UNIVERSITY OF JOENSUU
DEPARTMENT OF COMPUTER SCIENCE
REPORT SERIES A

Teaching Computer Ethics: Experiences of Integrating Ethics into Computer Science Courses

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Report A-1998-8

Abstract

Computer ethics could be taught at least in two ways: integrating ethics into computer science (CS) courses or arranging computer ethics course. In this report the experiences from the experiment of integrating ethics into CS courses are presented. In this experiment the integration means adding groupworks and dilemma discussions to the exercises of CS courses. Dilemma discussion as a teaching method was realised to be reasonable and useful even among teachers who had no prior ethics studies. However, it was observed that teachers and students should become familiar with ethics theory before dilemma discussions. Guidelines for arranging dilemma discussions are presented.

Keywords: computer ethics, ethics teaching, professional ethics, teaching of computer science

ACM: K.7.m, K.3.2
UDK: 681.3, 372.868.13, 17
ISSN: 0789-7316
ISBN: 951-708-691-1

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1. TEACHING COMPUTER ETHICS

Morality is a part of any reflective personal life and ethical problems are inescapable. It is difficult to think of any part of life which is not determined or conditioned by moral values (Callahan 1980). Computer technology has emerged rapidly to change and mould our society and culture. In Western society one cannot live without indirect or direct contact to computers. Computers have created old problems into new guise and phenomenon and problems of its own. Computer technology has social and ethical consequences: ethical problems like problems regarding privacy, confidentiality, security and ownership of intellectual property have emerged along the development and use of computer technology. James Moor (1985) define computer ethics in the following way:

> Computer ethics is the analysis of the nature and social impact of computer technology and the corresponding formulation and justification of policies for the ethical use of such technology.

Software, hardware and associated technology are included in the domain of computer ethics. The goals of teaching computer ethics in computer science education is to introduce students to these problems and courage them to become responsible professionals whose choices promote, e.g., the vision of National Conference for Computing and Values (NCCV) (Winograd 1995):

> To integrate computing technology and human values in such a way that the technology advances and protects human values, rather than doing damage to them.

According to Airaksinen (1995) Aristotle may be right claiming that the theoretical virtues are more important than practical virtues. With the help of the theoretical virtues one can get information about practical virtues (see Table 1-1). Virtues might be taught indirectly but the theory might be taught directly. Teaching ethics theory, critical analysis methods and developing awareness of how computer technology functions and affects we equip our students with tools with which they make their own choices. In this way students' autonomy is not violated.

Table 1-1: Practical and theoretical virtues (Airaksinen 1995)**.**

Practical virtues	**Theoretical virtues**
wisdom	understanding
courage	creativeness
integrity	rationality
reasonableness	criticality
benevolence	clarity

Integrating ethics vs. arranging course on ethics

Computing Curricula '91 (Tucker 1991) recommends knowledge units in social, ethical and professional issues as a part of the requirements. Computer ethics may be taught at least in two ways: integrating ethics topics into ordinary courses (Winrich 1994; Weltz 1998) or arranging a separate computer ethics course (Fisher and Abunawass 1994). Because the ethical problems in computing are an interwoven mixture of technical and ethical aspects, the theory and practice of computing and ethics should be handled together. This could be carried out by integrating ethics into CS courses: content of an ordinary CS course is dealt also from the ethics viewpoint. However, integration is not so easily organized: willingness of the faculty is needed and integration should be designed carefully to cover up all the necessary issues and to notice the development of students along the education.

In computer ethics course it is possible to go deeply into ethical theories and their application in real life. The content and teachers' education are, however, connected. Should philosophers, social scientists or computer scientist trained in ethics teach computer ethics and computers and society courses? Debate on this is found e.g. in Johnson (1994) and Martin (1994). According to Deborah Johnson (1994) courses on computer ethics and computers and society should have the following goals:

> 1) ”to make students (especially future computer professionals) aware of the ethical issues surrounding computers;
> 2) to heighten their sensitivity to ethical issues in the use of computers and in the practice of computing professions, so that they are more likely to see issues and respond appropriately;
> 3) to give them more than a superficial understanding of the ways in which computers (do and do not) change society and the social environments in which they are used;
> 4) to provide conceptual tools and develop analytical skills for sorting out what to do when in situations calling for ethical decision making or for sorting out what the likely impacts computer technology will have in this or that context.”

Computer ethics teaching in Finland

Currently there is no regular computer ethics teaching in the departments of computer science in Finland. To the author's knowledge there are Security and ethics (Tietoturva ja etiikka) and Computers and Society (Tietotekniikka ja yhteiskunta) course held at the University of Oulu and Computers and Society (Tietotekniikka ja yhteiskunta) course at the University of Turku. The author arranged Professional ethics in computing (Atk-alan ammattietiikka) course in spring 1998 at University of Joensuu in co-operation with the North Carelia Polytechnic. There was Information Technology and Ethics course held in the Swedish School of Economics and Business Administration in Helsinki, Finland during the fall 1998.

In this report the dilemma discussion method and the first experiences of using it in our department are presented. There was no aim to change the CS curricula - just take experiences from the separated discussions in different courses. The Research Fund of The Finnish Information Processing Association supported this study. The author wish to thank the teachers at the University of Joensuu and at the University of Kuopio for their patience and encouragement.

1.1 Integrated ethics and dilemma discussion

Integrating ethics into the curriculum (ethics-across-the-curriculum) means adding ethics module into an ordinary CS course. Most of the CS courses deal with issues which are easily discussed from the ethics or social point of view. For instance in Software engineering and Systems design courses the responsibility in systems development could be discussed and privacy and security issues could be taken out in Database course (see Table 1-2). Taking a few issues out in some courses is not enough. Integration should be planned over the curriculum so that the technology and ethics may walk hand in hand. According to Weltz (1998): ”becoming a responsible decision-maker is a process, and that process takes time”.

Table 1-2: Some computer science courses and suitable ethical topics.

Course	**Topics**
Introduction to computer science	Network ethics, email and newsgroup policies, piratism
Programming	Effects of programs in user environment
Computer systems	Network ethics, hacking, administrator’s duties and rights
Data structures and algorithms	Ownership of intellectual property
Databases	Privacy, large databases, security
Software engineering	Reliability, safety and complexity of software, professional responsibilities
User interfaces	The impact of interfaces on users, quality of worklife
Operating systems	Reliability, security
Artificial intelligence, Expert systems	Should computers make decisions?

