

## CaseMaster – an Interactive Tool for Case-Based Learning over the Network

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### Abstract

Research in the field of networked learning is steadily growing due to high capabilities of computer and telecommunication systems. Tools are developed to support web-based learning and the case method is often used in different ways to teach various subjects. The goal of the CaseMaster project was to develop a Web-based platform supporting presentation of and work with cases as well as other learning scenarios over the Web and to test this way of working. CaseMaster allows creating cases (course content) as a non-linear structure like a story with one start, but with many possible different endings. A typical case often includes problems that need to be solved, connected questions, and a portfolio. First, a teacher creates a case and stores it in CaseMaster, then students work with the case and the teacher overviews the students' results, and, finally, a follow-up seminar is conducted. CaseMaster has been successfully used in the PharmaPaC project for learning pharmacology and the SwedKid project for learning more about i.e. treatment of minorities, the position of recent refugees and immigrants. The platform was also used in the course "ICT and learning" at IML. The advantages of this platform are as follows. CaseMaster advocates human interaction and gives possibility for solving problems together. CaseMaster encourages a blended learning with human meetings and discussions without attempts to replace the teacher. It does not direct the students through the content. The students will be able to create their own paths through the case and argue for their decisions. In further research, we will concentrate on evaluation of the technical functionality of CaseMaster and investigation of how much CaseMaster affects the learning process compared with traditional ways of working.

### Abstract in Swedish

#### Sammanfattning på svenska

Forskningen inom fältet för nätbaserat lärande ökar ständigt på grund av hög kapacitet hos datorer och nätverk. Verktyg utvecklas för att stödja webbaserat lärande och det är vanligt att casemetoden används i olika sätt att undervisa. Målsättningen med projektet CaseMaster var att utveckla en webbaserad plattform som stödjer presentation av- och arbete med case och andra scenarion som beskriver lärsituationer över webben, samt testa detta sätt att arbeta. CaseMaster möjliggör skapande av ett case (kursinnehåll) i en icke linjär struktur som en berättelse med en start, men med många möjliga slut. Ett typiskt case innehåller oftast problem som skall lösas, frågeställningar och en portfolio. En lärare börjar med att skapa ett case som sparas i CaseMaster, sen arbetar studenterna med caset och läraren kan ta del av studenternas resultat för att slutligen följa upp arbetet med ett seminarium. CaseMaster har framgångsrikt använts dels i projektet PharmaPaC för att lära ut farmakologi och dels i projektet Swedkid för att lära ut mer om behandlingen av minoriteter och invandrades situation i Sverige. Plattformen har även använts i kursen "IKT och lärande" vid IML. CaseMaster har visat sig ha fördelar som att förespråka mänsklig interaktion och ge möjligheter att lösa problem tillsammans med andra. CaseMaster uppmuntrar ett blandat

lärande med mänskliga möten och diskussioner utan försök att ersätta läraren och styr inte studenten genom innehållet. Studenterna skapar sina egna vägar genom caset och argumenterar för sina val och beslut. I kommande forskning kommer vi att koncentrera oss på utvärdering av den tekniska funktionaliteten hos CaseMaster och en undersökning över hur mycket CaseMaster påverkar lärprocessen jämfört med traditionell undervisning.

*Keywords:* Case-based learning; Problem-based learning; Networked learning; Computer-aided learning.

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## 1 Introduction

Research in the field of networked learning is steadily growing due to high capabilities of computer and telecommunication systems. Many researchers investigate processes happening in the virtual learning communities filled with sophisticated interactions between human beings and supporting computerised tools. Research instruments include categorisation and other qualitative methods of analysis of interviews, observations and messages exchanged by learners, evaluation and action-based approaches to study the practice of networked learning. The study made by De Laat and Lally (2003) investigates the complexity and nature of interactions of theory and praxis in a networked learning environment hosted in WebCT. The purpose of the research was to study both learning processes and tutoring processes within a group of students undertaking a Master's Programme in E-Learning at the University of Sheffield. Asynchronous discussion transcripts content was analysed using coding schemas. The messages were coded to categorise and quantify the meanings contained in them. Content analysis was combined with critical event recall, which is intended to stimulate recall of learning events. Summary of the content analysis and the full transcripts of a workshop were used for recall of critical events of the group work. The analyses allowed De Laat and Lally to identify patterns of individual and group learning, and different individual roles in tutoring processes.

