An E-learning Module on Negotiation Analysis

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Abstract

We describe a web-site containing material and tools for learning mathematical models of negotiation analysis and discuss students' experiences of its use. The site is part of our general e-learning decision making site, www.dm.hut.fi.

The negotiation analysis section provides an introduction to the theory and gives online practice in negotiation support. The material consists of theory sections, case studies and assignments. It also includes quizzes for self-evaluation and video clips illustrating the use of the Joint Gains software.

Models of negotiation analysis are especially suitable for e-learning because of their interactive nature. The Joint Gains is an interactive negotiation support system for multi player multi issue negotiation problems and it is intended for real-life negotiations. Here, we apply the Joint Gains as an interactive tool for active learning through role-playing experiments in educational context.

"Introduction to game theory and negotiation" learning module was evaluated in a web-course on mathematical modeling. The experiences were encouraging and mainly positive; the students are willing to work in similar learning environments in the future.

Key words: Negotiation Analysis, Negotiation Support, e-Learning, Interaction

1. Introduction

The web seems to be a natural and promising platform for conducting various negotiations in the future. Nevertheless, people do not yet know various web-tools intended to support their decision making. Therefore, to promote the emergence of e-negotiations we aim to teach e-negotiation methods for the university students.

E-learning offers possibilities for learning "any time, anywhere", more extensive use of colorful graphics, animations, voice etc., and new ways of communication, such as e-mail, online chat, newsgroups and video conferencing. The new ways of communication play a crucial role when learning the practice of e-negotiation.

In our negotiation analysis learning material, negotiation refers to an interactive process by which different parties try to reach compromises and make an agreement. According to Raiffa, Richardson and Metcalfe [35] negotiation analysis is a field of study focusing on prescriptive models of negotiation for generating acceptable compromise outcomes. It has its roots in decision analysis and game theory [37]. These prescriptive models can be implemented as negotiation support systems (NSSs).

One way of introducing NSSs for real-life applications is that researchers practice their use in role-playing exercises and then illustrate the negotiation process to real negotiators. The researchers need to understand the methods behind the NSSs and their practical limitations as well. Therefore, our e-learning material consists of theory sections complemented with relevant references to the literature, case studies, quizzes and assignments. These are complemented with multimedia presentations such as video clips, animations and colorful graphics where necessary. We provide facilities for interactive and active learning by using the Joint Gains NSS [22]. The Joint Gains is a web-based implementation of an interactive negotiation method that is intended to be used for solving negotiation problems online. For instance, it has been successfully applied in a Lake-River regulation policy problem [20].

There is a variety of potential applications of negotiation analysis, e.g., in political and

environmental decision making and in e-business [20], [25], [35]. Our e-learning material is modular to make it possible to tailor it for different needs of different students. The students can work with the material either with a pair, in a small group or perhaps alone. The latter is not recommended, however, because in such a case learning may lose its social dimensions. Teachers can use the material as such or include their own material in it and have face to face meetings between teacher and students.

The e-learning module "introduction to game theory and negotiation" presented here corresponds to two to three hours engineering lecture plus the exercises; see the web-site [11]. So far we have taken the students of OR/MS and engineering as primary users of the module. Nevertheless, the material could also be used to form other modules for decision makers and mediators that are preparing themselves for real-life negotiations and possibly for the use of the Joint Gains NSS. These possibilities are discussed in Chapter 5.2.

2. Negotiation Analysis in the Web

There is e-learning material on *negotiation science* available in the Internet. Kersten and Köszegi are pioneers in e-learning of multi-criteria based negotiations. They have presented "Negotiations and e-negotiations: management and support" course and experiences of its use [23], [28]. Their course consists of an electronic textbook presenting theory, which focuses on basic concepts of economics, game theory and social psychology. It also contains some case studies and related *role-playing* assignments, which involve the students to negotiate both with a NSS and face to face directly. Our notions on e-learning of mathematical models of *negotiation analysis* are quite similar to those presented by Köszegi and Kersten. Our module and their course have been developed independently and they both emphasize *learning by doing* and take advantage of the electronic media to produce complete learning modules that can be used in combination with face to face sessions.

Even if our materials are relatively similar, there are some differences. First, our material is more focused. We discuss only mathematical modeling approach. Second, our material does not contain any assignments for face to face negotiations but it includes assignments on the use of the *Joint Gains* software. The Joint Gains software is publicly available online any time from anywhere. It is a general purpose software, which allows the users to create their own customized negotiation cases in it. Thus its use is not limited to the cases created by system administrators as is the case with the INSPIRE [26] applied by Köszegi and Kersten.

INSPIRE uses a standard case, which describes a simple culturally neutral two party buyer-seller problem. The case has been applied for educational purposes by negotiation sessions where students use the system anonymously. Typically, once a month a negotiation case is set up and there are 100-250 participating students from 3-6 universities [27]. The data gathered from these negotiations is used for studies on applications of decision analytical methods and cultural impact of e-negotiations; see, e.g., [24], [27]. New negotiation sessions are continuously organized including the tournament International Competition for Online Dispute Resolution 2003 [5]. The participating students form local teams and solve a negotiation case by negotiating with another team. There are six different NSSs available for these negotiations: Simple NS, MeetingOne, WebNS, Negoisst, INSPIRE and SmartSettle [6].

