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A Topical Course in ICT and Society

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Abstract

Students in Informatics (Computer Science) at the University of Nijmegen (The Netherlands) are offered both an introductory and an advanced course on the societal implications of Information and Communication Technologies. The courses start from societal problems and help students to analyse these problems in proper construction yet. argumentation. The introductory course combines philosophical and sociological perspectives, the advanced course is based on a sociological theoretical background concerning construction of science and technology. The courses should be an integral part of the informatics curriculum. However, bridges to other courses are under

Keywords

Societal and philosophical aspects of ICT, dynamics of science and technology, informatics curriculum.

1 INTRODUCTION

At the Catholic University of Nijmegen part of the curriculum of informatics is reserved for the study of societal and philosophical aspects of new Information and Communication Technologies (ICT). The courses provided allow for reflection on non-technical aspects of the development, distribution and use of ICT. They resulted from a movement of critical scientists in the seventies and over the years have matured in that they now approach contemporary scientific and technological activities in a broader context. The direct relationship between development and application of new informatics methodologies, techniques and tools makes the courses a prerequisite for adequate training of computer scientists. Scientific and technological practices do not have an unequivocally positive impact on society and students therefore need to be trained in the understanding of the complicated and multi-faceted relationship between their future job as ICT-professionals and society.

In the following the courses will be described in some detail with special attention to underlying thoughts. Also some ideas on future developments will be presented.

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2 CRITICAL REFLECTION AS PART OF THE CURRICULUM

The Nijmegen curriculum of informatics (computer science) can best be typified as a theory based curriculum. Students are trained in subjects from the core of informatics, such as compiler construction, machine architecture and programming styles. After a basic programme of two years students may choose one of four distinct programmes: informatics and mathematics, informatics, technical informatics or business informatics. To bring students to critical reflection on informatics is the core of all programmes; the - obligatory - courses are offered in the third and fourth year of the curriculum. There is an introductory course which combines sociological and philosophical perspectives, and an advanced course which offers a choice between a philosophical study of the concept of information and a sociological study of the information society. In all, approximately 5% of total curriculum activities is spent on these courses, a limited amount of time equal to 280 hours of study. Choices thus had to be made in scope and content of the programme. In the following paragraphs the introductory course and the advanced sociological course will be discussed.

3 SOCIOLOGICAL AND PHILOSOPHICAL REFLECTIONS ON ICT

3.1 Objectives of the course

The teaching objectives of the introductory course are threefold: training of analytical skills, training of argumentative skills and provision of insight in the relationship between informatics and society. Sociological and philosophical perspectives are used alternatively during the course. From a philosophical perspective the first two objectives of the course are obvious. Philosophy in our approach simply *is* the proper analysis and argumentation concerning reality. The search for implicitly or explicitly used presuppositions guides our actions and thoughts. But also the sociological perspective is well served in this approach. The courses present no *grand theories* nor specific sociological points of view, but are meant to increase the awareness for the non-deterministic, non-linear and non-rational aspects of the 'outer world'. The validity of claims of truth, when dealing with sociological events, is hard to prove, even in isolated micro-spheres. Understanding non-rational aspects of human behaviour, problem-oriented rather than solution-oriented policies of acting, and understanding that not all conflicts can be settled - even when rational decision making seems to offer a good basis - needs a 'mind-switch' of our students. The general approach is to stimulate this mind-switch.

The third objective is related to the topic of the course. We might teach students analytical and argumentative skills without reference to informatics, but of course we want to make them understand the world of their professional life through problems with which they might have to deal in their professional careers.
The overall objective of this course is therefore: training of students to critically reflect on societal constraints and circumstances on informatics practice.

3.2 Informatics-centred versus society-centred approaches
In general two basic approaches are used in the teaching of the topic of informatics and society. The first approach starts from informatics and looks at its societal impact. The second approach starts from societal problems and looks at the possible contributions of informatics. In the following we will stipulate some differences between both approaches.

