Systemic evaluation methodology: the emergence of social learning from environmental ICT prototypes

Journal Item

Systemic Evaluation Methodology

The emergence of social learning from environmental ICT prototypes

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Abstract

This paper investigates why and how systems approaches can help in evaluating the design of new Information and Communication Technologies (ICTs) as social learning platforms. It focuses on the prototypes created by the research project Virtualis[2], whose objective is to promote social learning on environmental concepts and practices amongst a variety of stakeholders.
The paper presents the principles of systems thinking and practice that did help in formulating such evaluation processes. It illustrates both how a peer systemic evaluation process within the research team and a participatory evaluation process (involving potential future users of the ICTs) were carried out.

Key words: peer evaluation; participatory technology assessment; systems thinking; ICTs

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[2] The Virtualis project, or 'Social learning on the Environment with interactive Information and Communication Technologies', was funded by the EU and lasted from Sept 2001 to April 2004. For more detail, check http://systems.open.ac.uk/page.cfm?pageid=sustdevptV

1. INTRODUCTION

The formulation of this systemic evaluation methodology took place in the context of the Virtualis research project. This project involved a multidisciplinary team of ICT specialists, 'learning experts' and environmentalists, all interested in exploring how Information and Communication Technologies (ICTs) can help a variety of stakeholders coming from different backgrounds in understanding the natural environment and how human activities can affect it. We constructed various ICT prototypes aimed not only at improving environmental awareness and stakeholders' involvement in environmental decision-making but also at facilitating changes of (environmental) practices in order to promote more sustainable ones. The premise of Virtualis was a special interest in ICTs as 'democratic, non-exclusive learning platforms' - that is, platforms that have the potential to give a voice to groups of people who are normally ignored, either for social or political reasons, or because they are considered as 'non-experts'. We believe that 'environmental knowledge' is multi-faceted and that learning platforms that welcome and merge a diversity of knowledges on environmental issues and sustainable practices are needed.

Here, we describe the learning processes that, we hope, will take place when people use these ICTs as 'Social Learning' platforms: the objective of these ICTs is not only for people to learn individually, but also to use an interactive tool as a way to share their knowledge. This project puts a special emphasis on the communication and exchange that can take place between expert and 'non expert' stakeholders.

The evaluation tool described can help us identify whether the objectives of these ICTs have been met and, consequently, what makes a good interactive ICT, the use from which can generate social transformational learning.

Various types of methodologies can be used when evaluating ICT tools. In this paper, we explain why developing a systemic methodology is of particular relevance when working on ICT prototypes that are focused on social learning processes. We also present the two main dimensions of this methodology (a peer evaluation process taking place within the research team and a participatory evaluation process involving future users) and how it was implemented while the Virtualis water prototypes were being developed by the Cranfield Virtualis team. Interestingly, these evaluation exercises highlighted the fact that social learning was potentially going to take place when the ICTs would be used but also precisely when the ICTs were being constructed, within the very team of virtualis partners.

2. Evaluating Social Learning: why focus on a Systems Approach?

2.1. Social Learning on environmental issues

Learning takes place in different ways for different people living in different contexts; it extends well beyond the boundaries of traditional 'educational structures'.

In the area of environmental decision-making and debates, stakeholders, including policy-makers, have realised that the construction of environmental knowledge cannot be limited to collecting data constructed by 'environmental experts'. Many stakeholders, considered as non-experts, also have a respectable knowledge of environmental practical problems and could suggest a plethora of potential 'best sustainable practices' to each other.

In this paper, we are interested in the broad notion of 'learning' on environmental issues, both in conceptual terms (for instance, we need to understand better the

notions of uncertainties and complexities related to the functioning of the natural environment and the way in which we impact upon it) and in practical terms (for instance, what does respecting sustainable yields means in practical terms). Recently, agencies such as the UN, or the EU, have realised that they would benefit from the participation of stakeholders in environmental policy-processes. The consequent popularity of the notion of stakeholders' participation has been taking place, in parallel to a growing scepticism regarding scientific expertise. This, remarkably, opened the door of environmental debates and decision-making to more of the 'non-experts, more practical, stakeholders'.

This resulted in not only revolutionising the way in which we think about the natural environment but also the way(s) in which we learn about it. 'Environmental learning' extended in terms of its content, its learners, its teachers, and its outcomes. Understandably, it has thus become one area of focus for what is now described as 'social learning'.

In this paper, we argue that evaluating whether social learning is taking place in the context of environmental issues, and when using ICTs such as the ones developed in the virtualis project, can be greatly helped by using systems thinking.

2.2. A systems approach to social learning

Systems thinking considers the various agents interacting in the world as 'systems'. It provides a multi-dimensional framework in which information from different disciplines and domains can be integrated without being forced into one-dimensional mapping. As Flood explains, "Systemic thinking explores things as wholes and is highly relevant because the world exhibits qualities of wholeness. Life events appear to be distinct in space and time, but they are all interconnected. They can be made sense of in a meaningful way only in the knowledge that our actions contribute to patterns of interrelated actions" (Flood, 1999:13). In what follows, we use the main systems concepts defined in Box 1 to explain our perspectives on social learning and environmental issues.

Box 1. A few key systems terms

System: A part of reality conceived as a coherent whole of interacting entities. An open system is connected to, and interacts with, its environment. A closed system does not take in from, or give out to, its environment. In practice, close systems do not exist. The world can be thought of as a large and complex system, which contains sub-systems such as ecological, economic and human social systems.
Emergence: Systems have properties that the systems components do not have.
An emergent property of a system is that which is not readily explainable with reference to sub-components.
Hierarchical control: Hierarchies are levels of relative complexity within a system, and hierarchical control refers to the imposition of new functional relationships by each level on the detailed dynamics of the level below. Controls can be positive (where certain actions are promoted) or negative (where certain actions are constrained).
Boundary: The real or abstract delineation between a system and its environment.
Feedback loop: An iterating chain of causal connections. With negative feedback loops, change is effected in a direction that makes further changes less likely. With positive feedback loops, change is effected in a direction that makes further changes more likely.
Complex systems: Complex systems generate outcomes that depend on numerous interactions. For instance, global socio-economic and environmental systems are complex systems.
Complex adaptive systems: They interact with their environment and change in response to environmental change.

Sources: Clayton and Radcliffe (1997) and Hoekstra (1998)

Numerous authors have been working on the analysis and the operationalisation of sustainability in systemic terms (Clayton and Radcliffe (1997), Marten (2001), Stowell (1998), Hoekstra (1998)). In this paper, we present the concept of sustainability from a 'human ecology' or 'ecological economics' (Martinez-Alier, 2002) angle: ecological and human systems are inter-connected. To understand sustainability therefore requires some understanding of the behaviour of human and ecological systems and how they dynamically inter-relate.

We understand the set of activities of the virtualis project as a complex system dominated by one main objective: social learning - focused both on the improvement of stakeholders' environmental awareness and societal practical changes in natural resources management. The main boundary of our system reflects this particular focus on social learning. The representation of social learning as a system reflects its dynamic complex and adaptive characteristics.