Levy (2003) presents a practice-based approach to carry out research in networked learning. The approach is a methodological framework being a hybrid of evaluation research and action research. The framework was employed to develop a course offered by NetLinkS for learner support staff in the UK. The goal of the course was to support collaborative learning according to constructivist perspective. A typical action research cycle included a problem-solving sequence of developmental tasks. In the study, the tasks focused on the experience and practice of network learning. Through critical reflection and discussion within the context of action, the participants were able to construct practical knowledge. The paper (Frank, Reich, & Humphreys, 2003) examines a distance-learning course based on the use of electronic mail in Israel. The participants of the course were 11-12 year old students who were the object of the research. The course combined constructivist and individualised principles of teaching and learning. The study aimed at establishing what was happening with the students. The data collected were qualitatively analysed and showed that learning through e-mail was both active and interactive.

The method of case-based learning often underpins the learner-centred approach used in teacher education. Nowadays cases usually have rich multimedia content and researchers consider them an important facility for developing reasoning abilities, narrative knowledge and bringing different aspects of teacher work into focus. Cannings and Talley (2002) explore the use of multimedia and on-line cases for teacher education in the USA. They reviewed a number of multimedia case products and pointed out that video cases could be a potentially

effective tool in teacher education allowing teachers to reflect on classroom practice. Although, as they have mentioned, the best way of applying the technology to teaching is yet to be found.

The research (Dolk, den Hertog, & Gravemeijer, 2002) addresses the use of multimedia cases for teacher education in mathematics. The course was designed for beginning mathematics education teachers in the Netherlands and aimed to support students' learning to mathematise, didactise, and use multimedia cases in their work. Dolk, den Hertog, and Gravemeijer applied the method of design research that encompasses first, thinking of a possible activity including case-based learning, then, trying that activity, and, finally, interpretation of the activity in connection to the initial thinking. A six-step framework was proposed for working with multimedia cases and developing participants' narrative knowledge. Wedman, Rha, and Baker (1999) evaluate the use and construction of multimedia cases for pre-service teachers education in the USA. They exploited the theoretical framework based on theories of anchored instruction, reflective practice, situated cognition, generation of knowledge, and treatment of teaching as an ill-structured task. As a result, cases were developed that brought work of individual students into focus.

Case method is used in teaching different subjects and tools are developed to support case-based learning. For example, Akin (2002) conducted an empirical study of using case-based learning in architectural design instruction in the USA. He developed an approach to present material with the help of case-based technology, studied how designers use cases, and developed the case-based learning tool EDAT intended to support instruction in the studio. The aim of our research was to create a software system supporting case-based and problem-based learning over the network. The underlying idea of the project, called CaseMaster, was to encourage blended learning with human meetings and discussions without attempting to replace the teacher. This research deals with the problem of developing a Web-based platform to support presentation of and work with cases as well as other learning scenarios.

## **2 Networked case-based learning with CaseMaster**

The CaseMaster project started in autumn 2000. The project originated from the collaboration between Karolinska Institute in Stockholm, School of Medicine at Stanford University in California, and Umeå University. The collaboration aimed at educating medical students in pharmacology using a set of cases. The team at the Department of Interactive Media and Learning (IML) of Umeå University decided to create a standalone platform, which was named CaseMaster. The goal set by the team was to develop a Web-based system supporting presentation of and work with cases as well as other learning scenarios over the Web and to test this way of working. CaseMaster follows the learner-centred approach and lets the learner take the responsibility for his/her own learning process by means of reflection, communication and analysis of action consequences.