Difference between a moral dilemma and a conflict

A moral dilemma is a situation in which a person morally ought to do A and morally ought to do B and s/he cannot do both at the same time - perhaps because B may be -A (Gowans 1987). If a person has promised to tell all and nothing s/he is in moral dilemma. The situation is called *moral conflict* if there is a genuine resolution. If a person has promised something but he must break that promise to save lives s/he is in *a moral conflict* (Foot 1987). Moral dilemmas are often situations where duties or obligations collide or one should choose between incompatible moral ideals (Mason 1996; Railton 1996). According to Hare (1981) if we knew more facts ethical dilemmas would show to be conflicts which are resovable. Let us imagine a programmer in project which is couple of months behind the schedule. He finds an error which would cause damage in the user environment. He tells about the error to his boss who says that the programmer should proceed to the next worktask. Now the programmer is at least in moral conflict: he should obey his boss but he has certain duties to the persons using the software. Circumstances define whether the situation is moral dilemma or conflict. Profound discussion about ethical dilemmas is found in Gowans (1987) and Mason (1996).

Dilemma discussion

In *dilemma discussion* a group of persons try to find out the ethically best solution to the given problem which may be real-life example or teacher’s invention. The problem may be at least apparent ethical dilemma or an ethical conflict. Persons participating dilemma discussion should analyse the situation with the help of ethical theories and try to find out the most defensible and justifiable solution. They may or may not find out the best possible solution. The main strength of the dilemma discussion is the diversity of opinions and thoughts which help enlarge the viewpoints by the help of the interactive discussion.

According to Winner (1991) dilemma discussion as the only method of ethics teaching in the engineering field is inadequate. In dilemma discussion the focus is usually on the professional who works for the organisation and who has met an ethical conflict or problem. The context in which the professional works is seldom questioned. According to Winner in the teaching of engineering ethics in addition to dilemma discussion the questions about the profession and it’s commitments, institutional patterns and power relationships should be dealt. Future computer professionals should not automatically accept the traditions of computing profession but they should be practised to critique and make changes when needed. Students should be aware of the possibility to re-evaluate or even reconstitute the profession field.

According to Lisman (1998) using integrated ethics in curricula students may become cynical about the importance of careful ethical thinking. This happens if courses fail to provide students with critically grounded approach for thinking about ethical issues. Students should be encouraged to take a basic ethics course in the philosophy department.

1.2 Psychological components of moral behaviour

According to Rest (1994) there are four psychological components that determine moral behaviour (see Table 1-3). Components describe four possible ways the person may fail to act morally. Strengthening each component could be seen as the goals of ethics teaching. There are complex interactions between components and they do not represent a temporal order.

Table 1-3: Four psychological components determining moral behaviour (Rest 1994)**.**

Component	Description
I. Moral sensitivity (Interpreting the situation)	Moral sensitivity means awareness of how our actions affect other people. It also involves being aware of alternative actions and how those actions affect other parties. Persons may fail to act morally because it just did not occur to her that her action would affect other people.
II. Moral judgement (Judging which action is morally right/wrong)	With the help of Component I person finds out lines of action and the Component II judges which alternative is morally justifiable (just or right). Kohlberg’s (Rest 1994) six stages of moral development are based to the theory that people change their moral problem-solving strategies as they grow. People in higher stages can understand the principles they used in lower stages but they do not prefer them anymore.
III. Moral motivation (Prioritising moral values relative to other values)	Moral motivation means prioritising moral values above non-moral values. A person fails in this component when s/he is not sufficiently motivated to put moral values higher than other values.
IV. Moral character (Having courage, persisting, overcoming distractions, implementing skills)	Certain amount of psychological toughness and strong character are needed in to carry out a line of action. A person may observe the ethically relevant issues, be able to make good moral judgement and prioritise moral values above non-moral values but if the person is weak-willed or discouraged s/he may not carry out the line of action.

Moral judgement develops as a person takes part in social life. In ethics teaching one aim is to bring students into contact with a highly diverse range of facts and views about world and address the complexities and dilemmas that arise when different people try to live together in this world (Rest 1994). Dilemma discussion provides the opportunity for persons to discover, understand and appreciate higher level moral arguments from their peers. Thus it would be useful to have diversity of person participating in dilemma discussion. According to Kohlberg (1976) experiences of role taking provide opportunities to growth in moral judgement.

The four component model is comprehensive model for moral development and the ethics teaching should support as many components as possible. How do we develop ethics teaching in CS? Dilemma discussion supports the components I and II (McNeel 1994). Components III and IV could be developed by the example of teachers. Components III and IV may be fatally violated if the university and its leaders do not act as model for it’s students (Hamming 1997; Väisänen 1997).

Moral sensitivity in computing

Development of moral sensitivity in computing means raising awareness both among users of the systems and those that design and develop those systems. Siponen and Kajava (1998) divide computer ethics awareness into two categories: professional ethics and end-user ethics. According to Rubin (1994) there is the *moral distance* between acts and the moral responsibility in computer usage. A person can act anonymously and remotely in computer networks and s/he may not see the consequences of his/her acts. One goal of developing moral sensitivity would be the narrowing of the moral distance. Computer users and professionals should be awakened about the fact that their computer usage make changes in the world and that those changes have often ethical implications.

The future computer professionals need understanding about the problems concerning the practice of software engineering and how computers and their usage affect other people and society. Money, time and quality are often the main factors for (ethically) problematic situations between computer professionals, their clients, employees and society.

1.3 Neutral teacher and relativism

To advocate neutrality in teachers is the desire to avoid turning teaching into indoctrination. Indoctrination means imposing body of doctrines held by the teacher to the student who receives beliefs uncritically and on the basis of unquestioning authority (Warnock 1975; Lisman 1998). The limits of indoctrination are sometimes hard to define. Charismatic teacher may cause students to be disinclined to doubt what s/he says. Free will and autonomy are prerequisites to ethical decision making. We cannot held someone responsible if s/he is not capable to independent decision making. Indoctrination should be avoided because it excludes autonomy.

The second reason for advocating neutrality in teachers is to guarantee the independence of the learning and discovering by thought experiment in the way that they reach their own conclusions. Trial and error and genuine argumentation are needed in independent moral learning (Warnock 1975). According to the belief of *liberal neutrality* we should respect student's right to make up his or her mind about ethical issues (Lisman 1998).