Social Learning, within Virtualis, is both a set of processes, a means and an end. The premise of our project is that Social Learning processes can improve stakeholders' awareness and participation in environmental deliberation and decision-making and therefore contribute to practical change in environmental management as well as institutional change. In other words, social learning can not only contribute to the operationalisation of sustainability; it also encourages more social learning - hence fuelling a positive feedback loop centred on governance, participatory processes and collaborative learning. The main tool used for this social learning process to take place is the suite of virtualis prototypes.

The emergent properties of the system as a whole can only be identified in the long run - when the effectiveness of the prototypes will be testable once they have been implemented by a wider audience than our evaluation samples. Nevertheless, some emergent properties relating to sub-systems can already be analysed and contribute to the tuning of the prototypes. The delineation of the sub-systems represented in Figure 1 resulted from the ways in which we identified areas and criteria of evaluation of the virtualis prototypes, in lines with the original objectives of our project.

This systems diagram presents 6 main systems of interest focused on the prototypes:

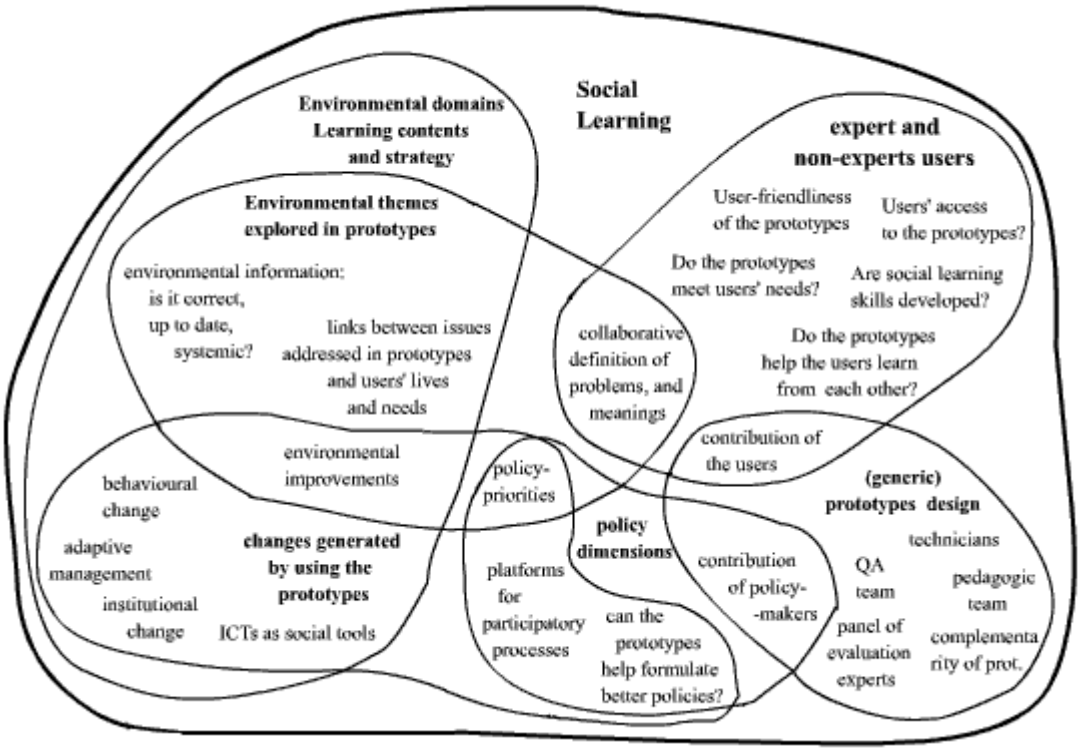
- their users, be they experts and non-experts;
- their design;
- their policy dimensions;
- the changes that their use will, we hope, generate;
- the environmental domains they cover and
- the learning content and strategy they encompass.

The bigger, overall, system, 'social learning', illustrates the fact that the learning that is taking place when the prototypes are being used goes beyond the mere use of the tool: it extends to the way in which the learning effects changes in society, in policy design, in participatory processes, or in the improvement of the prototypes throughout time.

One can identify the interactions taking place between the components of each of these systems. For instance, within the system 'Environmental themes covered by the prototypes', it is interesting to examine the links between the information provided within the prototypes, the way in which stakeholders collaboratively define an environmental problem or issue, and the process through which a stakeholder becomes sensitive to an issue, whether this issue is directly related to his/her daily life or not.

Looking at these three components can help us understand a great deal about the meaning of environmental information and the perception of 'environmental problems' in a context of social learning. These three components are also related to the other components of this system - for instance, the various ways of improving stakeholders' motivation to learn and construct meanings about the environment can be strongly motivated by the wish or need to improve the quality of the environment, or by new policy measures.

Figure 1: Activities, application domains and areas of interest in the Virtualis project.



2.3. The systemic evaluation of social learning processes taking place in ICT platforms

Information and Communication Technologies can be evaluated in various ways: some evaluation methods do, for instance, focus on Quality Assessment, or on the ways in which information is being presented or stored (OECD, 2000). In this paper we evaluate the ICT prototypes created by the virtualis project in terms of the learning processes and outcomes they generate, based on the assumption that these outcomes are to be systemic in nature. The Virtualis ICTs will be used by various types of stakeholders to investigate their impacts on the environment as well as various options for environmental practices. This will be done through the use of an interactive ICT platform which will serve as a 'learning facilitator'.

The four types of prototypes[3] that have been developed are:

- the personal barometers - they allow users to identify their personal environmental impacts

[3] For more information on these prototypes, visit http://neptune.c3ed.uvsq.fr/virtualist/project_description.php

- the scenario generators - these explore how various individual impacts are aggregated at the level of a region, for instance
- the multi-player games - they explore deliberative processes and how both knowledge and different perspectives can be shared
- the virtual reality supports - they help the user explore a situation as a whole.

In the context of this evaluation, we are particularly interested in the area of 'team learning' as explored by systems thinkers. The aim of team learning is to achieve alignment in people's thoughts and energies: even if people do not agree on everything, they can collaboratively construct a more common balanced understanding of a situation. Through communication, and the focus on a common direction (in our case the pursuit of sustainable practices and lifestyles), the learning process can create resonance so that the whole team achieves an understanding of an issue that is more than the sum of the team members' understanding. If the learners have got conflicting objectives and aspirations, however, the qualities valued in the learning process, such as empowerment, may actually increase conflict, yielding a whole team that achieves less than the sum that its members can, if they were to work in isolation.

Team learning in Senge's outlook (Senge, 1990) is best pursued through methods of dialogue. In this way, people make a genuine attempt to appreciate matters of concern through the eyes of people who raise the concerns. People learn from this by expanding their understanding of circumstances that prevail. Systems thinking can help to bring together people's mental models in a shared systemic language, generating team learning and understanding, and a shared sense of purpose.

Within team learning, one type of open learning (the most common) is *participatory*. It can be described as the freedom to speak one's mind and to state one's view and is reflected through interactive processes in ICTs, as well as debates with other stakeholders. It can encourage wide modes of involvement in decision-making. Another generative learning comes from *reflective openness*: this entails challenging one's own thinking. It necessitates surfacing assumptions that shape our views and then subjecting the assumptions to open criticism.