### **2.1 Working with cases**

The case method can be described in different ways. Enkenberg (2001) states that in problem-based learning students are to be placed in a situation containing a problem or challenge and they have to take it as a starting point for their learning. She defines a case as "a real-life situation or object that combines different points of view and fields of knowledge". To be able to solve problems described in the case, the students need to collaborate and reflect over the case from different perspectives. Both Ekenberg (2001) and Baker (2000) consider reflection to be an important part of the case method. In the book "Teaching & Learning with Cases",

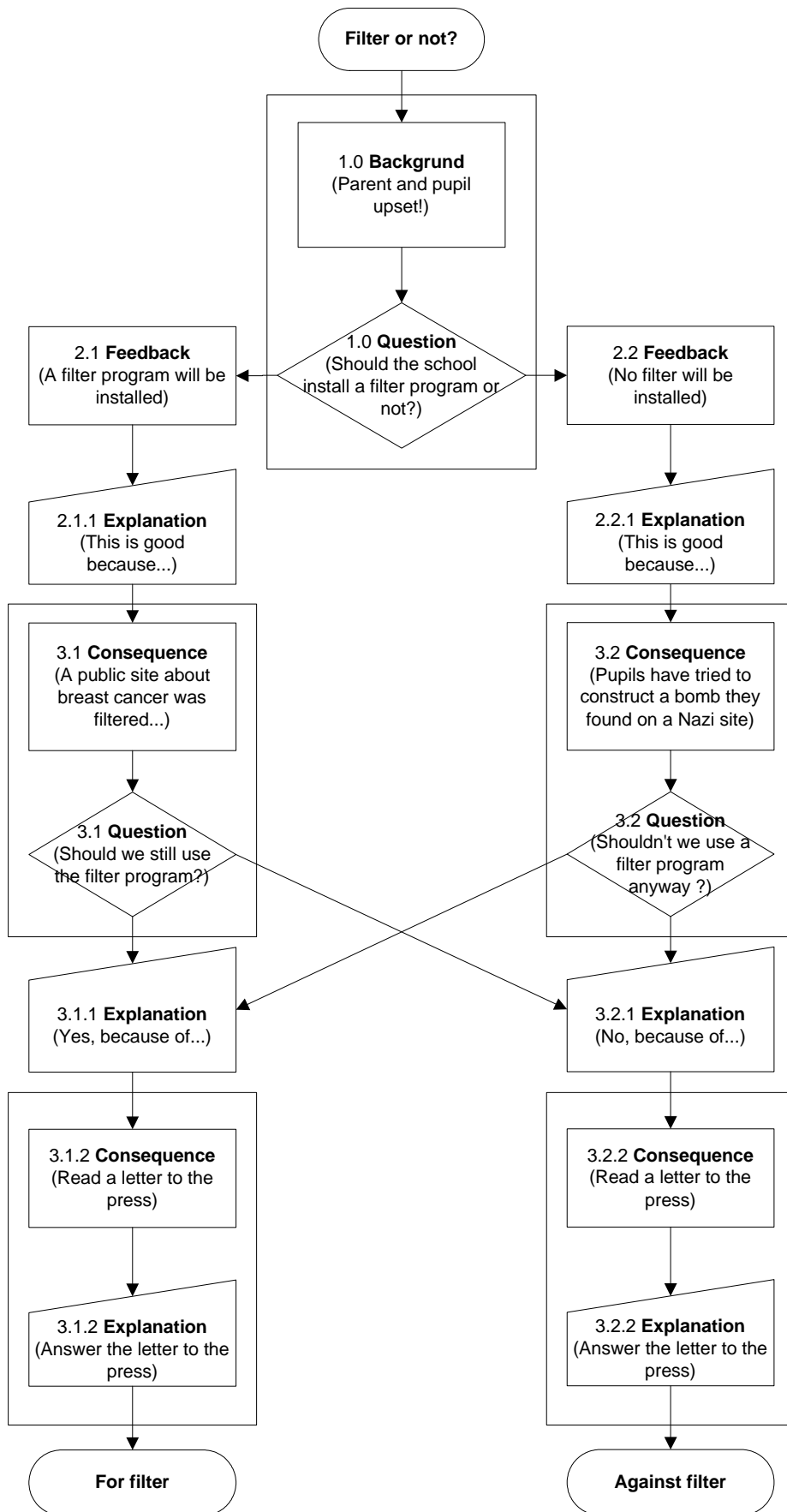
Lynn (1999) uses this definition of a teaching case: “A teaching case is a story, describing or based on actual events and circumstances, that is told with a definite teaching purpose in mind and that rewards careful study and analysis.” He points out that the case method is problem-oriented, concerned with discussion and reflection on real-life complex situations where there is no single answer, and intended to prepare students for professional life demanding critical thinking and argumentation.