Learning computer ethics means ability to find out ethically important viewpoints and parties affected by different courses of actions. Some conflicts may be solved with the help of computer technology itself. Thus the technical know-how is vitally important. Computer professionals need skills to see situations from other people's standpoints (e.g. users and colleagues) and ability to observe larger connections of their actions. Discussions concerning ethical issues of ADP profession (lead by computer professional or computer ethics teacher) should be neutral and open-minded situations where students are encouraged to express their opinions and criticise other students' opinions. CS students should be taught to think by themselves finding ethically best solutions by themselves.

Relativism

According to *moral relativism* there is no single moral code which has universal validity but moral truth is some way relative to factors that are culturally and historically contingent. According to *normative relativism* it is wrong to pass judgement on others who have substantially different values or to try to make them conform to one's values (Wong 1993). Making decision in moral life is not easy: trying to find out the best possible alternative when we recognise that there may not be single and final truth at all. It seems that we must accept *moral uncertainty* as essential part of human life (Bauman 1997). Because there are no unequivocal answers to ethical questions students may believe that we may make up ethics on the side (Lisman 1998). Although we may agree that in dilemma discussions every seriously held views and opinions have equal right to be heard and examined - all moral views are not equally correct (Rosen 1980). To avoid relativism (and the extreme *nihilism*) the teachers should highlight the importance of argumentation and critical analysis to find out the ethically relevant issues. Cases which seem to be ethical dilemmas may turn out to be ethical conflicts in which one can produce defensible decision.

2. THE INTEGRATION EXPERIMENT

This experiment was based on the question: what an ordinary teacher could do in the area of ethics teaching? It was supposed that a CS teacher could coordinate discussions in his/her research area and possibly enlarge students' viewpoints. The goals of the integration experiment were to find out how the discussions about ethical issues worked and how useful the dilemma discussion were felt by the students and teachers. It was expected that teachers would be able to coordinate the discussions even without ethics theory know-how. Students were expected to be motivated in ethical decision making practices because the dilemma discussion would combine the computer science theory and future worklife situations. In this report we are interested in how the problem solving went and how teachers and students experienced the experiment. The profound analysis of the dilemmas used in the exercises is bypassed. Dilemma discussion may be used at least in two different ways: general discussion or role-playing (Shaftel and Shaftel 1982). Role-playing was not used in this experiment.

2.1 General arrangements

Five teachers in the Department of Computer Science (University of Joensuu) and the Department of Computer Science and Applied Mathematics (University of Kuopio) took part in the experiment. During fall -97 and spring -98 five courses were selected (see Table 2-1): one from the approbatur (KUO1), two from the cum laude approbatur (JOY2, JOY4) and two from the laudatur stage (JOY2, KUO5). Five voluntary teachers took part in this experiment. In every course one teacher held the exercises. JOY4 course was taught by the author of this report. Student participation in exercises was voluntary.

Table 2-1: CS-courses in the experiment of integrating ethics (JOY = in Joensuu, KUO = in Kuopio). Quantity of students means students participating in the general discussions.

Code	Timing	Course	Issue of dilemma(s)	Qty of Students	Academic year
KUO1	fall -97	Introduction to Computer Science	different questions	26	1
JOY2	fall -97	Systems Design	privacy, reliability, responsibility	8	2
JOY3	fall -97	Software Engineering	privacy, reliability, responsibility	11	3
JOY4	spring -98	Computer Systems	privacy of files	24	1
KUO5	spring -98	Methods in Systems Analysis	testing	17	3-4

Teachers of JOY2 and JOY3 participated beforehand in an ethical problem solving exercise arranged by the author. In the planning phase of the experiment four teachers in Kuopio took part in same kind of exercise, one of them explained the idea of the ethical problem solving to the teacher of the excersices of the course KUO4; the teacher of KUO1 did not participate in the exercise at all. During the exercise teachers were told about ethical decision making and they resolved an ethical dilemma in the same way as they were expected to coordinate ethical decision making during the experiment.

At the beginning of the courses in CS departments (fall'97 and spring'98) students filled the questionnaires in which their attitudes towards certain worklife and studentlife situations were measured. The questionnaire is a replication of the study of Benham and Wagner (1995). The results are to be published.

For the courses JOY2 and JOY3 students were given a booklet My Choices are My Ethics, Introduction to Computer Professional's Ethics (in Finnish: Valintani ovat etiikkani - Johdatus tietotekniikan ammattilaisen etiikkaan) (Vartiainen 1997) as a background text. The booklet included a short introduction to ethical theory and main ethical problems in computing. The booklet was created with the help of the Ethics workgroup of The Finnish Information Processing Association.

2.2 Arrangements in courses

In every course, except KUO1, students were given the ethical problem solving method and a case description about which they had to discuss before the exercise. The ethical problem solving method was changed by the experiment. Different versions of the method are found in Vartiainen (1998). The author has developed this new method based on the idea of prima facie duties (Ross 1987). Cases of JOY4 and KUO5 were from Kallman and Grillo (1996).

Course KUO1

In the KUO1 course, students were given four cases (see Appendix A). Case 1 is based on author's experiences as a CS student. Case 2 was found in Slimick (1995) and transformed to a different form (Vartiainen 1998). Case 3 is based on a study of Benham and Wagner (1995). Case 4 was created by the inspiration of Palme (1997). In this course students did their homework independently and during the exercise there were general discussions about the problems.

Courses JOY2 and JOY3

In both courses students were divided into two groups: (A) students participating in dilemma discussion and (B) students not participating in dilemma discussion. There were 8 (JOY2) and 11 (JOY3) students in groups A. Both groups were pretested and posttested: at the beginning of the course and after dilemma discussion students filled the questionnaire in which respondents attitudes were evaluated. The questionnaire was the same as Wagner and Benham (1995) used in their surveys in USA. Groups A were given two cases in which a computer professional had met an ethical dilemma. The first was the administrator's dilemma and the second was the quality engineer's dilemma. The first dilemma was meant to be for training purposes and it was not discussed during the exercise. The second dilemma was discussed during the exercise. First the students solved the dilemmas independently and wrote down their thoughts. Then they gathered into groups of 3-4 students and discussed the situation and tried to solve the problem. The resolution of the group was written down. Finally they arrived in the exercise where they all discussed the problem.

The ethical problem solving method and two cases in Finnish are found in Vartiainen (1998). The administrator's dilemma (Surveillance in the net) is described below and the quality engineer's dilemma is found in McFarland (1990). In the latter dilemma, a quality engineer has met a situation in which he is pressed to pass the safety-critical software although he has expressed himself that it may fail.