One important challenge of the Virtualis ICTs is to demonstrate that team learning can empower their users, be they environmental experts or not. One way to do so is by generating a common sense of purpose in which they focus energy in a meaningful way. Systems thinking may empower people by enabling them to begin to appreciate rather than be confused by the inter-related nature of the world and how this might cast insights into their experiences. In order to put these principles into practice, systems thinkers have been keen to promote 'interactive planning'. Interactive planning builds on the premise that obstruction to change sits mainly in the minds of participants, rather than separately 'out there' in the problem context. Interactive planning is a form of scenario building methodology that offers in tangible form helpful guidelines about realistic intrinsic desires and shared vision. The Virtualis ICTs have been developed in view of helping stakeholders understand better the impacts they have on the environment and how they could, individually or collectively, change their practices and lifestyles. A change in their way of thinking and behaviour would reflect the outcome of a successful learning process.

We have chosen to develop our systemic evaluation with these principles in mind - the objective being to check whether the ICT platforms developed in the project genuinely allow team learning and interactive planning to take place in an empowering learning environment. In order to do so, we have focused on:

- examining three types of systemic interactions (between learning stakeholders, environmental applications and between learning and change) in a peer evaluation and
- allowing main evaluation concerns to emerge through a participatory evaluation process

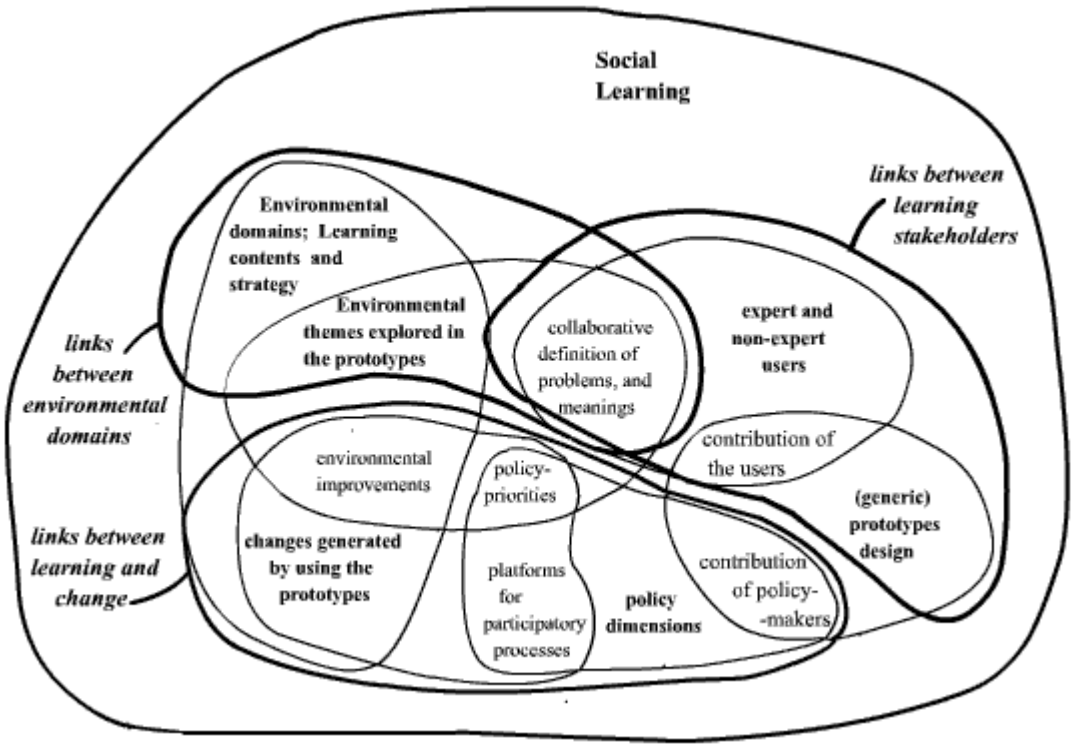
as described in the next two sections.

3. Long-term peer evaluation: focus on three types of interactions

In this section, we describe the evaluation that some of us (the 'learning experts'), within the virtualis team, carried out on the ICTs being developed by our ICT colleagues. We did this over a long period of time which, we initially hoped, would help us adopt a systemic approach by allowing us to take time to appreciate all the components at play and how they were related to each other. The objective was to have a systematic approach and to communicate our feedback to the technicians in view of recommending some refinements in the design of the prototypes.

Figure 2 illustrates the three types of interaction we examined when helping our research partners design the prototypes. We evaluated the storyboards and the draft versions of the prototypes over many months.

Figure 2. Focus on three types of interactions



From a systemic perspective, we wanted to ensure that the prototypes were designed in such a way that they could:

- help users understand the links between various environmental domains and problems

- be used as a platform for deliberative, interactive, reflective learning amongst learners
- facilitate the users' transformational learning experience.

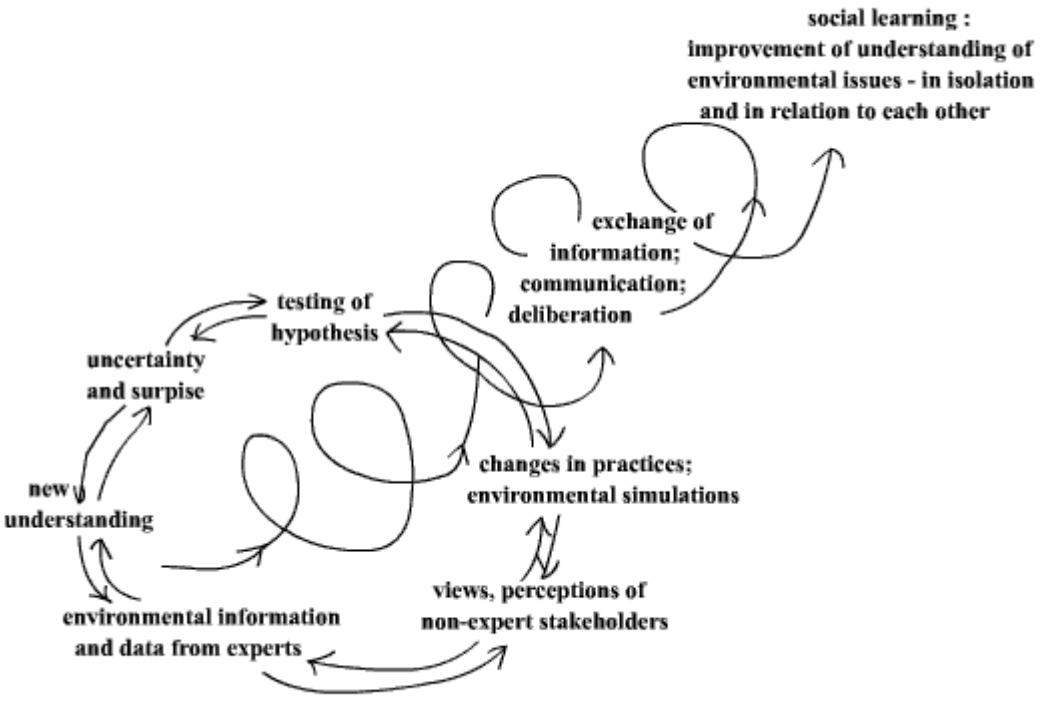
We developed an evaluation questionnaire that we and other members of the team could use, while the prototypes were being designed and from which a series of recommendations for improvement could be made. The parts of this questionnaire that are relevant to each of these types of links are presented in the next paragraphs. We used these questions to evaluate the prototypes focused on the water and agriculture themes. The recommendations were exchanged within the virtualis team via e-mails.