Baker (2000) examined several difficulties encountered in teacher preparation and developed a theoretical framework providing argument for case-based learning (CBL) and guidelines for development of software supporting CBL. Baker’s framework includes the following five parts. First, CBL is anchored instruction providing common points for learners to compare their diverse experiences and contrast understanding of the case. Then, CBL can provoke reflective practice, which means that students are involved in a real situation so they can reflect over effectiveness of the decisions they make. Situated cognition is the third part and means that CBL encourages transfer of knowledge into practice by situating the knowledge in context similar to the one in which the knowledge is used. Fourthly, CBL helps generate knowledge. It means that students generate knowledge through discussions and assignments and students themselves decide what they need to learn more. The last part of the framework emphasises that teaching is an ill-structured process and that it is necessary to offer different perspectives and solutions to a problem.

In the design process of CaseMaster, we decided to accept a wide definition of the way of working with cases. The starting point is a description of a scenario or a set of incidents that builds a story or a problem to solve. CaseMaster allows creating cases (course content) as a non-linear structure like a story with one start, but with many possible different endings. A typical case is comprised of text, images, video, sounds, and other multimedia. Cases are divided into a number of small parts and each one of them can be followed by a question. Students work with the story and connected questions, which are of either multiple-choice or essay type. Depending on the students’ answers and decisions, the story will be changed in the next step, which often includes a description of the consequences of the student’s actions followed by a question that may require arguing for a decision. Undertaking different activities, the student goes through the case content in a non-predetermined order and each student may take a different way through the case.

CaseMaster uses portfolios, which can store data and facts about the case. For example, the portfolio can be used to give the students more information on the consequences of their actions. The students can add to the portfolio their own notes and reflections, connected to every part of the story they have worked through. Reference material, clues, communication, reflection, questions and answers are also stored in the portfolio in order to make them accessible for consideration and encourage this through the whole process of learning. Teachers can there find resources, connected with the case, for the follow-up, summary and evaluation.

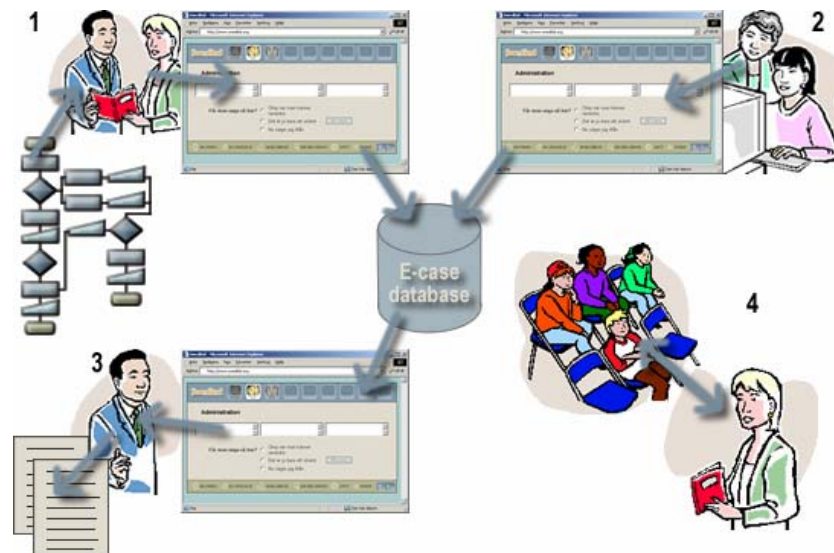
An example of the structure of a non-linear case, “Filter or not?”, is shown in Figure 1. This case is about installing a filter program at children school computers. Students make choices and examine consequences of their actions. The aim of the case is to let students learn more about advantages and disadvantages of filter programs.



