interest for local wastewater management.</td>
<td>- Science shop decides to try to embed activities on ‘green water management’.</td>
<td>- Teacher proposes new project themes – from a more critical angle.</td>
</tr>
<tr>
<td></td>
<td>- Debate on the reuse of rainwater.</td>
<td>- Proposes two departments to organise seminars together with science shop.</td>
<td>- Departments get research projects.</td>
</tr>
<tr>
<td></td>
<td>- Stakeholders participate in seminars.</td>
<td></td>
<td>- Teacher starts integrating topics in existing courses due to the growing relevance for engineers.</td>
</tr>
<tr>
<td></td>
<td>- EPA starts projects on reuse of rainwater and local wastewater management.</td>
<td></td>
<td>- Researchers have problems publishing in scientific journals.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Also used to publish in non-scientific journals.</td>
</tr>
</tbody>
</table>

Table 2: The embedding of ‘green water management’ at Technical University of Denmark as interaction between the societal discourse, the activities in the science shop and the affiliated research centre and the interest of the researcher.

In some cases, it is the interest of the students that builds upon the experience from a science shop project, through further courses and thesis work within the field and maybe a Ph.D. grant. The case studies have shown cases within life cycle assessments and within hemp as an environmental friendly material. It has, however, not been possible in the SCIPAS project to do in-depth studies on these examples and see how the focus in the further studies and research has developed. In the case of hemp at the Technical University of Denmark the students have had close contact and co-operation with the ‘green’ entrepreneurs within the area, although the fair trade organisation that formulated the first
project the students worked on is no longer interested in hemp as a possible environmental friendly material for textiles.

In North America the criteria for getting a tenure position seem to be a barrier for some researchers’ interest in community research. A community researcher has now been encouraged to apply for a tenure position. This might pave the way so more researchers become interested in community research and do not skip the area because they fear they put their scientific career at a halt.

4.4 Introduction participatory research methods

At the University Centre for Pharmacy, the co-ordinator in the Science Shop for Medicines some years ago introduced focus group interviews as a way of involving patients in research projects to her colleagues at the department, where the science shop is affiliated. The co-ordinator did this due to her own experience with this method. It is her experience today that the scientific staff is now so confident with the method that they propose themselves to use the method when the department considers new research projects. (interview with Evelyn Schaafsma, 30 Nov 2000). The enabling factor for this impact is the close relation between the science shop and the department (as described in chapter 3 about impact on curricula), due to the fact that the present head of the department is former science shop co-ordinator and the present science shop co-ordinator also teaches at the department.

4.5 From science shop to centre for participatory research

Two case studies cover the creation of a centre for education and research within which the co-operation with citizen groups – but also the development of initiatives within curricula and research – take place. The two cases are the Center for Urban Research and Learning (CURL) (and the affiliated PRAG network) at Loyola University and the former interdisciplinary centre at Technical University of Denmark. The advantage seems to be the possibility of using resources as well as research and teaching, as networking initiatives within the university and with citizen groups and other important stakeholders.

These two aspects were also mentioned in paragraph 3.5 in the discussion of the renewing activities at the Technical University of Denmark. The centre was formed as a so-called ‘common unit’ among five departments at the university. The experience from the centre is also that the challenge precise is the balancing of these two types of activities: ‘own’ activities and networking activities. An example of a research network activity combined with concrete research was a three years research programme on urban ecology and cleaner technology at the university from 1991-94. The Interdisciplinary Centre was encouraged to organise and co-ordinate this programme, because university politicians found the community relations and the research capacity of the centre as two important prerequisites to the research programme within urban ecology and cleaner technology at the university. Altogether, 16 departments and research units took part in the programme, which was applied for as a so-called high-priority area at the university. The group got money from the university for half a year of visiting professorship, three Ph.D. grants, two senior researcher grants and seed money for preparation of research projects.

Networking activities can also be seen from the activities that PRAG as network and CURL as centre are doing besides the work with support for collaborative research through interns, research assistants and community apprentices and fellows:

- PRAG working groups in order to support more focused research and action activity in subject and geographic areas that have emerged in the projects already supported. Each
working group has two co-chairs, who represent either the research or action sides of policy issues;

- Community access to routine research tools. Through some of its participating universities, PRAG has been providing computer accounts and library privileges to community partners in collaborative research;
- Policy breakfasts with local government officials. Through a formal agreement with the mayor's office, PRAG is sponsoring policy breakfasts that brief city commissioners, city staff, and city council members on completed research projects (Nyden et al, 1997, pp.25-26).