3.1. The links between environmental domains:

The social learning processes that relate to these links could be described as an iterative learning process (Figure 3). The prototypes are intended to provide information but also invite people to deliberate in order to collaboratively construct meanings and exchange knowledge on environmental issues. They provide simulation tools that can help people understand the impacts of their individual or collective actions (environmental practices), hence affecting the way in which they initially perceived the environmental issue. Uncertainty and surprise also entered the 'equation' and contributed to the practical testing of the original understanding.

The social learning processes based on the environmental domains explored in the prototypes is therefore made of a 'mixture' of practical experience, perceptions and understanding of an environmental issue, provision of 'scientific information', and uncertainty and surprise. By 'mixture', what I really mean is that these components are linked to each other through the deliberation processes facilitated by the prototypes.

Figure 3: Social learning on the environmental domains



The evaluation questions related to the links between environmental domains, as well as their relevance from a systemic perspective, are presented in Table 1.

Table 1: Evaluation questions focused on the links between environmental domains

Issues covered - is the information provided correct, up to date, systemic?	Here the evaluator identifies whether the prototype offers a reductionist view of environmental domains or whether it allows the users to appreciate the broader, systemic meaning of the issues presented in the prototype.
Are the issues relevant to the users?	The links this evaluation question is intended to highlight are the links between the representation of reality in the ICT and the real life experience of the user - how is the prototype highlighting such a link?
Are the environmental issues covered contextualised?	'Contextualising' is a crucial component of systemic approaches. In order to appreciate the systemicity of an issue, one can be helped by exploring the boundaries that delineate the issue from its 'external environment'
Concepts used - how do they affect the users' perceptions of the issue at stake?	This evaluation question relates to the choice of concepts used to animate the curiosity and interest of the users on the subject. The question is: how do these concepts bridge the reality of the issues and the perceptions of these issues by the users?
Are meanings clearly explained?	This evaluation question is intended to assess whether the understanding of what defines the issues and domains explored is both clear and shared. The prototypes should help the users to share their understandings of an issue
Is the information on the environmental theme precise and up to date?	The prototypes are intended to address current 'priority issues'. We also need to ensure that the ways in which people's perceptions, understanding and sensitivity to certain issues evolve with time are taken into consideration.
Are users likely to be motivated to re-use the prototypes?	This evolution of understanding and ways of addressing an issue can, in part, emerge from using the prototype and through embracing an iterative mode of learning. The question is whether the prototype can be used as an inviting means for people to make sense of various environmental issues and to improve their understanding of them - which might ideally include them being able to appreciate the systemicity of environmental issues.
Are notions such as complexity and uncertainty related to the environmental themes addressed in the prototypes?	The environmental domain must be presented in a way that is not simplistic nor reductionist. The prototypes must help in addressing the complex characteristics of the issue discussed as well as the uncertainties attached to it. The social learning process is intended to acknowledge and face both complexity and uncertainty as important characteristics of environmental issues to be taken into consideration both in 'environmental information' and in environmental decision-making processes.
Is the presentation of the issues clear? Does it affect the users' perceptions of the issues?	The use of ICTs allows one to represent issues in alternative, creative ways - we therefore believe in the importance of making the best out of these ICTs capabilities in view of both animating the users' curiosity and opening up their perspectives on the issue.
Is the learning structure presented in the prototype clear and understandable?	The learning path designed through the prototypes must help the user in developing a systemic cognitive representation of the environmental issue.
Does the prototype provide hyperlinks to useful urls that contain information on these issues?	The advantage of using hyperlinks is that the users can concentrate on one main domain, while appreciating the ways in which they are linked to other domains.
Does the prototype provide hyperlinks to other types of similar ICT tools?	These might represent the 4 domains in different ways and this might help the users understand better the links between different types of environmental domains.

Is more than one environmental domain covered by the prototype?	Although the prototypes focus on one environmental domain and hyperlinks can be used to highlight the links with other issues, the facilitation carried out within the prototype needs to explicitly make it clear that, for instance environmental domains focused on in different prototypes or suites of prototypes (for instance water and agriculture) are very closely interrelated.

These questions could be used and adapted by anybody designing a questionnaire aimed at evaluating, in a systemic way, ICTs focused on environmental issues. More questions could be asked, of course. We found that explaining why asking these questions was relevant (right column of the table) proved to be an important part of the design of the questionnaire as well as of the learning process involved in identifying 'what makes evaluation systemic'.

The outcome of our evaluation of the virtualis water and agricultural prototypes can be presented as a series of recommendations that are valid to anybody trying to develop the same type of ICTs. They relate to the following themes:

- *Systemic visualisation of inter-related environmental issues*

Illustrating the links between environmental domains and issues should be helped by the creative innovative representational systems provided by new ICTs. Virtual reality, for instance, can help the user explore an environmental domain and get an overview of how different issues and aspects of this domains relate to each other.

- *Links between geographical scales*

The progression in learning between the various types of virtualis prototypes (e.g. between the personal barometer, focused on individual environmental impacts, and the scenario generator, focused on aggregated impacts at the society level) allows the users to understand the context of their impacts and which effects they have, once combined with other stakeholders' impacts.

- *Links between the specific issue and the broader context*

The instructions given (text, videos, audio, animations) and the Virtual Reality tool in particular, should clarify the context within which the environmental issue is being explored. We felt that this contextualisation was potentially missing from the prototypes we evaluated and that the integration of some hyperlinks to sites that either help understand the background or context better could be a good starting point to correct this shortcoming.

- Social learning processes should allow users to understand the links between environmental domains *through the perceptions of stakeholders (from the same or from different countries) on these inter-connected issues.* The facilitation questions (or 'learning triggers') used in the prototypes could allow the users to express their views and perspectives.

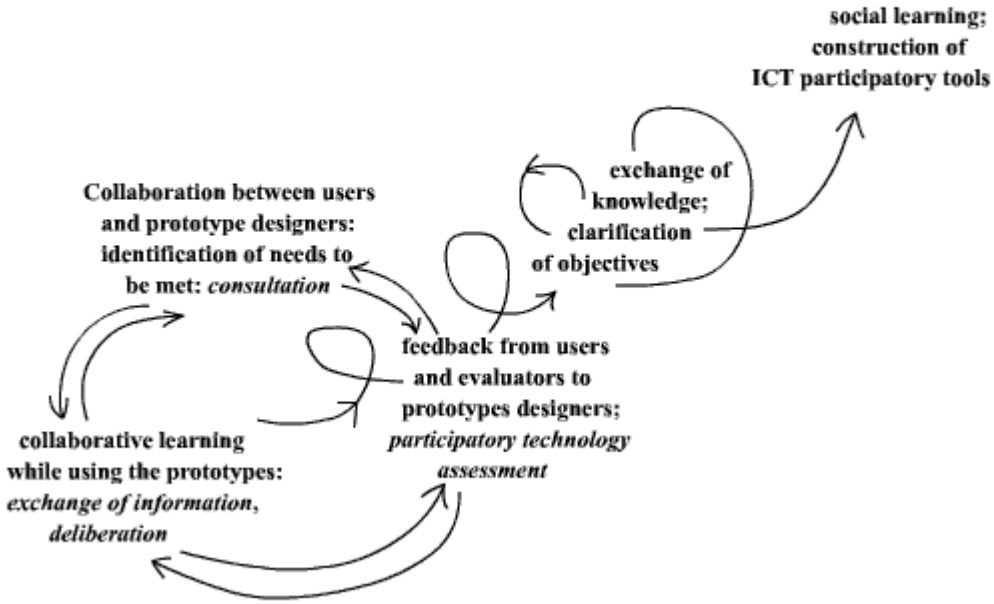
- The *policy relevance of the prototypes* is clearly focused on the sustainable management of resources: the links between environmental issues and domains is therefore also made in the context of 'sustainable policies' and practices. The examples of sustainable practices provided through the prototypes should come from users as well as from the experts who designed the prototypes if a real social learning process and exchange is to take place.