> Surveillance in the net
>
> Both X and Y are computer science students. During a social event they meet each other. Y allures X who fall in love with Y. After the next morning when the 'truth' has been revealed Y does not want to be in contact with X any more. X can't get Y out of his/her mind. While doing exercises the workstations of the CS department s/he uses *finger* and *w* commands to observe Y's activities. Later X writes UNIX-program (script) which starts itself in every tenth seconds and finds out all possible data concerning Y in the system. Y does not know anything about the surveillance.
>
> One day the administrator of the UNIX-machine observes that the script takes too much processor time. Administrator looks for the script and finds out how it works. Now he wonders what he should do...

Course JOY4

The author was the teacher (both lectures and exercises) of the JOY4 course. During the lectures the students received a short introduction to ethical problem solving, the problem solving method (see Appendix B), and Case 4 ”Abort, Retry, Ignore - Recovery of Data Leads to Discovery of Confidential File” (Kallman and Grillo 1996). The author developed the problem solving method combining the good points of Collin's and Miller's (1992) Paramedic method and Kallman's and Grillo's (1996) Four step analysis method. The development of this new method is not introduced here.

In the used case the technical supporting person was asked to recover a file from the hard disk. She did it but she felt that she should rescue more files because she had the time. During the cleanup of the disk she found a file the content of which was peculiar: there was confidential data concerning the staff of the organisation. She started to wonder what she should do with the confidential file.

Course KUO5

The teacher lead the discussion in two groups in KUO5 course. Students were third and fourth year students who tried to solve the problem in Case 13 ”Test Data - Confidential or Dummy Data” (Kallman and Grillo 1996) with the help of the same method used in the JOY4 course. The main problem was to decide whether use of real-life data in testing the software when the regulations of the organisation denied that possibility because of the privacy of clients.

2.3 Students' experiences

In the end of the exercises students were given questionnaires with which they could give feedback of the dilemma discussion. The questionnaire was filled after the discussion in their own time except in the course KUO1 the questionnaire was filled just right after the discussion.

Students were given guidelines for ethical decision making and the description of situation in which a computer professional had faced an ethical dilemma. Students tried to solve the dilemma in groups before entering the exercises where one group was selected to tell their views and decisions. The general discussion followed the performance of that group.

Course KUO1

The students' feedback from the KUO1 course was mostly positive. Most of the students felt that they learned useful and reasonable matters for their future profession (42% agreed totally and 27% agreed slightly - see Table 2-2). 15% of students slightly agreed when asked if their opinions were changed. However, the majority felt that their opinions didn't change. In the questionnaire students were asked what they learned during the discussion and whether the discussion was useful or useless. Here are some answers:

> There is no absolute truth. The presuming of the absolute truth kills the discussion.
>
> I learned that I am not alone with my opinions which are a little bit different to the general opinions. There are other people who think like me.
>
> The discussion was useful. I learned more about other students than about the subject of the discussion.
>
> The discussion was useful. Not until this course I noticed that these matters should be deliberated and we should not just overlook the situations which are ethically doubtful.
>
> A couple of new viewpoints. The discussion cannot be said to be useless but not absolutely necessary.

Courses JOY2 and JOY3

The students' feedback from the JOY2 and JOY3 courses were slightly positive. In Tables 2-3 and 2-4 there are the numerical evaluations of the students' experiences. Tables should be read with care because the quantity of respondents is small. Some students in the JOY2 course pointed out that it was difficult to find out the solution because the case descriptions did not tell all the details needed in decision making. Student were asked whether it was difficult or easy to deliberate, discuss and solve the situations. Some of them answered in the following way (in the JOY2 course):

> The deliberating and solving of the situations were hard because the things seem to become contradictionary to each other while thinking about the situation. The things are so dependent on each other that it is not possible to form solution which benefit every one.
>
> It was difficult because the scenario descriptions left so many open questions. There were too many solution models.
>
> Everyone has an opinion and therefore it is easy. The decision making (final solution) was harder.

The students were asked if their opinions were changed during group work and/or discussions. Some responses from JOY2 and JOY3 courses:

> Opinions did not change. Some new points came out.

> Opinions did not change. In the group discussion I started to think about a few new points of view. In the group discussion there did not come out radically different opinions but all were nearly in agreement.
>
> Opinions did not change during groupwork and discussion and there were no big differences between the opinions of my own and those of others. But perhaps in the discussion some points came out that did not occur in my mind.
>
> Because the group discussion was not very fruitful my opinions did not change. In the general discussion I got a little bit distance to Heikki[George] orientation. After hearing several points of views I started to think from a little bit larger point of view. My opinions enlargened but I did not become to disagree with other students.

According to the students' written responses in the case of Surveillance in the net they were concerned about privacy of both X and Y. The privacy of Y is violated by X who constantly gets information about Y. The practice of X is seen to be immoral because X uses constantly finger and w commands. The occasional use of those commands is seen acceptable but using them in every tenth second is seen unacceptable although the information obtained is not critical. In some answers the action of administrator was seen questionable because he was looking into X's script without his/her permission. The situation of the administrator was seen difficult because he had to do something to solve the case but the correct action was not easily found.

In the case of the quality engineer, students understood George's (Heikki's) difficult situation and the complex web of obligations and duties. Student understood the criticality of the software and the requirements of high quality. Pilots' and peoples' safety was highlighted and the action of the management was seen to be unethical. There was slight disagreement about the party in the worst position (George, pilots and the firm were mentioned). The decision making seemed to be difficult because there were lots of influencing issues in the dilemma. Most students felt that the management should listen to George and delay the production.

The results of comparing the pretests and posttests among the A and B groups are to be published.

Course JOY4

The students' feedback of the JOY4 course was slightly positive (see Table 2-5). There were three exercise groups in which the discussions were held. One of the groups was so small that the start of discussion needed teacher's push. In the two other groups the discussions about the case were lively and students expressed their opinions. The author tried to be neutral. When the author observed that students did not notice some important matters he made neutral questions like 'Is there any other party which could be affected by that alternative?' and 'Is there any other way that problem could be solved?'.

When asked to describe how the teacher should lead the discussion some students responded in the following way:

> The teacher should stimulate the discussion with arguments and questions. The teacher may present and state arguments for his/her opinions - but not as "the final truth."
>
> It is useful that the teacher mentions points of views that students haven't said or guessed.

> The teacher should guide the discussion. S/he should not necessary present his/her opinions.