**Figure 1.** Non-linear structure of the case “Filter or not?”

## 2.2 Using the CaseMaster tools

CaseMaster is designed for case-based and problem-based learning over the network. A teacher first needs to elaborate an idea of a case (scenario) and then uses CaseMaster to create, store, and structure the case content. The first illustration (1) in Figure 2 shows how teachers can create a scenario and structure it with the Web interface. All added data are stored in the database that is shown at the centre of the diagram. The second illustration (2) shows students working with the cases contained in CaseMaster after they have logged in the system. They answer questions, reflect over their decisions and, depending on their answer, they get new questions. All the students do not necessarily navigate through the same way in the case, and can complete the case in different ways. The students can work with the created cases synchronously and/or asynchronously, being all at the same place or dispersed geographically. The third illustration (3) indicates that when the learning session is over, the teacher can retrieve the students' results from the system and examine reports to see if there are some unplanned decisions made, or some questions to be highlighted. The fourth illustration (4) shows what is happening after the teacher has compiled the results. The students and the teacher meet to have the final seminar to discuss different decisions and arguments they have utilised to solve the case.



**Figure 2.** Concept of using the CaseMaster tools

One of the main ideas of the CaseMaster interface was to use a simple and functional design, i.e. one should be able to use CaseMaster with an ordinary web browser without any special plug-ins. The student part of the user interface contains the main navigation bar to the left and the content pane in the centre of the Web page. CaseMaster also includes a portfolio that opens in a separate window. Figure 3 shows the student tools interface.



Figure 3. CaseMaster interface including a portfolio

The teacher part of the user interface provides possibility to change colour and background of Web pages without any programming in HTML. If a teacher needs to create a new case or modify an already existing one, he/she can use drop-down menus to decide how to navigate through the case content. To change or add content to the case, the teacher can work with different forms and upload functions, e.g. for images, videos or other media. An example of the teacher tools is depicted in Figure 4.

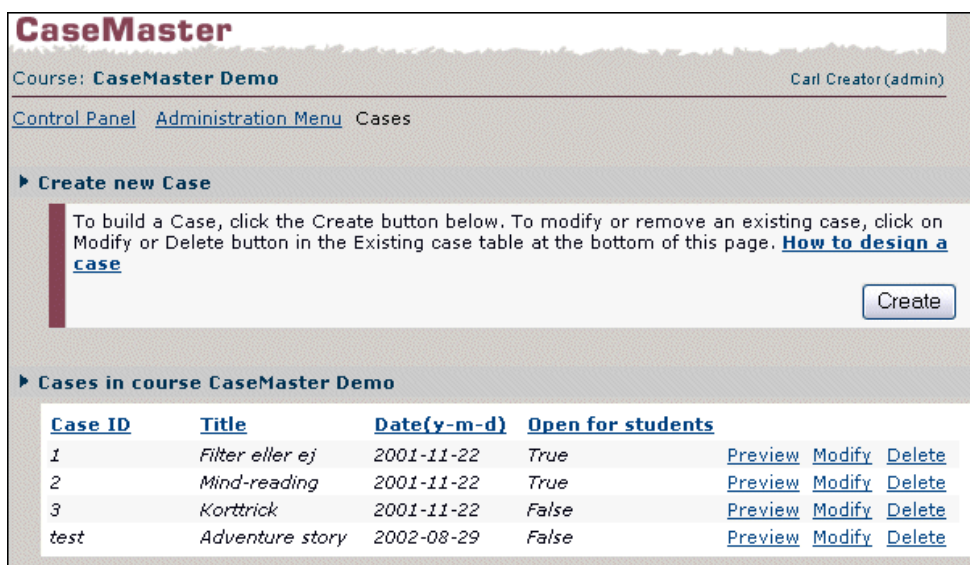


Figure 4. The tool for creation of a new case

### 3 Experience of using CaseMaster

CaseMaster has been used in several courses at Karolinska Institute in Stockholm and School of Medicine at Stanford University in California, two courses at the Department of Interactive Media and Learning of Umeå University, and in the research project SwedKid. Moreover, in November 2002 CaseMaster became a finalist in European Academic Software Award – a competition for the Europe's best pedagogical software.

### **3.1 Pharmacological patient cases at Karolinska Institute**

CaseMaster has been used in medical courses at Karolinska Institute (KI) in Stockholm and at School of Medicine at Stanford University in California since April 2001. At present, CaseMaster is also used in medical courses at the Danderyds hospital in Stockholm.