When designing and constructing such prototypes, one difficult question to tackle relates to the stakeholders' perceptions of how environmental issues and domains inter-relate. Here, allowing the participants to share their views is necessary and so is the facilitation of the 'collaborative construction of meanings' and of the process of capturing the outcomes and evolution of the debates. They both require careful moderation.

3.2. The links between learning stakeholders

Our second focus of evaluation was the ways in which the prototypes' users deliberate, are empowered to do so, and how they learn from each other. Here again, the social learning process takes place throughout time and can be described as another spiral within which three main components (consultation, deliberation and participatory technology assessment) interrelate (Figure 4).

Figure 4: Social learning on the construction of participatory ICTs



The questions we focused on, in our evaluation questionnaire, are listed in Table 2.

Table 2: Evaluation questions focused on the links between stakeholders

Relevance of the subjects covered and discussed for a varied audience?	Often, people disagree on environmental issues; have different objectives, interests or constraints. For them to become interested in learning together and from each other, not only the facilitation of these deliberations must be carefully designed but also people must be interested in the subject to start with. The prototype must highlight how relevant the issue is to the users.
Clear instructions concerning the involvement and participation of the users in collaborative learning?	People from different backgrounds, professions, views on an environmental issue, do not communicate as often as would benefit society. Learning from conflicts is something we are not used to value and therefore people are not used to deliberating and learning from each other in a participatory, non exclusive way. The instructions included in the ICTs on how users can deliberate, negotiate, collaborate, must be genuinely facilitating. These instructions can really be the key to successful social learning.
Clear learning structures?	Facilitating social learning processes is one thing, helping the participants in capturing the learning from it is another. Whether they are linear or not, the learning paths designed in the prototypes must help the users in realising than various learning steps have been 'climbed' and that something (learning and potentially practical change) is emerging from this process.

Hyperlinks towards other learning ICT platforms?	Social learning refers to what is being learnt about but also how learning is taking place. In terms of learning, participation and collaboration comes into play not only regarding the exchange of various views on an issue, or the exchange of information and knowledge, but also when people are prepared to learn differently, through different processes. Social learning can therefore also take place when it comes to 'learning to learn'.
Possibility of using the ICT learning tool at a distance?	The type of participation that Virtualis is encouraging could involve people who live far from each other. This is one of the most interesting characteristics of ICTs that such prototypes should make the most of.
Identification of targeted users?	This should help the prototype designers in building some flexibility (in terms of presentation of the material, type of help provided, examples given, type of learning feedback provided, etc.) and in helping participants in communicating better too.
Relevance of the modes of learning for a varied audience of users?	There are different ways of learning about a same issue. To retain the motivation and attention of all types of participants, the modes of learning must be varied enough and appropriate to different types of tastes and needs.
Promotion of autonomous learning?	For social learning to take place, people must trust each other and also their facilitator. The trust must not only focus on what is learnt and how, but also on people's belief that them becoming autonomous learners is one of the main outcomes of this social learning process.
Bias taken into account in collaborative learning?	The existence of bias in the way in which issues and/or perspectives are sometimes presented in society has to be addressed in the context of social learning process, not only in order to install an atmosphere of trust but also to demonstrate a rigorous exploration of knowledge and meanings.
Communication promoted amongst stakeholders?	Communication is a key component of social learning! The prototypes must allow the participants to communicate, deliberate with each other.
Emotional involvement of the users?	The differences in views, attitudes, etc. towards a subject can be expressed through emotions. One must bear in mind the fact that, the more motivated to learn a user is, the more he or she will 'feel' about this issue. Encouraging participation and deliberation implies that the deliberation platform has been designed in such a way that people can express these feelings. Often, it is when feelings can finally 'get out' than people realise the importance of an issue.
Participation of expert as well as non-expert stakeholders?	One of the characteristics of the virtualis prototypes is that they promote social learning as an 'enabling process' through platforms that build bridges between experts and non-experts. Not only participants must be enabled to contact experts, but their communication must be facilitated by the platforms and skilled moderators.
Users enabled to input their knowledge?	The communication and deliberation promoted through the prototypes ought to not only focus on information and issues provided through the prototypes but also on information and knowledge inputted by participants themselves. The prototypes must be used not only as an enabling platform but also as a recipient to new information to be stored and to work on.
Instructions given in different languages?	If collaborative social learning is to be promoted through such platforms, using internet facilities, then participants from different countries should ideally be able to communicate in their own language and have translation of what other participants reply.

Here again, these questions can constitute the basis of other evaluation questionnaires of ICTs focused on social learning and participation. Indeed, debating with other researchers like yourselves, about which other questions might be seen as relevant in the context of systemic evaluation of participatory process would be a social learning experience in itself!

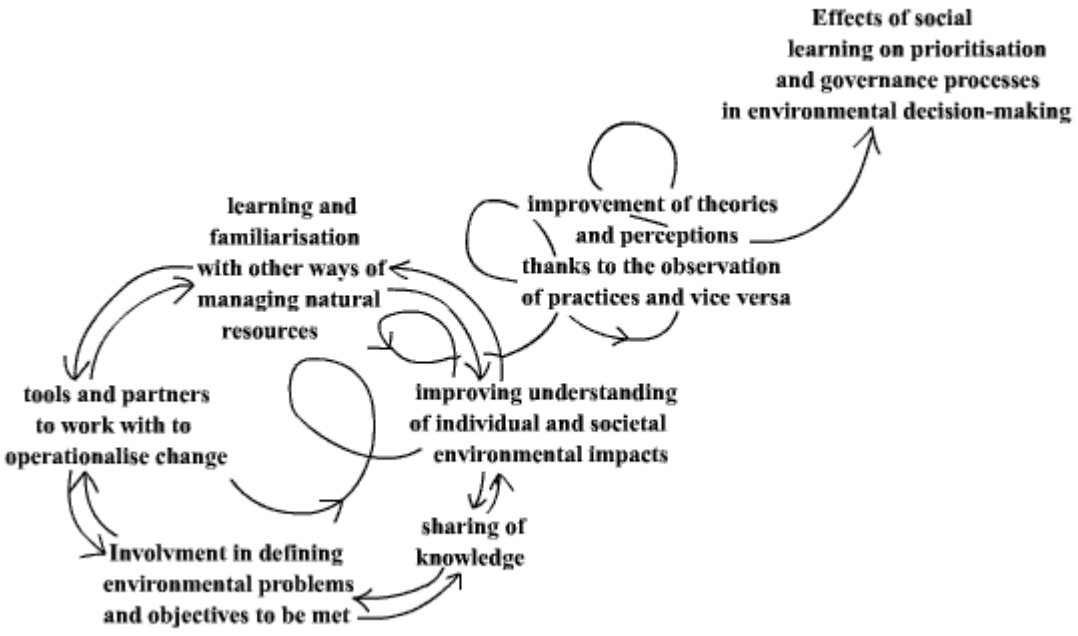
The various ways in which social learning is to be promoted in the virtualis prototypes are through people's sharing of knowledge and experience, deliberation and collaborative tasks. Certain skills have to be developed through the social learning process. Thus, meaningful interaction of the form argued by Cobb (1996) requires some negotiation of meanings, probing one another's understanding, in