When asked what they learned most of the students wrote that they felt that they noticed new viewpoints and opinions about the dilemma. Some wrote that ethics is a difficult area and that there is no clear solutions to problems.

Course KUO5

The students' feedback of the KUO5 course was slightly positive (see Table 2-6). The discussions were occasionally heated and opinions strong. According to the written feedback the students seemed to be devided into two opposing groups: the others felt that the programmers do not have the right to the genuine data and the others felt that because the programming team was inside the company they should be given genuine data. Students were asked what they learned in the discussion. Responses were similar to the students' responses in other courses. Students learned different viewpoints although their opinions did not change dramatically. Here are some answers:

> The questions about employees' responsibilities in the organisation like insurance companies. The formulation of the right decision might be ethically impossible.
>
> The skills of discussion.
>
> People have many different views even in small matters.

Couple of students mentioned that the map of parties and duties and the decision tree were very useful. Some students talked about their experiences from the summer jobs:

> The participants had their own experiences from the summer jobs. It was nice to hear about different manners used in different workplaces.

Table 2-2: Students' responses (percents) in KUO1 Introduction to computer science course (26 respondents; of those 73% were male and 27% female).

Argument	totally disagree	slightly disagree	not able to comment	slightly agree	totally agree
In groupwork and discussion I learned useful and reasonable matters for my future profession.		4	27	27	42
In the worktasks of computing there is need for ability to make ethical decisions.				38	62
In my studies in CS I do not feel the need to be introduced about matters of professional ethics.	56	44			
My opinions about the solutions to cases were changed during *discussion*.	38	15	31	15	
If Computer ethics course was arranged I would participate it.	4		8	44	44
Even if attitudes of ethical decision making were done anonymously I feel surveying attitudes uncomfortable.	73	19	8		

Table 2-3: Students' responses (percents) in JOY2 Systems design course (8 respondents).

Argument	totally disagree	slightly disagree	not able to comment	slightly agree	totally agree
In groupwork and discussion I learned useful and reasonable matters for my future profession.		38	13	25	25
In the worktasks of computing there is need for ability to make ethical decisions				38	62
In my studies in CS I do not feel the need to be introduced about matters of professional ethics	50	38		12	
According to my experiences the teachers of CS department take out as a whole good professional values and good models for worklife.	12		25	62	
Generally I take part in group works willingly		50		25	25
This group work was all in all reasonable		25	25	38	12
My opinions about the solutions to cases were changed during *group work*	12	50		38	
My opinions about the solutions to cases were changed during *discussion*	25	38		38	
If there were course on professional ethics in computing I would participate it.			25	50	25
Even if the questionnaire about attitudes was done anonymously I feel surveying my attitudes uncomfortable.	62	25	12		

Table 2-4: Students' responses (percents) in JOY3 Software engineering course (6 respondents).

Argument	totally disagree	slightly disagree	not able to comment	slightly agree	totally agree
In groupwork and discussion I learned useful and reasonable matters for my future profession.		17	17	33	33
In the worktasks of computing there is need for ability to make ethical decisions				33	67
In my studies in CS I do not feel the need to be introduced about matters of professional ethics	50	17	17		17
According to my experiences the teachers of CS department take out as a whole good professional values and good models for worklife.		17	33	17	33
Generally I take part in group works willingly		33	17	33	17
This group work was all in all reasonable		17	17	50	17
My opinions about the solutions to cases were changed during *group work*		33	16	50	
My opinions about the solutions to cases were changed during *discussion*		17	17	67	
If there were course on professional ethics in computing I would participate it.			33	33	33
Even if the questionnaire about attitudes was done anonymously I feel surveying my attitudes uncomfortable.	50	33	17		

Table 2-5: Students' responses (percents) in JOY4 Computer systems course (24 respondents; of those 73% men and 27% women).

Argument	totally disagree	slightly disagree	not able to comment	slightly agree	totally agree
In groupwork and discussion I learned useful and reasonable matters for my future profession.	4	8	33	33	21
In the worktasks of computing there is need for ability to make ethical decisions		8		38	54
In my studies in CS I do not feel the need to be introduced about matters of professional ethics	29	33	25	13	0
Generally I take part in group works willingly	4	13	4	39	39
This group work was all in all reasonable	4	30	4	52	9
My opinions about the solutions to cases were changed during *group work*	33	42	8	13	4
My opinions about the solutions to cases were changed during *discussion*	33	25	21	17	4
This exercise of solving ethical dilemma is well suitable to this course	17	21	17	33	13

Table 2-6: Students' responses (percents) in KUO5 Methods in systems analysis course (17 responds - gender was not asked).

Argument	totally disagree	slightly disagree	not able to comment	slightly agree	totally agree
In groupwork and discussion I learned useful and reasonable matters for my future profession.	6	18	41	35	
In the worktasks of computing there is need for ability to make ethical decisions	6	12		53	29
In my studies in CS I do not feel the need to be introduced about matters of professional ethics	24	47		18	12
Generally I take part in group works willingly	6	6	18	47	24
This group work was all in all reasonable		24	35	35	6
My opinions about the solutions to cases were changed during *group work*	12	53	24	6	6
My opinions about the solutions to cases were changed during *discussion*	24	41	24	6	6

2.4 Teachers' experiences

The teachers found the adding of ethics module into exercises and leading of the dilemma discussions reasonable and useful idea (see Table 2-7). There were no prior studies in ethics among teachers (except the author) participating in the experiment and the unfamiliarity with ethics caused teachers to feel uncertainty in general discussions. The author asked teachers to evaluate their familiarity with ethics as it was before the experiment (and before rehearsal of solving ethical dilemmas). In the scale 0=none, 1=very little, 2=little, 3=to some extent, 4=much, 5=very much the mean value was 2.4 (all teachers) and 2.0 (all except the author). The rehearsal in which teachers tried to solve an ethical dilemma was seen as prerequisite for teachers to be able to coordinate the discussion among students.

One teacher felt that she was one of the students while discussing about the dilemma. One was convinced that students at least learned that other people have different opinions and that ethics is quite relative. Some feedback:

> Even if I do not believe in learning by discussion in computer science, in this case it is otherwise.
>
> About the amount of the discussion it could be noticed that ethical questions are interesting and important.

Two teachers felt that it may be dangerous to let teachers without ethical knowledge to guide dilemma discussions. Without ethical knowledge teacher may be uncertain and may not have the courage to lead the discussion. In addition teacher could emphasise wrong matters and make mistakes. One teacher argued that teachers leading dilemma discussions could not be found any other way. One teacher pointed out that s/he could add ethics into lectures but there would be difficulties in connecting ethics module to the main issues of the course. Putting ethics module to the last lectures would not be good idea but ethics modules in the exercises would work well.