In 2001, CaseMaster was used in a pharmacology course with 20 cases for 12 students at KI and Stanford. In 2002, KI and Stanford used CaseMaster in a pharmacology course with 10 cases for nine students and KI organised two courses in pharmacology with one case, one with ten students and another one with 52 students. KI also organised a course in biomedicine with three cases for 52 students. During Spring 2003, KI organised one course in pharmacology with one case for 60 students. KI and the Danderyds hospital have organised one collaborative course in medicine with one case for totally 55 students. CaseMaster has been used in eight other courses at Stanford with totally 39 students (Osterberg et al., 2003).

The cases, which were developed at KI and Stanford, are intended to teach medical students to make better decisions in their medical work. Students follow a disease history of a fictive patient and learn how to decide on the treatment of the person. Depending on their decisions they get a new scenario and a new decision to make. The overall students' impression of the CaseMaster tools was positive and the evaluation showed improvement in student performance (Osterberg et al., 2003).

### **3.2 Cases for teenagers in SwedKid**

CaseMaster is the technology behind the research project SwedKid (SwedKid, 2003). Today 92 schools and 40 organizations, and single persons have registered as users of SwedKid. The evaluation of the SwedKid project will be made during autumn 2003.

The project goals are defined in the following way (SwedKid, 2003):

*“The project will develop a Swedish language website which addresses issues of difference, conflict and diversity in today's Sweden. It will include issues such as the treatment of minorities, the position of recent refugees and immigrants, xenophobia, anti-Semitism and linguistic differences. It will use the advantages of the Internet to provide online teaching and learning resources which are freely available to schools and which are interactive and engaging to young people. The main target audience for the website is teenagers.”*

The cases in Swedkid are designed as eleven different personalized characters. The characters represent Swedish young persons with different culture backgrounds and one can choose to follow one of them in a daily situation. All activities and answers to questions are stored in a backpack (portfolio) for later reflection and discussion.

### **3.3 Cases for teachers at Umeå University**

At the Department of Interactive Media and Learning (IML) CaseMaster was used in two courses (Spring 2002) in the teacher education (Spring 2003). The goals of the courses were to test standpoints for teachers in school and to teach the students more about an alternative method to work case-based and problem-based over a network.

For the first time CaseMaster was used in teaching at IML in the distance course “ICT in learning environments, 31-40 credits” during spring 2002. First, 22 students had a short

introduction to the case methodology and CaseMaster, and then they worked through the case “Filter or not” at home. When the students met each other next time, they had a seminar, at which they were divided into four groups depending on how they had answered or how they had changed their opinions working through the case. In the groups, they had to become united around five arguments of filter programs. After the seminar about the case, a new seminar was held to discuss the advantages and disadvantages of case-based learning over the network.

After the students had worked with the case, they were given an assignment to create an own case. Most of the cases were about acting “right or wrong” in school situations. Some of the titles were:

- Is it okay to snitch on bullying?
- Playing computer games on brakes or not?
- Having an abortion – freedom or murder?
- Euthanasia – right or wrong?

Some of the student opinions recorded during the seminar and the evaluation phase were:

- “A good method to learn to make a standpoint”
- “You need to explain why you think the same way as you act”
- “The technology sets the limit when you want the cases to be more dynamic”
- “You need to think and motivate your standpoints”
- “It takes a long time to create a complex case”

For the second time CaseMaster was used in a course at IML during Spring 2003 and in the educational programme “Special Teacher Education” (SÄL) designed for students who have already passed academic examinations and want to be teachers. The students first got an introduction to Case methodology and the CaseMaster and Swedkid project. After that they worked with the case “Filter or not” and had an exercise to create their own case and describe it on paper. Later they discussed the cases in a seminar and some of the conclusions were:

- A case is best created if two persons with different opinions about the topic work together. This way allows finding more solid and convincing arguments.
- It is very good to discuss the case with other teachers before it is used for teaching students. If doing so, it is easier to find leading questions that affect students’ opinions.
- The most time consuming thing when a case is create is to find and collect material for a portfolio, but it does not differ so much from collecting references when one writes an academic paper.

