EXPERIENCES WITH A SCIENCE AND SOCIETY COURSE FOR MATHEMATICS STUDENTS

1. Introduction

One of the results of the activities of the student movement in the student movement in the late sixties and early seventies in the Netherlands was that in many universities "Science and Society" courses were included in the curricula for mathematics and the natural sciences. The department of mathematics at the University of Groningen decided in 1974 to establish such a course. In the past four years I have organised this course. (My further duties were research, teaching and consultation in mathematical statistics). Some of my experiences and problems may be interesting to you.

2. Organisation of the course

The Science and Society course is an almost compulsory part of the curriculum for mathematics students in the first and second years of study. The organisation of the course has changed over time, but it always consisted of two parts:

(1) An introductory part, where the students are confronted with some social aspects of mathematics in the form of lectures or small group sessions and discussion groups. In this context, "mathematics" is understood primarily as "the work done by people who have studied mathematics" and "application of what one has learned in courses designated by the name of mathematics". Only secondarily is mathematics designated as an academic discipline. No attempt was made to give a systematic account of all the social aspects of mathematics; the aim of this part of the course was to make the students conscious of the fact that mathematics too has its social aspects, and to give an idea of where to look for social aspects of mathematics.

Some subjects which were studied are:

* what kind of jobs do mathematicians have; what else do applied mathematicians do besides doing their sums?
* which social functions are served by mathematics education at secondary schools (discussions went e.g. into the use of maths as a tool for selection and into discrimination against girls);
* political backgrounds of the "new maths" movement;
* uses of applied mathematics in sciences and industry; elucidation and mystification using mathematical concepts and methods;
* social aspects of automation: centralisation of power, privacy, level and kind of employment;
* social factors in the history and contemporary development of mathematics as an academic discipline.

Other subjects include aspects of the relations between science and society which are not specific to maths in particular.

(2) A project group, where groups of 8 students studied certain subjects more intensively. Over five months, the students could spend three weeks in total on this project work. The projects were guided by advanced students, who in their turn were supervised by me. The greatest interest of the students went to subjects which have a bearing on their future occupation such as mathematicians in industry, and teaching maths at secondary schools. We tried to guide the students interests into the social-political backgrounds of these, but did not always succeed. Their interests focussed more on their own occupational perspectives than on the socio-political perspectives of their future occupations. This is of course to be expected, especially in a time of under-employment; but to us (advanced students and me), it sometimes was disappointing.

Other subjects to which projects were devoted include

* social influence of scientific expertise;
* popularisation of science;
* science in China;
* consulting work in the fields of statistics and numerical mathematics at the mathematics department of our university;

* social influences on the development of real analysis and of computer science;

* science policy;

* automation (especially data banks);

* nuclear waste disposal.

It is clear from this list that the project subjects were less centred around mathematics than the subjects treated in the introductory part of the course.

The aims of the course were more attitudinal (achievement of a more open attitude towards the social aspects of mathematics) than cognitive (academic knowledge of the interaction process between mathematics, science and society). As a consequence, the course did not work in an examination; we tried to see to it that all participants were actively present in the introductory part and did enough work in the project group. Everybody completing the project group passed the course. The absence of an examination did not create any serious problems.

The touch of responsibility for this course has now been passed to Henk Broer, another worker in our department. For this reason I have given only an account of past experiences and not of plans for the future.

(3) Evaluation

Our original aims were pretty high. We expected that this course would answer a need felt by most of the students, and that the students would have from the start a reasonable insight into social phenomena and social problems. Retrospectively speaking, this was very naive, stemming from a projection of our own interests and knowledge into the students. It turned out that some of the students were actively interested, many were passively interested, and many others were apathetic (they followed the course because they were expected to). Also there was the strange contrast that some students were disappointed by the shallowness of the course, while we were disappointed by the students' shallow understanding of many issues raised in the course. After some time (and a lot of frustration) we understood that this was no contrast at all, but just the result of our too high estimate of the students' interests and insights into social questions. Subsequently we lowered our aims and tried to better reach the level where the students are at, and this did have some success: less frustration and more understanding. The aims of the course have now crystallised to something like: giving an impression of the social aspects of mathematics, discussing these with each other, and doing some of our own work (in the project group) at uncovering some aspects of a particular interaction field between science, or mathematics in particular, and society. And these aims were set in the ideological background which we also tried to convey by our approach, that it is not necessary to be content with the state of affairs as they are, and that if you are not content it is up to you to try and change things. Writing this down I should apologise that the aims of the course are not more revolutionary. Well, they are not, and that is well.