attempt to generalise meaning across different experiences. For social learning to take place, the prototypes must therefore be tailored appropriately and certain characteristics of ICTs have to be valued - for instance, the ability of people to use these tools at a distance and to work on interactive tools. Hypermedia have in fact been described by many as 'enablers of social learning' (Jonassen, 1993; 1996) in that they can help generate a shift from electronically presenting information to providing support for the learner in constructing knowledge and deriving meaning.

3.3. The links between learning and change

Social learning processes promoted through the virtualis prototypes are also intended to provide platforms to what is most commonly known as stakeholders' 'participation' in environmental decision-making. One of the premises of the project is that people will not be motivated to embrace new environmental laws, awareness and sensitivity to environmental issues, and more environmentally friendly practices unless they can be involved in the deliberation processes, and acquire a sense of ownership of the issues at stake. The virtualis prototypes are therefore designed as enablers as well as facilitators towards practical societal change. Here again, the system we are looking at and want to evaluate is made of various components that are interrelated as described in Figure 5. Social Learning results both from deliberation, linking perception and practical change, and evolutionary thinking in systems of governance and policy priorities.

Figure 5: Social Learning: towards practical societal changes



The evaluation questions focused on such interactions were formulated as described in Table 3.

Table 3: Questions focused on the links between social learning and societal change

Context of issues discussed in prototype and context within which prototype used and developed	Often, stakeholders do not realise that a particular issue ifs actually practically relevant to them. Articulating this relevance to them and helping them understand in which context the ICT platform is used and useful then becomes crucial.
Clear expression of objectives of the prototypes, context, and expected outcomes?	Most users will want to know why they are doing what they are doing in the prototypes - the learning and practical outcomes (changes in practices) constitute the major motivators for the users.
Is the user motivated to go all through the learning experience until he sees a result (reflected through changes of practice)?	Maintaining the motivation of the users all along is crucial - otherwise the social learning process will be incomplete and meaningless. This can be done both by articulating what has been learnt and how, plus what is going to be explored next and also by reminding the context within which this exercise is being carried out: i.e. why it is useful to them.
Do the instructions help users realise when they have learnt and how?	A component of 'social learning' lies in helping the participants become autonomous learners. The instructions must help them first by articulating such learning steps and outcomes, and then by helping the participants in reflecting on learning and practices.
Gains in knowledge from learning experience when using the prototypes?	Reflecting capacities developed throughout the learning experience must help the users in articulating what was learnt, what changed through the learning processes. Not only the users should be able to reflect on this, but they should also be encouraged in articulating this clearly.
Links between prior knowledge and practice and outcomes of learning?	Various pedagogic strands have been developed to describe 'social learning' processes. One that we particularly value derives from experiential and 'students'-centred learning: it is important that the users realise (through the design and learning processes facilitated in the prototypes) that their prior knowledge and experience is being valued and genuinely contributes to the social learning process. If too much comes from the 'machine', … we are back to an 'expert versus non-expert' learning traditional process.
Common, collaborative construction of meanings?	Social learning is not only about exchanging knowledge and information but also about learning and working together. From a social learning process, collective outcomes should emerge - the construction of meanings, the concerted decisions to change a way of managing a resource…The role of the facilitator / moderator in the prototype becomes then absolutely crucial.
Change of attitudes towards the subject explored as a result of learning through using the prototype?	This is (potentially) one outcome of the social learning process, one that the moderator must help the users realise. The prototypes could provide information for people to be better equipped to actually change and overcome the barriers in place that are preventing then from doing so.

The prototypes explore the practical context within which changes resulting from the learning experience offered in the prototypes might emerge - thus, the water prototypes explain the importance of the Water Framework Directive, or the new approaches to catchment management, for instance.

The information explored in the prototypes concerning *alternative options to 'environmental management*' can help users initiate a change in the way in which they 'do' things. *Users should be able to share their own knowledge* concerning alternative practices. Also, changing practices is not only related to 'having more information' on how to do things differently; it might be related to feeling empowered because part of a group of stakeholders who have decided to change the way in which they do things, for instance. By building bridges between stakeholders who are not used to learn from each other in an equitable way, the prototypes could also encourage the building of bridges between institutions or actors who typically have

the power to initiate change or ensure that change takes place. Explanations on how the environmental issues explored in the prototypes relate to current, up to date, environmental action are crucial for users to understand the importance of what they are doing.

A further consideration relates to time: how long does it take for learning processes to generate practical changes? What is needed, during this period of time, to keep people interested in changing their way of life? The design of prototypes ought to be considered over a long period of time: their maintenance and the way in which learning experiences are combined in a real continuum will both help in ensuring that the prototypes, as learning platforms, can progressively constitute real stepping stones to action.

These were the types of issues that we thought were important to take into consideration in an evaluation of our prototypes based on transformational learning. Here again, other evaluation questions could be thought of in the context of other similar projects.

This long term evaluation process was carried out within the temporal and logistical constraints of the project: the teams that focused on the construction of the ICTs and those which focused on the pedagogic evaluation of these 'tools' had different ways of learning and working, different time constraints[4], and often used different 'languages'. And so, having carried out this type of peer evaluation, we conclude that, regrettably, and even though it did respect some important systemic principles, it was a rather linear, one-sided process. Above all, we learnt that the systemic dimension we concentrated on had mainly focused on the design, content and future use of the prototypes but not enough on the interactions taking place between the members of our own research team during the construction of the prototypes. This was partly due to the fact that evaluating our own social learning processes had become a sensitive issue:

- The co-ordination of the project proved to be difficult, not only because people came from different disciplines and had different tasks to focus on but also because, like in any European Research project, many partners were involved (11 in our case, with at least two people involved per host partner institution) and asked to provide deliverables that would complement each other but which ended up doing so only at the end of the project's life.
- Evaluating our own social learning process and the difficulties involved when a genuine social learning process is taking place amongst people coming from different disciplines and different cultures proved to become a tricky exercise, from a political perspective. A critique of our learning process was directly synonymous with a critique of our ability to do what we actually researched on and … preached! We did carry out our evaluation but made sure that it was presented as an outcome of our learning process, something positive to build on - our funders, them, were keen to hear that *various* evaluation processes had been taken place throughout the project and that *iterative modifications* of the ICTs had helped in generating tools that were 'nearly perfect'.
- The timing related to the delivery of the material to evaluate, thus, did not allow for any substantial iteration and modification, therefore making the evaluation exercise appear as being quite linear.