CURL has built on its collaborative policy and educational work by seeking to establish a local-to-local, community-based policy research network that provides an alternative to the dominant top-down policy development process. The intention is to create links between university-community collaborative projects in multiple cities as the foundation for developing national policy alternatives that are anchored in the day-to-day realities of urban communities (Report on Accomplishment and New Initiatives, 1999, p.14).

The Chemistry Science Shop at University of Amsterdam is an example of a science shop that has developed into an independent research centre. This development has been based on their work with projects particularly on the substitution of chemicals and processes (giving risks in relation to occupational health and safety and/or external environment) and the ability to get external funding for these activities.
5 Conclusion and recommendations

This study has shown that science shops, besides ‘helping’ citizen groups by carrying out a project based on their knowledge need, also can ‘give’ the host university a lot. Students can get other types of qualifications. The science shop projects can inspire to new ways of project based and problem oriented studying and to new course topics. Researchers might get inspiration to new research topics and might involve citizen in their research. It seems, however that many science shops do not have a strategy for how to get impact on curricula and research at the host universities. The focus is mostly at the co-operation with the citizen group on the single project.

The analyses have discussed the direct impact on the curricula when students do science shop projects as part of their education, which is possible in around 70% of the science shops answering the SCIPAS questionnaire. The indirect and more long-term impact on curricula and research seems more difficult to obtain. Only around 30% of the science shops report that science shop research has been included in course and modules. Less than 30% of the science shops report to have had impact on the research methods and the research agenda at the university.

A number of enabling factors and conditions for obtaining long-term impact on curricula and research have been identified through the case studies:

- Science shops can influence strategic university decisions, either through participation in the decisions or through alliances with scientific staff or university management with influence on strategic decisions;
- Personal resources for networking and own initiatives at the university and towards citizen groups. This can be in terms of science shop staff with scientific qualifications, grants for scientific staff, Ph.D. grants etc.;
- Science shop staff also working as teachers and/or researchers gives the opportunity to develop own courses and research activities;
- Visibility of the achievements and the competence of the science shop make the university administration and the scientific staff aware of the potential in involving the science shop;
- Scientific staff gets involved in science shop activities due to social and or scientific interests;
- Tenure criteria not acknowledging community research can be a barrier to scientists’ involvement in community research;
- Changes in the societal discourse about the competence needs of academic candidates towards more practice or user oriented competence discourse and about the relations between university and society towards more interactive relations are a potential for the science shop. These changes can give science shops possibilities of getting involved in the dissemination of the competencies that can be obtained through science shop projects to more students and disseminating participatory research methods to the scientific staff.

It is not possible to point to a blueprint strategy on how to obtain the most impact on curricula and research. It is more a question about utilising those occasions that show up and which can be used for strengthening the role of the science shop and the role of practice orientation and participatory methods and thereby making the science shop valuable and indispensable to the university. When a science shop gets involved in activities aimed at developing education and research it is a challenge to balance between the day-to-day activities and the long-term impact. It can also become a challenge to maintain the identity and the role of the
science shop, when the interactive approach is expanded to include more than citizen groups, like small and medium sized enterprises. That is, the impact should be seen as a local or situated interaction between the science shop, the university as institution, the teachers and researchers and the development in the societal discourses.

The theoretical approach where the impact at the universities are analysed as processes of social change, where the changes are related to the local history and the development in societal discourses, has proven to be valuable. There is, however, a need to make more analyses. One type of analyses needed is statistical analyses relating the impact on curricula and research to the approach of the science shop, to the resources available etc. Another type of analyses needed is more interviews with researchers that have taken part in changes of curricula and/or research related to topics emerging from science shop projects in order to understand their motivation of taking part in this kind of activities and in order to get more information about how the interaction between science shop, researcher citizen group and societal discourses actual impact the research agenda and by that impact a central part of the knowledge production.
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