One aspect of the students' attitude which surprised us deserves special mention: their high level of identification with "mathematics" and "the mathematical community". We had expected that being newcomers, these students would look critically at the customs and norms in the mathematical community. The dominant attitude, however, we found to be conformistic. For this conformism I can see two reasons: one sociological, the interest that the students have in becoming a member of the group, so as to maximise the chance that they will successfully complete their studies and find a good job; and one psychological, the fact that most maths students chose mathematics because they like to do sums and do not want to be bothered. Conformism builds you a nice little shelter where you can do your sums, while too much involvement in the Science and Society course bothers you, and makes you question things which should be safely left in peace. I must say that I know these sociological and psychological reasons for conformism to the maths community all too well from my own experience.

(4) The naive paradigm

One of the main problems for the work of the project groups was the poor background of the mathematics students in research methodology. The trouble sprang not so much from methodological ignorance as it did from methodological naivety. This expressed itself in the way of stating the problem, the kind of investigations made, and the kind of answers found acceptable. The problem originally was stated like "how is the situation with this or that", implying the expectation that the part of social reality to be investigated has a very simple structure. The idea that social phenomena must be investigated with subtlety, and with a critical attitude towards apparent findings,

was often emotionally refused. What was read in a book, or heard in an interview, was accepted as the truth; we found it hard to convey the idea that what a person says is, at its best, his subjective interpretation of his personal experience. The students tended to have an unshakeable faith in objectivity. Even if a group succeeded in producing a reasonably sophisticated problem formulation, then the investigations would be conducted so that the problem actually investigated was deprived of all its sophistication. One example: a project group investigated "the" influences determining the contents of the curriculum in their own studies. They interviewed a number of professors, and concluded that the curriculum is determined mainly by what the professors find interesting. Oh la la! Especially after this experience, we tried to take the methodological naivety better into account: easier subjects for the project groups and a more intensive and critical guidance. But it does remain a cause of trouble.

(5) Responsibility

One of the original aims of the Science and Society course was to make the students more aware of the social responsibility of the mathematician, and to promote a positive and active attitude in this respect. This was experienced by many students as a zealot's appeal, and they reacted aversely. As it seemed that this aim was in danger of engendering opposite effects, it was retained as an implicit rather than an explicit aim. The students' averse reaction was caused partly, of course, by their resistance against being bothered in doing their sums: "the applied mathematician gets a problem for which he must find the objective solution. That is his job, he has nothing to do with the origin of the problem or the consequences of the proposed solution. The mathematician makes nothing so he does not do any bad things" (that is left to the engineer). This attitude is exactly what Science and Society courses are intended to fight. Our changing of the aim of promoting responsibility from an explicit to an implicit one can be seen as a move from a head-on attack to a more cautious strategy. But my criticism of our earlier approach is not only tactical but also conceptual. My ideas about responsibility and how to promote it were rather simplistic. What we did in the course in this respect amounted to telling the students that they have a duty, but we remained silent about the contents of that duty. But what on earth can you tell 19 year-olds about what one might see as the responsibility of the mathematician? As for the teaching profession, they only see the didactical side; as for the applied mathematician, they have no idea what his work amounts to; as for mathematical research, they see its contents as value-free knowledge and hope for the leisure, paid or unpaid to pursue it. I found it too difficult, at least for the past years, and chose the implicit way. But I shall think that it must be possible to work out the responsibility thing in a concrete fashion, with a meaning which can be grasped by beginning mathematics students. By Tom Snijders, Dept. Of Maths., P. 800, Groningen, The Netherlands.