[4] The evaluation team was dependent on the production of the tools it was to evaluate and the 'ongoing' recommendations ended up becoming 'end-of-process' recommendations - there was no time left to make the iterations and changes recommended by the evaluation team.

If more time had been allocated to do so, the ICT evaluation process would have, in fact, greatly benefited from having the prototypes designers involved in taking part in the design of the evaluation questions. In effect, we wondered whether the improvement of the prototypes wouldn't have been more effective if we had facilitated the collective design of the evaluation questionnaire with the designer team - rather than asking that team to fill the evaluation questionnaire once it had been written. We attempted to address this shortcoming in our evaluation methodology in a participatory evaluation session we carried out with potential future users, as described in the next section.

4. Participatory technology assessment - iterative, short-term evaluation processes

While the Virtualis team worked towards promoting social learning processes when stakeholders come to *using* the prototypes, it is also interested in observing the social learning processes that are taking place while the prototypes are being *constructed*. Indeed, one of the important characteristics of the project is to encourage the members of the team to converse with members of the public as well as experts, all potential future users, to ensure that the design of the prototype is, in itself, participatory and respectful of future users' needs and expectations. It is with this perspective in mind, and in view of complementing the peer evaluation process, that the OU team organised an evaluation session with a group of our Open University tutors coming from a range of backgrounds and perspectives, social classes and ages (and who, therefore, tend to be more representative of the general public than other, more traditional university tutors).

In order to carry out a participatory evaluation process, we varied the types of activities the tutors went through and ensured that the day was made of a mixture of individual tasks, group work (in pairs and groups of 5, as well as a few collective brainstorming sessions), sharing of perspectives, exploring the prototypes, and filling the evaluation questionnaire online.

4.1. Participatory evaluation techniques

The main differences with this participatory evaluation session (as opposed to the peer evaluation) were that:

- the evaluators were numerous and their perspectives on the prototypes, but also on the evaluation exercise, were varied
- through this evaluation session, we were facilitating the emergence of un-expected ideas and outcomes, both on the prototypes and also on the notion of ICT evaluation.

The principles of participatory evaluation are, to a very large extent, in complete agreement with the understanding of the notion of social learning in the virtualis project: while 'non-experts' can learn from experts (in this context on learning processes, structures, platforms…), 'experts' also have much to gain from the knowledge, common practical sense, experiences, … of 'non-experts'. So, leaving the task of evaluating the ICT prototypes to 'learning experts' only would be, from a social learning perspective, a mistake. What works and what doesn't, from a point of view of learning, depends on the learner and the facilitator. The Open University makes a point of concentrating on student-centred experiential learning, where the 'teacher' is a facilitator. As a complement to participatory evaluation processes carried

out in the context of other technological developments (such as those focused on Genetically Modified Organisms (Joss and Berllucci, 2002)), the OU Virtualis team therefore focused its participatory evaluation processes on enabling certain recommendations and collective outcomes to emerge, hence empowering the 'users' by allowing them to take part in the design of the (communication) technology itself.

The session therefore focused on

- honouring people's prior knowledge on how ICTs can promote social learning and why;
- identifying what evaluation criteria seem to be of particular importance in a broad brainstorming session organised around three themes
    - the relevance of ICTs to improve people's awareness and participation in environmental debates and decision-making processes
    - the relevance of ICTs to motivate learning processes
    - ICTs, social learning and change
- discovering the prototypes in small groups
- filling the evaluation questionnaires
- discussing about the questionnaires and
- identifying ways in which the prototypes could be best disseminated and used.

The evaluation of the prototypes constituted, in fact, a platform for broader reflections and recommendations on how ICTs can help promote social learning. A variety of recommendations emerged from the session.

4.2. The outcomes

In the first brainstorming session, focused on participation and ICTs, the tutors concentrated first on discussing the notion of participation. It was first acknowledged that ‘participation’ facilitated by such ICTs could range from getting informed, being more environmentally aware, to changing one’s behaviour as a result of ‘transformational learning’. But the differences in levels of knowledge and awareness were presented as having the potential to result in interactions amongst participants that are very different from what we normally imagine in ‘participatory processes', as explained in this quote (from one of the tutor): “Participation has many facets. It can be dangerous if people take part from a position of ignorance. It can increase ownership of decisions and could cause disillusionment if participants have different power levels”. Ultimately, what emerged from this first discussion is that “the question [of whether ICTs can facilitate participation] is impossible to answer! The technological tools are neutral: what needs to be evaluated is how they are used - we can only evaluate the actual usage of tools”. The discussion then focused around three areas. First, tutors were keen to address the question of ‘participation around what issues?’. On the one hand, people acknowledged that the use of ICTs can help in providing up to date information, from a range of sources. But they expressed concerns regarding the choice of information provided to people. Would people trust this information? How relevant would this information be to people if they don’t choose it? Will the presentation of information in ICTs make it appear as unimportant because part of a ‘game’? And, beside, would the use of such tools in the arena of decision-making dictate what type of issues, selected, ‘frozen’ by decision-makers, would be discussed? Would the choice of issues discussed be updated, maintained frequently enough?

This led the participants to discussing who would take part in using such ICTs platforms. The fact that these tools are targeted at the ‘general public’ generated more

scepticism than enthusiasm in the group, as expressed by one of them: "Are this form of participation and choice of issues equivalent to '*the others' telling us* (the general public) *what to do* - while commercial organisations are still not changing their understanding of environmental issues nor their environmental practices?". Beside the question of 'who are these tools for?', the question of 'who can they realistically be for?' was raised. While the issue of accessibility was regarded as less and less of an obstacle, at least in European countries, the questions of who would be motivated to use such tools and how to bring these issues to the attention of a wide audience was discussed at length. As was stressed, local (environmental) authorities web sites - including the ones with consultation platforms - do exist but it doesn't mean that people take part in using them. It was emphasised that, ideally, a maximum user coverage, including corporations, was needed for an effective use of these prototypes. In other words, the use of these ICTs by a self selected audience who would, anyway, be interested in these issues, would somehow defeat their object - they would 'preach to the already converted'. Much more of a challenge would be to direct the attention of a wide range of people to the existence of these tools by, for instance, using other media (radio, TV, magazines, etc.). Interestingly, many tutors emphasised the importance of the 'human factor' in promoting the use of such ICTs. Thus, "young people might come to use these ICTs by browsing or by 'word of mouth' between their peers' and 'school pupils, excited by the use of ICTs, will help older generations in getting familiar with and interested in them". So the non-ICT aspect of the initial introduction to the tools was presented as having a major importance, somehow beyond the way in which the ICTs were designed. The variety of media encompassed in ICTs was therefore presented as having a positive impact on their users. But it was recognised that users had to be ICT literate in order to make the participation processes more effective - or else, the navigation tools included in the ICTs, the way in which the information is presented and the interactive tools integrated in them, have to genuinely enable people to comfortably take part in the social learning process.