Table 2-7: Teachers numerical evaluation (4 respondents, everyone except the author). KUO1 teacher did not answer the question concerning whether students were active and motivated in groupwork.

Argument	totally disagree	slightly disagree	not able to comment	slightly agree	totally agree
Adding a professional ethics module into exercises in the course was all in all useful and reasonable.				3	1
Adding a professional ethics module into lectures of the course would be all in all useful and reasonable.			1	2	1
Dealing with professional ethics in the exercise lessen the amount of theory teaching in disturbing manner.	1	3			
Dealing with professional ethics in lectures would lessen the amount of theory teaching in disturbing manner.		4			
In leading discussions about professional ethics I would need studies in ethics theory.			1	3	
The students were active and motivated in groupwork.			1	2	
The students were active and motivated in general discussion.				4	
I could add a short review about professional ethics into my lectures.			1	2	1

3. CONLUSIONS AND FUTURE RESEARCH

The author's viewpoint to the dilemma discussion changed during the experiment. We need more profound education in ethics theory among teachers and students. Guidelines and proposed future actions are presented.

3.1 Lessons learned

In feedback forms students told that new viewpoints come out during the general discussion when many students expressed their opinions. According to students' numerical evaluations their opinions did not change but in the open ended questions they felt that they acquired new viewpoints. In there is the collage of the students' written responses converted to the numerical format (see Table 3-1). Some students felt that they noticed new parties in the situation during general discussion and that they saw the situation in larger context.

Table 3-1: Course specific number of questionnaires in which the respondent told that his/her opinions were *enlarged* or s/he got *new ideas*. Respondents were asked whether their opinions were *changed.*

Course	Qty of questionnaires	% of students experienced opinion enlargement or got new ideas
KUO1	26	62%
JOY2	8	63%
JOY3	6	67%
JOY4	24	63%
KUO5	17	41%

Groupsize

In two courses there were discussion groups which appeared to be too small (8 or fewer students). In these exercises students felt that the opinions were similar to each other and the discussion was not good enough:

> Opinions were quite similar to each other so the discussion was not good enough.
>
> The diversity of opinions was smaller than I expected.
>
> We could have handled the situation more versatile and think about the situation from the other persons' viewpoints.

On the other hand some students hold their solutions as the final truths:

> Weak points of the discussion was that some hold their views as the final solutions and truths. Discussion about ethical matters is impossible for some ones because they shout their own opinions eyes and ears closed and do not want to hear about other alternatives.

One goal of discussions is to introduce students to variety of opinions and viewpoints. The more larger group the more different opinions could came out. But if the group is too large some ones could not get turn of speech. In too small group one student's opinion would get too much attention. The exercise groupsize of 10-20 students could be the appropriate size. If we are trying to strengthen students' moral development the quantity of students may not be the the crucial factor. Instead if there are diversity of opinions and students represent different moral development stages the overall development might be better.

Neutrality of the teacher

Many students felt that because teachers have more experience from the worklife than students teachers could present their opinions and experiences but not hold them as final truth. A few students wrote that because teacher is in authority s/he should not express her/his opinions at all:

> The teacher should guide the discussion to avoid it going to irrelevancies. The teacher should not present his/her opinions because s/he is always some kind of authority.
>
> The teacher should take out totally different viewpoints because students tend to have same kind of opinions.
>
> The teacher should keep the discussion in the right subject. Teacher may present his/her own opinions because they often further the discussion.

Need for ethics teaching

According to the students (see Table 2-2 ... Table 2-6, Table 3-2 and 3-3) there is need for some kind of ethics teaching in computer science. However, there are only few CS teachers specialised in ethics in Finland. Computer ethics courses could be carried out by videoconferencing or CS teachers could take studies in ethics to be able to arrange dilemma discussions.

Table 3-2: Student evaluation of the need for teaching professional ethics in computer science.

Is there need for teaching professional ethics in computer science?	KUO1 (26 respondents) %	JOY2 (8 resp.) %	JOY3 (6 resp.) %
Yes	64	25	50
Maybe	16	25	16
Somewhat	20	50	33
No	0	0	0

Table 3-3: Student evaluation of the phase in computer science studies when the professional ethics should be dealt with.

Phase	KUO1 (26 resp.) %	JOY2 (8 resp.) %	JOY3 (6 resp.) %
General studies	15	57	0
Cum laude aprobatur	23	29	50
Laudatur & the final study	15	0	33
Practical training	4	0	0
All the time	38	0	17
Laudatur/postgraduate studies	4	14	0
No need for professional ethics	0	0	0

Need for methods

Few students felt that there is no final truth at all and some didn't know to which alternative turn to:

> The solving of the problem was very hard; every party in the situation was in a way right (at least in some senses) so I didn't know to which alternative I should turn to.
>
> Some kind of solution came out quite easily but during close examination the finding of the right solution became harder because many influencing factors emerged.

Teaching of ethics theory is needed because if we leave students into the moral dilemmas (or conflicts) without appropriate tools they may start thinking that because you cannot make solutions it does not matter what you do. Although students may be given problem solving method the ethical theories used should be taught somehow (lectures or background text).

Other foundings

The arranged groupwork was seen reasonable (both slightly and totally agreed) among over 40% of students in every course. Over 70% of students in courses JOY4 and KUO5 felt that they generally take part in groupworks willingly. Half of the students in courses JOY2 and JOY3 felt in the same way. Over 80% in every course felt that they did not find the attitude questionnaire uncomfortable because it was responded anonymously. Anonymous measurement of attitudes does not seem to violate students' sense of privacy.

Summary

In this experiment we were taking the very first steps in searching for useful ways to teach ethics to CS students in the Finnish computer science departments. Students like the dilemma discussion but the modules in different courses should be connected into larger wholeness.

Dilemma discussion helps in developing student awareness of the situations in the worklife. In their best the discussions may connect the theory taught in the courses and the real life situations. Students appreciates the stories about worklife either told by the other students or teachers. Dilemma discussion helps students to understand the variety of thoughts and opinions and the possibility to change one's mind when necessary. Taking part in discussion means that student must defend his/her arguments and compare those to others' arguments. The possibility for the development of the moral judgement increases when there are students representing different stages of moral development. There is need for tools and methods with which students could analyse situations and give arguments for their decisions. Ethics theory should be taught in some way (background text or lectures).