## **4 Discussion**

We have developed CaseMaster, a Web-based platform for supporting case-based and problem-based learning as well as other scenarios. The proposed way of work with cases has been tested in real learning environments in both our department and other institutions. The initial evaluation showed that CaseMaster could be successfully used in education to work with cases or similar learning scenarios.

The idea of CaseMaster was not to direct the students through the content. We think that this approach have several advantages. The activity of the student leads him/her through the content in a non-predetermined order. Students create their own paths through the case and argue for their decisions. They take the responsibility for their own learning process via reflection, communication, and analysis of consequences of his/her actions. CaseMaster asks questions with many possible answers and does not give ready-made solutions. CaseMaster advocates human interaction and gives students possibilities to take part in solving the problem by others. The teacher is the owner of the content and the final aim, but not the owner of the learning process.

Our experience shows that the role of the teacher changes from being the owner of all knowledge to acting as a guide through the process of learning. Each student develops his/her own knowledge in interaction with others, through guidance, discussions and seminars. CaseMaster encourages a blended learning with human meetings and discussions without attempts to replace the teacher. CaseMaster provides teachers and students with an open and dynamic tool to work with cases and problems via the Web. It allows storing communications and reflections of the users to support follow-ups and evaluations. Portfolios create an additional stimulus for thought and consideration

The student interviews indicate that CaseMaster seems to be best adapted for clarifying standpoints, motivating decisions, and testing attitudes. Today we spend a lot of time in (expensive?) meetings to solve problems, without reaching the point of making decisions. CaseMaster makes it possible to work with attitudes and standpoints before the meeting. During the meeting, solving problems and making decisions can be brought into focus. However, one student opinion was that the technology restricted the possibility of creating cases that are more dynamic. One way to overcome this obstacle is to change the technical functionality to let students add new facts and own opinions as new ways through the case.

We found that one good way of working with cases was when students themselves created cases. To be able to do that, they needed to collect a lot of information describing all points of views. Some students thought that it took a long time to create a complex case. In fact, it takes a long time to find all material and all different ways through a case. Hence, this way of working seems to be best appropriate when the case can be used in many courses. Furthermore, it seems to be a good way to create a case if students have different opinions on the topic. They find more solid and convincing arguments in this way. After the students had created their own cases, there was a conclusion that it was very good to discuss a case with other teachers before using it for teaching students. It simplified finding leading questions that affected students' opinions. It is always a problem not to make influence on students with own attitudes. We think that it is very important to consider this point when CaseMaster is used in order to highlight all different standpoints.

Our experience of using CaseMaster shows that we have succeeded to create a tool for presentation of case content and we have tested this way of working. Nevertheless, more research is needed to determine when CaseMaster is most useful. At present, we think that it is best of all to use CaseMaster in combination with other ways of teaching. In addition, CaseMaster is a good tool to start a discussion about a new topic.

In future, we plan to use CaseMaster in several courses in the teacher education at IML and undertake the following evaluation. A questionnaire will be created to evaluate the technical functionality of CaseMaster. Then students will be asked to answer it after they have worked with CaseMaster. Finally, the results of the evaluation will be used for further technical

improvements. We will also use different methods of working with cases in two groups of students. In one of the groups, we will use traditional paper-based scenarios. In the other group, we will use CaseMaster as an interactive tool. The students will be asked to answer a questionnaire and take a test before and after the courses. Using the results, we will evaluate how much CaseMaster affects the process of learning.

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## **Authors' information**

Örjan Johansson, Director of Studies

Research interests: Computer-aided and network-based learning and methods of distance education

Phone: +46 90 786 93 94

Fax: +46 90 786 96 95

E-mail: Orjan.Johansson@educ.umu.se

Personal web page: <http://www.educ.umu.se/~ojje>

Vladimir Tarassov, Visiting Researcher

Research interests: Computer-aided and network-based learning; learning technology standardization; database and knowledge-based systems; intelligent agents and multi-agent systems.

Phone: +46 90 786 65 19

Fax: +46 90 786 96 95

E-mail: Vladimir.Tarassov@educ.umu.se

Personal web page: <http://www.educ.umu.se/~vladimir>

Department of Interactive Media and Learning  
Institutionen för interaktiva medier och lärande  
Umeå University  
SE- 901 87 Umeå, Sweden