3.3 The problem of the informatics-centred approach
In the first approach different encompassing spheres of interest are presupposed. There first is informatics in the centre connected to the outside world through an interface. This is a quasi-isolated and quasi-central approach: informatics somehow exists and somehow is basic to our existence. The interface is crucial: tools, theories, acts, skills, money, programmes, artefacts, etc. which are exchanged between core and periphery, and the way in which these are exchanged, determine how both core and periphery develop.

There is a number of problems with this approach. It takes informatics as its kernel: Informatics makes the world go round. The world is seen through the glasses of the informatics specialist. Problems are essentially seen as mismatches between the 'ideal' world, as aspired by ICT-professionals, and the 'real' messy world which is in need of some adjustments to be able to meet the 'ideal' of these professionals. As an illustration we describe how vulnerability of society is treated in this approach. Vulnerability may be defined as a characteristic of technical systems which makes adequate protection measures necessary like authorisation, build-in redundancy, etc. But vulnerability may also be defined as a characteristic of society. People may feel insecure, institutions may experience a loss of societal integrity, individuals may fear to loose their track in society. These two separate approaches lead to different perspectives, to different problem definitions and to different possible solutions (Berleur, Beardon & Laufer, 1993, Van Lieshout & Massink, 1993).

Another problem concerns the suggestion that informatics is well-defined, with well-defined interests, cognitive fields, professional attitudes and practices, etc. This is not the case, as all who are working in the field know, and it is highly unlikely that views like this will be successful in any course on informatics and society. Still, students lack the bird's eyes view which allows them to see the contingent character of ICT developments and which finds them fixed points to base their understanding on. One of the possible fixed points is the believe that cognitive progress is by definition to be desired. This idea is questionable and may lead to a wrong assessment of the relationship between ICT and society. This is illustrated in the concept of technical imperative which states that every opportunity of technical progress must be grasped because this will serve society best. Technical progress and societal progress here are two sides of the same coin, and their dynamics is presupposed to be similar as well. This is a dubious presupposition. What is really needed is an analysis of what precisely does constitute societal progress and the role of informatics in this progress. The notion of progress thus must be 'deconstructed'. What kind of progress: technical, theoretical, societal? For whom? By what means?

3.4 Society as the starting point

When taking societal practices as a starting points, topics may be identified in which the influence of ICT is clearly present. This does not have to imply that these influences will determine the content of the societal practices. They just play a part. The analysis of *which* part is precisely the task for the students to perform.

This approach is based on the following presuppositions. ICT, as a science, a technology and a social practice is seen as essentially 'socially constructed'. This means that we presuppose that ICT has different meanings to different actors. It is impossible to find one frame of knowledge which unambiguously constructs the (cognitive) field of ICT, one identifiable route of development which has been followed during the past thirty or forty years. ICT as such does not exist, but is defined by the societal practices in which it functions. The presuppositions which guide the development of ICT are societal presuppositions, even when these seem to be strictly related to cognitive events. The notion of an encompassing cognitive and rational approach is abandoned. An analysis of the discussion about Artificial Intelligence could serve as an illustration of what we mean here.

Also philosophical reasoning starts from societal presuppositions and not from scientific or technological ones. What presuppositions are used when people say they have right of privacy? If we accept that privacy needs a notion of individuality, of being a person, what do we mean by that? Where does this notion come from? Can this be shown to be a universal notion, etc?

Sociological reasoning starts from the presupposition that there is no *a priori* difference between ICT and other societal practices. Science and technology themselves are societal practices with certain characteristics which differentiate them from health care, the practice of labour organisations and other institutional forms of acting. But science and technology certainly have much in common with these other practices. So, what we need to do is to analyse societal practices in terms of the contribution of informatics. The problem of privacy, to give an example, then is above all a problem with sociological characteristics, like the Weberian rationalisation of government practice, the growing need to control citizen's behaviour and broader cultural changes in people's attitude to each other and to the institutions they are part of. Then there is the contribution of informatics: the widespread distribution of information, the almost uncontrollable use of information within networks, the techniques of making sophisticated profiles of persons and of events, the automation of decision processes where large amounts of personal data are used, etc. Finally, attention may be given to the use of informatics for the protection of personal data, like encryption technologies, chip cards and the like.