Integrating ethics into curriculum successfully would mean curriculum-wide decisions, willingness and education of the faculty. Ethical issues could be addressed as they naturally arise in the students' experiences (Rest and Narvaez 1994). There are at least two objections using only dilemma discussions in ethics teaching. Firstly dilemma discussion would be inadequate because the wider questions about the consequences of computing and the interests and goals of employees may not come out. Secondly computer professionals meet difficult dilemmas rarely and these discussions would not represent the worklife conditions properly. In ethics teaching the importance of everyday decision making (e.g. in systems design) should be emphasized.

However, dilemma discussion is an important method with which the awareness and decision making are improved. Dilemma discussion is worth accomplishing although the wider questions might be left out.

The idea of the dilemma discussion lead by teacher who is not familiar with ethics theory should be abandoned. Teacher may present totally new viewpoints even without ethics knowledge and thus students' awareness may be enlarged. But if teacher and students do not know the groundings of the ethics students may be left drifting among the numerous alternatives. There is danger that students start to feel that all the ethically relevant situations are dilemmas and there is no use to investigate whether the situation would be an ethical conflict. In dilemma discussions ethics theory is needed to some extent both among teachers and students. Teachers could, however, raise general questions about ethical issues like the questions used in KUO1 course (see Appendix A) but not the question 2 which is a dilemma description.

It might be argued that we should not hire philosophers from philosophy departments to teach CS students ethics. According to Gotterbarn (1994) CS students understand the importance of professional ethics better if they were CS teachers who teach ethics rather than if they were philosophers. Philosophers would, however, be better in teaching theoretical skills like the ethical theories, logic and argumentation. There might arise the question about compulsory ethics course either in philosophy department or computer ethics course in CS department. Compulsory ethics courses may not be good idea because they might make technically oriented students disinclined to ethics.

If the students' subjective opinions are relevant (feedback questionnaires) the experiment has shown that although the change of mind (which was not the main purpose) was minimal the enlargement of students' opinions were at least mediate (see Table 3-1) and that students' sensitivity developed at least somehow. Probably some students did not achieve solid solutions but hopefully they learned argumentation skills and their awareness increased. The author cannot recommend the replication of this experiment without more profound teacher and student education in ethical theories.

All in all the dilemma discussion needs a) teacher's knowledge in ethics and his/her neutral attitude, b) a lecture about main ethical theories, c) connection between the issue of the dilemma and the issues of the course and d) talkative students.

3.2 Guidelines for teachers

Teachers who plan to integrate ethical decision making into their courses should seek ethics knowledge from the literature (e.g. Kallman and Grillo 1996) or take part in the basic ethics courses in philosophy departments. Exercise in decision making with other teachers is also recommended. Students should be taught ethical theories somehow.

In the introduction courses dilemma discussion about worklife may not be good idea because first year students do not identify themselves in the roles of worklife. Separate questions and discussions about honesty, privacy, email or computers and society are useful. The dilemmas or conflicts confronting students in educational institutions are in the domain of students' experiences and thus useful: e.g. student playing games in workstation in microclass while another student needs workstation to complete a homework assignment (Sumner and Werner 1997). The more familiar students get into worklife through different CS courses the more they have capabilities of identifying themselves in the worklife situations.

In analysing and decision making students need some background in ethics theory. Basic course on ethics or background text like Vartiainen (1997) or Kallman and Grillo (1996) is appropriate. Before the dilemma discussion there should be a lecture about the main ethical theories with which students could produce defensible decisions. Ethical problem solving method like the paramedic method (Collins and Miller 1992), Kallman's and Grillo's (1996) or Pierce's and Henry's (1996) method could be given to students for a framework. In the third and fourth year courses the broader questions should be taken out. The effects of computers in society and the interests and goals of students' future employers and the computing profession should be critically analysed. The best groupsize might be 10 - 20 students.

Teacher's role in dilemma discussion

Teacher should get acquainted with the case so that he could present questions and viewpoints which do not occur in students' minds. Dilemma discussion could be carried out in the following way: At the beginning of the exercise teacher selects one group which could present shortly the dilemma and the parties affected and their obligations. First they should draw a map of the parties and obligations and a decision tree into blackboard or overhead projector (see the picture in appendix B). After that they should present the good and bad points of each alternative and give arguments for the best alternative (if they found any). Then is the time for general discussion when the students are couraged to express their opinion. Students may start conversation by themselves but sometimes teacher must make the first questions to warm up the discussion.

In the situation when teacher is uncertain whether it is appropriate to take out her/his opinions s/he should act in the neutral way. Generally teacher could use the following kinds of neutral questions: Is there any other parties which are not mentioned? How alternative X affects party Y? What other consequences does this alternative have? Does this alternative violate Y's rights? What else could Y do? If the discussion is going to irrelevancies teacher could say: Let us go back to argument that one of you said. If students are very unanimous in their opinions teacher should give different viewpoints: How about Z? If someone suggests X how would you respond? Is that alternative universalizable into different places or times? Do you find any negative consequences of your alternative?

However, problems may rise. A student may not listen to anyone but consider his/her opinion as the only right solution and may even try to convince other students to his/her opinions. Sometimes discussion may not start at all. In both cases the teacher should point out to the students that the purpose of the discussion is to enlarge each others' viewpoints and that the listening to the others' ideas is vitally important. Some students may start thinking that there is no use in discussion about ethical matters because there is no right answer at all. Courses of actions differ and one should be able to make defensible action. The importance of argumentation should be pointed out. Situations which seem to be ethical dilemmas may by the closer investigation appear to be ethical conflicts.

In the end of the discussion the teacher could e.g. sum up the best alternatives or find out if there were alternative that everyone could accept. The teacher and students could also discuss about the discussion itself and analyse whether it was reasonable and useful exercise.

3.3 Future actions and research

The next step in the integration experiment would be the design and implementation of total ethics-across-the-curriculum integration. The impact of ethics teaching in computing should be evaluated e.g. with the help of metrics developed for analysing moral judgement (Rest 1994). Usefulness of role-playing should be tested.

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APPENDIX A: Exercises of the course KUO1

1. User surveilance in UNIX

X and Y are computer science students. Both of them have taken part in the C-language course whose examination is approaching. X notice with the help of w command in UNIX that their teacher is editing **palindrome.c** file. Later the teacher edits **hanoitower.c** file. X tell Y about it with advising Y to practise writing palindrome and Hanoi tower programs. Y did as X advised.