The tutors spontaneously divided the second brainstorming, focused on the relevance of ICTs to facilitate learning processes, in two parts:

a) The first point focused on 'motivation ingredients' for learning. From a design perspective, tutors highlighted the fact that the learning instructions, the facilitation within the ICTs, need to address the issue of 'retention of knowledge and understanding' - and therefore reflective and self assessment questions need to be included. The temporal dimension of the learning processes was also related to the design of the ICTs in that the tutors stressed the fact that the ICT users need to have time to follow the learning through each prototype. Beside, and amazingly so, the principal focus of discussion became "interaction, interaction, interaction" as the best motivation to learn. The main advantage of using ICTs as learning processes was explained by the fact that these facilitate 'learning from others'. "The interaction component is the crucial motivator for deeper learning". The use of ICTs for doing so was presented as particularly interesting because still novel to the users: this means of learning is progressively breaking down barriers for long put between education and leisure and the learning experiences can be varied with the user being in control of his/ her own learning path.

b) The second point covered in this brainstorming session was on the characteristics of ICTs that would help in promoting participation and interactive learning. Many advantages in using ICTs as learning platforms were highlighted (they take out some of the tiresome reading; they offer all sorts of multi media potential (sound, sight,

interactive environments, 3D representations of information, etc.), etc.). They were seen by the group as generally giving learning more scope. However, the tutors also highlighted the fact that, in order to make the best use of these new tools, people must be trained to use them, like they would use a new language.

In the third brainstorming session, we addressed the issue of transformational change - i.e. how the learning processes experienced in such ICTs could result in practical changes in the users' ways of life, for instance. The main change that the group highlighted was the fact that "ICTs will certainly change the way in which we socially interact". But whether these changes are for the better or for the worse depends on the overall structured framework and societal strategy within which these changes are taking place. As one tutor stressed "affordable housing is high on the agenda in the UK, but what about helping with making computers affordable to more people?". This would help bring new learning opportunities to previously excluded groups (disabled, people for whom the cost of higher education is prohibitive, etc.). Beside, the use of ICTs as educational / learning tools will have to be introduced carefully since, whether these ICTs are supposed to be participatory or not, "current evidence appears to suggest that the use of ICTs in education reinforces societal divisions".

An adaptation phase (the one we are currently experiencing, at least in some European countries) during which people will 're-skill' in these new forms of communication will take place. So, to some extent, the changes experienced as a result of using ICT tools such as the ones developed by virtualis might initially be mainly focused on the methods of interaction - beside the environmental issues explored within these tools. During this phase, another main change, maybe less obvious, will probably be related to the raise in awareness on certain issues. And that's a start! But in terms of linking the participation processes facilitated in such ICTs to the actual decision-policy-making processes, the group was not over-enthusiastic: "Do they really want your contribution to a poll or will they then use the poll results to justify decisions of powerful education or manipulation?". Overall, therefore, the changes expected from the use of such ICTs were regarded as … deriving from the use of these tools in itself!

4.3. Discovering the prototypes

The objective of these brainstorming sessions was to deepen the group's understanding of the *context within which the prototypes created in Virtualis have emerged.* The mistake, from an evaluation perspective, would have been to present the prototypes first - and, in the process, make tutors believe that they were representative of any good ICT learning platform. These brainstorming sessions constituted an interesting insight to us on what final users would expect from our prototypes and what they would be sceptical about even before starting using them. Having gone through these discussions, the tutors then went on discovering one of the prototypes (the water 'personal barometer') in depth. The water personal barometer[5] allows its users to calculate his/her water consumption and 'water shadow' - i.e. the area of water needed, in the region where the user lives, to meet his/her water needs. This tool can be viewed as a platform for reflection on how to use water resources better.

People worked in pairs to discover the water prototype constructed by Cranfield. We thought that working in this way would allow them to help each other feel more

[5] For more information, check http://neptune.c3ed.uvsq.fr/virtualist/water/personal_barometer.php

confident about the discovery of the technological tool and also that it would allow them to express themselves freely.

The prototype had been installed on a laptop placed between the two people. People explored the prototype on screen and were also provided with the users' manual that complements the software. For a bit more than an hour, people navigated through it and had the opportunity to share their views within their pair. They were asked to write down their first reactions as well as the criteria that would, in their view, help one evaluate such ICT tools.

The prototype worked beautifully and the navigation was faultless. The comments therefore focused more on the content, assumptions, guidance and presentation of the material.

Interestingly, most comments were focused on the fact that there was a crucial need for the contextualisation of both the content of the learning and the learning tool itself. In other words, the reason(s) why any stakeholder might be interested in using this tools, how they would be invited to do so, why they would be interested in focusing on an environmental domain such as water when they perceive that there is enough water as it is in a country like the UK, etc. … needed to be presented, if not in the prototypes themselves, at least in a 'learning support' that would introduce them. Using participants' knowledge, as opposed to mere data and information, was also highlighted as one of the main issues.

The users also found the prototypes relatively dry and it is noticeable that, even amongst older generations, the expectations for up to date graphics and sounds in such ICT tools has become very high.

4.4. Participatory evaluation process: some interesting lessons

This method of evaluation of the prototypes opened up our understanding of what the final users of such tools would need and expect. Interestingly, while our peer evaluation was focused on the structure of learning processes and on whether and how these would facilitate social learning, this participatory evaluation process helped us in stepping back and evaluating these tools in a broader context. This context includes the motivation for using such tool, the training needed by many to feel comfortable in using such tools, a better understanding of the domains covered in the ICT tool, and the creation of an atmosphere of trust within which the learning could take place. These series of evaluation comments and recommendations are being used to design an *online learning support*[6], very much based on these contextualisation characteristics, aimed at complementing the four virtualis water prototypes.

At the end of the day, the 'human side' of technology all depends on how humanly its use and design are integrated within society.

5. Conclusion

'Evaluating ICTs' from a systemic perspective can mean different things.

One fundamental principle of evaluation is to carefully reflect on the context within which these tools are going to be used, whom by, why, and to what extent these ICTs can offer what other tools apparently cannot. In this paper, we examined how to approach the issue of 'systemic evaluation' of ICT prototypes that have been designed to promote social learning. We observed how the social learning could happen within the research team and also between the research team and potential

[6] For more information, check http://systems.open.ac.uk/page.cfm?pageid=ShortCourse

future users of these prototypes. The peer and the participatory evaluation processes appeared to complement each other in different ways. The peer evaluation examined the ways in which the design of the ICTs took account of the interactions between environmental domains, learning stakeholders, and learning and change, and was carried out in the form of discussions with our research partners and questionnaires designed by the 'learning experts' team and filled by the ICT designers as well as the 'learning experts'. The outcomes of this evaluation were somehow 'timid' to be as constructively critical as we would have allowed ourselves to be had we had enough time to rectify what needed rectifying within the ICTs. On the contrary, a series of provocative recommendations came out of the participatory process carried out with external future potential users, highlighting the fact that, even if these three types of interactions were thoroughly explored in the prototypes, the contextualisation of their use was missing. To some extent, thus, the evaluation *of the prototypes* as platforms for social learning would gain from really concentrating on the evaluation *of the social learning context within which the prototypes were designed, constructed and intended to be used.*

Above all, the message of this paper is that a systems approach to evaluation can help in approaching an issue from various crucial angles, the links between which is more important that their sum.

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