3.5 A combined perspective

The philosophical and sociological perspectives are closely related. The philosophical analysis follows the sociological one, and concentrates on relevant sociological presuppositions. The sociological analysis of privacy, for instance, shows the need of a concept like individual person. The philosophical roots of this concept can be traced and positioned in historical perspective, starting with the etymological origin of person as the Greek *persona*, i.e. a mask with a build-in megaphone used at Greek theatre

plays to reach the entire audience. It follows the route to Descartes' adagium "Cogito ergo sum", showing the principal difference between human beings and other living creatures. The philosophical line of reasoning is valuable in itself. It takes its examples from problematic concepts in the relation between informatics and society.

Students finish the first course by preparing a paper in which they have to show that they have mastered proper analysis of societal problems related to ICT and that they know how to construct a relevant argument. In general, students evaluate the course positively, both with respect to approach (the combination of philosophy and sociology, the accent on the development of analytical and argumentative skills) and to content (privacy, quality of work, artificial intelligence, military industrial complex, and responsibility of ICT professionals).

4 DYNAMICS OF SCIENCE AND TECHNOLOGY

After having completed the introductory course, students may choose an advanced course in philosophy or sociology. The philosophical course concentrates on the concept of information. The sociological course focuses on the sociology of science and technology, and takes the concepts of the information society and the so-called information super highway as illustrative examples. In the following the sociological course is described.

4.1 The sociology of science and technology

This advanced course tries to let students make another step in the direction of a sociological interpretation of ICT practices. The theoretical background derives from theories about the social construction of science and technology, originating from the Sociology of Scientific Knowledge by David Bloor (1976) and the Social Construction of Technology by Bijker, Hughes and Pinch (1987).

Bijker (1984) follows Bloor in identifying four constraints which theories about science and technology must meet: these must be symmetrical towards success and failure; these must avoid an implicit linear structure in describing the evolution of a theory or an artefact; these must be founded in a strong empirical base; and these must be able to explain continuity as well as change.

The requirement of symmetry is needed to avoid the trap that theories or artefacts are deemed successful because these are successful. For instance, the fact that Word Perfect is a highly successful text processing programme is precisely what must be explained, and not taken for granted. In a similar vain, it must be explained why Atari computers were no match for IBM computers.

Theories, artefacts, methodologies etc. do not follow a clear-cut route to success or failure. Variation and selection processes contain a mix of variables which together force decision processes to continue on one route and to bypass another. With hindsight it seems as if the one and best solution revealed itself with strength and clarity to those who were able to see. But that is only in hindsight. When a choice

must be made, a myriad of aspects plays a role giving the route followed a whimsical course.

The empirical base stresses the importance that the study is based on 'real facts' or 'events' and not only on theoretical or philosophical reflections. The requirement to explain continuity as well as change is a trivial requirement, but not easily fulfilled within one theoretical framework.

Taken together, these four requirements define an approach to the social construction of science and technology which is based on the idea of evolution: variation and selection processes can be discerned and interactions between both processes - through a so-called nexus - make the development 'quasi-evolutionary' (Van den Belt & Rip, 1987).

4.2 Key concepts of social constructivist theories

Theories which satisfy the formulated requirements, still may differ in their concepts and rules. In our course we focus on the network approach, in which actors negotiate about developments through the exchange of intermediaries (Callon, 1986). Intermediaries do take different forms: artefacts, skills, money, knowledge, reports. Key concepts in the network approach are interpretative flexibility, resilience and stabilisation.

Interpretative flexibility means that the same thing may have different meanings to different people, depending on who they are and how they behave. It means that a concept as the information super highway means different things to different people. This is not a trivial observation. Even when all kind of intermediaries are exchanged between two actors with a different definition of the situation, neither of them will be able to fully grasp the meaning the other actor attributes to the 'same' concept. Taking an extreme view, neither of them is principally able to understand the other; or less extreme, it may take a lot of time to discover shared believes and opinions underlying both definitions.