Write your evaluation and consideration about the behaviour of X, Y and the teacher from the ethics viewpoint in the following cases:

a) The teacher did not know that his/her commands are seen in the system. Palindrome and Hanoi tower were asked in the examination.
b) The teacher knew that his/her commands are seen in the system but s/he did not care that the students could guess the problems. Two assignments in the examination were about palindrome and Hanoi tower problems.
c) The teacher knew that his/her commands are seen in the system. The teacher wanted to cheat the potential spies and in the examination s/he did not ask about palindrome and Hanoi tower.

2. The databases of library

Background: Fran is an information specialist in the library of a large state university. Recently, a group of radical animal rights activists has threatened to blow up the biology building unless biomedical experiments on dogs are stopped.

[State Police Officer] "We’re trying to stop the animal rights activists from blowing up the biology building and we would like for you to provide us with a computer printout of anyone who has ever checked out any books on explosives, demolition, or animal rights."

[Fran] "It is against university policy to give out computerised student records."

[State Police Office] "But this is a life or death situation."

Do police have right to ask records? Should the manager specialist give the records?

3. The ownership of software

A student at a university learned to use an expensive spreadsheet program in her accounting class. The student would go to the university microcomputer lab, check our the spreadsheet, complete her assignment and return the software. Signs were posted in the lab indicating that copying software was forbidden. One day, she decided to copy the software anyway so she could work on her assignments at her apartment.

Evaluate the ethicality of the student's actions and possible ethical problems concerning the situation in the following cases: **a)** the student were going to destroy the copy at the end of semester, **b)** the student was not going to destroy the copy.

If your considerations differ in a) and b) state arguments for the differences.

4. Computers and society

Read the exemplary scenario. Evaluate how the use of computer based applications affect our society. Is it reasonable/useful to add computer based applications everywhere? Give arguments for the reasonable/useful introduction of computer technology. What purposes or uses there are that computers should not be taken into? Give arguments for all your responses.

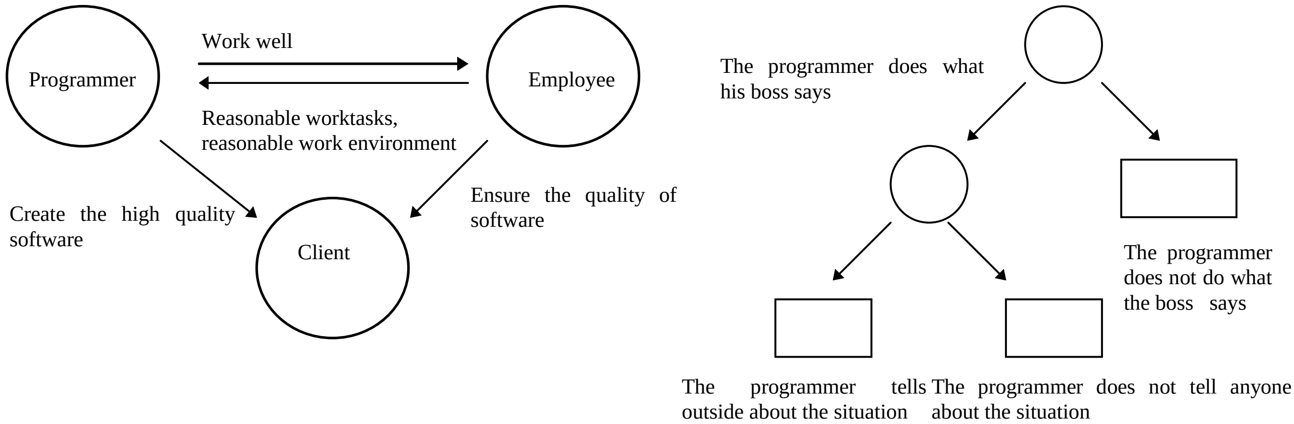
> X, Y and their friends were having a social event in a distant cottage where they had come by a car. Everyone but Y drank alcohol. Suddenly Y got pain in the chest and fell onto the floor. No one could tell what kind of first aid he should have been given to. X tried to call the ambulance with her mobile telephone but because the cottage was situated in the blind spot the connection between emergency central and the cottage could not be established. They made decision that the person who had drank least alcohol would drive Y to hospital. Y was situated into the backrest of the car and X was seated to the driver's seat. The car did not, however, start because it had drunk proof system which prevents drunken driver to start the engine. X knew that the system could be disconnected. She tried to find the switch in the panel but the multiplicity of switches confused her anxious mind and she did not find the switch. Even the manual of the car was not found. One member of the group decided to run to seek help.

APPENDIX B: The Ethical Problem Solving Method

The Ethical Problem Solving Method

With the help of this method you may survey, analyse and give arguments for the decision. If needed - you may turn back in the flow of method. The method is based on Collin's and Miller's (1992) and Kallman's and Grillo's (1996) methods.

a) What affecting issues are ethically important? What issues need reaction now or in the future?
b) List all the parties in the situation. Parties are persons or organisations which take part in the situation or are affected by the situation. Society can also be a party. Recognise the party which is in the weakest position.
c) Which party has met an ethical dilemma which need instant resolution?
d) Draw the map of parties and the most important duties between parties (see Picture 1). Recognise the rights of the parties. The other party's right might be the other party's duty. Define which duties are more important than other duties.



Picture 1: The map of parties and their responsibilities and the decision-tree.

e) Alternatives: What the party chosen in c) could do in this situation? Draw the decision tree (see Picture 1).
f) Create new alternative: All the parties are in the meeting where they try to create a new alternative which would be accepted by all the parties (consensus). Every party has right to veto - also the party in the weakest position.
g) Analyse *every alternative* with the help of the following questions:
    1) What good or bad *consequences* the alternative causes to the parties?
    2) How the alternative affects to the *fulfilment of duties*? The alternative may fulfil the duty totally, partly or not at all.
    3) How the alternative fulfils the following rules: "*Act as if the maxim of your action were to become by your will a universal Law of Nature*" and "*Always treat every human being, including yourself, as an end in himself and never merely as a means to an end*"? Totally, partly or not at all.
h) Which alternative i) produce *the best consequences,* ii) fulfils *the most important duties* and fulfils the rules of g/3? The alternatives selected here may be the same or different to each other.
i) What alternative is the best (or least bad)? Give arguments for your decision.

How the same kind of situations could be avoided in the future? What long term changes (political, law, technical, social, organisation) are needed to avoid the situation?