Resilience means that a network will experience resistance against change. It is not easy to incorporate new ideas within old frameworks, to prove their superiority over older ones. Old structures will resist to sudden change and will try to neutralise this change. A successful analysis ('deconstruction') of resilience in a network is an important step to an understanding of the dynamics of the network.

Finally, stabilisation (or closure) is the process through which actors within in a network beget a shared meaning, a shared definition of the situation. How the stabilisation occurs, which mechanisms are successfully used and which mechanisms fail is what must be studied.

4.3 The Information Super Highway

In the study of societal phenomena we concentrate on the information society and the information super highway. Both are problematic concepts and both share a high level of casualness in discussions and work of ICT specialists. The deconstruction of the

content of these concepts is part of the course. Various tools are offered to cope with this deconstruction. A prominent place is reserved for science and technology studies. It needs little imagination to see the many fields in which the information super highway has become an appropriated term, and the various meanings it has gained in these field (viz. the governmental field, the economic field, the cultural field).

In the end students make their own analysis of a limited problem situation. A part of a government programme, for instance, or the dynamics guiding the introduction of the set-topbox, or a local experiment with two-way interactive services. Their analysis must be theoretically grounded, and it must be based on empirical data.

5 RESPONSIBLE BEHAVIOUR

5.1 Objectives of the course

The reader may wonder why we have presented such a lengthy discussion of the theoretical approach used in the course. It may give the impression that we are out to make half-time sociologists of the students. Why so much attention for the theoretical requirements? What is the relevance of the network approach, what is the relevance of Science and Technology Studies (STS) for students whose professional career will be in informatics, and not in explaining change and continuity in the Information Super Highway?

Again, part of the answer is the perspective we have chosen: to study the role of ICT and ICT professionals from the sociological point of view. We want to show the students that the primarily rational and solution oriented approach of informatics is not the only approach available to study societal phenomena, and that the validity of this approach may even be questioned under certain circumstances. They have to be submerged in a scientific way of thinking which allows different schools of thought and which is not directed to the solution of practical problems, but to the understanding of complicated social events which cannot be brought under direct control. They must obtain a - be it introductory - notion of how other scientific disciplines and bodies of knowledge are constructed and used.

Still, and almost conflicting with the foregoing statement, in the end the course must attribute to a critical attitude of students aimed at responsible behaviour in a professional career. Our point of view is that responsible behaviour is, again, not typical for ICT specialists, though circumstances may lead to specific aspects of responsibility. We hope to increase the awareness by students for the complicated structure of the world in which they will have to perform their tasks. And we hope that deeper knowledge, together with the ability to be critical - in an analytical and an argumentative sense - contributes to an attitude supporting responsible behaviour. Both the introductory and the advanced course offer a range of tools which students may use in their professional life.

6 FUTURE ACTIVITIES

The courses described above should not be seen isolated in an otherwise strictly technical informatics curriculum. Other courses stress the importance of analytical skills as well in ambiguous problem situations which require coping with many aspects at once.

In the near future, two kinds of activities might strengthen the ties between the courses described in this paper and other courses. First, the educational system will be more oriented towards the learning of students than the teaching by teachers. Our introductory course will be one of the first courses to experiment with the new educational approach. We hope that this approach enables closer co-operation between different study activities.

Second, the co-operation between distinct fields in the curriculum will be intensified by introducing aspects of responsibility in other courses. Codes of Conduct, for instance, may offer relevant views and contribute to good practice of ICT professionals. These Codes of Conduct may be introduced in courses in which students face 'real' problems, for instance a contractor with unrealistic claims. But not only this form of cross-fertilisation is possible. In courses where students are trained in the technical aspects of real-time systems, a discussion about the different - technical and non-technical aspects - of vulnerability could be introduced along the lines described above.

The importance of having students trained in analytical and argumentative skills is fully understood in our Department which offers a good starting position for awareness towards the societal impact of ICT. Overall aim is to educate responsible professionals and this aim motivates us to keep on developing our courses and strengthening awareness of the societal aspects of ICT.

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8 BIOGRAPHY

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