Harvard University Press e-learning division has published an e-learning program "Yes! The On-Line Negotiator" based on the book by Fisher and Ury [15], [17]. It is only commercially available and it contains slideshows summarizing the theory, presenting some case problems and related quizzes. The slideshows summarize the concept of *principled negotiation* [15], which emphasizes the importance of co-operation between the negotiating parties, who should work together side by side and focus on their common problem and each others interests and objectives. This *joint problem solving* idea is also in a central role in our e-learning material.

There is a lot of e-learning material available on game theory. For instance, Al Roth has an experimental economics site, which contains articles and textbooks on the theory and applications of game theory in electronic format [36]. There are also many interactive applets in the web which let the students play against the computer specific games, such as variants of the prisoners' dilemma game, see, e.g., [4], [39]. The sites related to traditional game theory do not, however, cover the negotiation analysis.

Negotiation analysis has its roots also in decision analysis, which provides aid for a single decision maker to make individual decisions. In the case of negotiations, we now have many decision makers working with a common problem instead of a single decision maker. There are general sites linking to web-material on decision analysis; see, e.g., "courses and syllabi" site by decision analysis society [7] and the Decisionarium, which is a site providing access, e.g., to the Web-HIPRE value tree software [21], [31]. Related to this, Hämäläinen and Dietrich have presented the

first complete e-learning module on value tree analysis [18].

3. Contents of the Module

In "introduction to game theory and negotiations" e-learning module, we teach mathematical models of negotiation analysis through practical examples. First, we describe basic concepts of game theory and negotiation problems through two classical game theory examples: the *prisoners' dilemma game* and the *problem of the commons*. For different variants and history of these games, we refer to textbooks by Luce and Raiffa [29], Myerson [32] and Gibbons [16]. These games are relatively simple but they are also rich enough to illustrate the central concepts and even to describe phenomena encountered in real life.

This is followed by an introduction to methods on negotiation analysis that can be used to give prescriptive aid for *negotiating parties* to make joint decisions. Here we refer to Raiffa, Richardson and Metcalfe [35] and Sebenius [37]. We present a classification given by Teich, Wallenius and Wallenius [40] and by Ehtamo and Hämäläinen [9]. They divide various methods in negotiation analysis according to: whether the utility functions of the negotiating parties can be elicited or not, and whether the parties take joint problem solving attitude or *concession* making attitude. Thus, we can discuss roughly about four modeling categories:

1. utility function and concession based methods
2. utility function based *joint gains* searching methods
3. *interactive* methods based on concession making
4. *interactive* methods searching joint gains

In the module, we also present ideas of third party intervention, i.e., *mediation* and *arbitration* to help the negotiating parties.

As a detailed example of methods in negotiation analysis we describe the *jointly improving direction method* [9], [12], [13], which is a mathematical formalization of the *single negotiation text* (SNT) procedure presented by Raiffa [34]. In the jointly improving direction method, joint gains are searched interactively and iteratively starting from an *initial point* under assistance of a mediator. The Joint Gains software implements this method and it acts as the mediator.

The mediator generates step-by-step new *jointly preferred intermediate points* for the parties. To produce a new intermediate point, the mediator directs the parties through the three steps [12]:

1. Identification of the parties' *most preferred directions* at the intermediate point.
2. Determination of a fair *compromise direction* based on the most preferred directions.
3. Determination of a new jointly preferred intermediate point along the compromise direction.

At steps 1 and 3, the mediator gathers preference information from the parties by stating a sequence of questions of the form: "Which one of these points do you prefer, A or B?", see Figure 8 in Chapter 4. Step 2 is based on fairness of the compromise direction. For instance, in the case of two parties it is the direction bisecting the angle between parties' most preferred directions.

By repeating the steps 1-3, the mediator guides the parties to a Pareto optimal agreement, see Figure 1. By varying the initial point, the process can produce several Pareto points and thus the parties can approximate the *Pareto frontier*.

In the e-learning material, we present the method by using verbal and simple geometrical reasoning through an example where it is applied to find Pareto points for the problem of the commons.

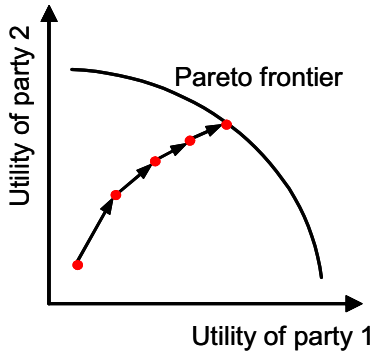

Figure 1. Joint Gains produces successive jointly preferred intermediate points

4. Module Description

Conceptually the learning module means an independent whole, which corresponds to few hours lectures and assignments in a traditional engineering course. We can form complete courses by sequencing learning modules into larger entities, which we refer to as *learning paths*. A learning path may contain material from different sources, e.g., it could combine the learning module described here, more details and

more interactive assignments on game theory from Al Roth's material [36] and social viewpoints from the "Negotiations and e-negotiations: management and support" course [23].

The e-learning module "introduction to game theory and negotiation" is part of the negotiation analysis e-learning site [10]; see its front page in Figure 2. The module is intended for students that have some mathematical background and it covers the mathematical parts of the theory and the assignments. The module is suitable among others for the students of operations research and engineering. The modularity of our material allows customization of the learning modules, e.g., for students with non-mathematical background. This possibility is not, however, tested and therefore we have very little to say about customization of learning modules.

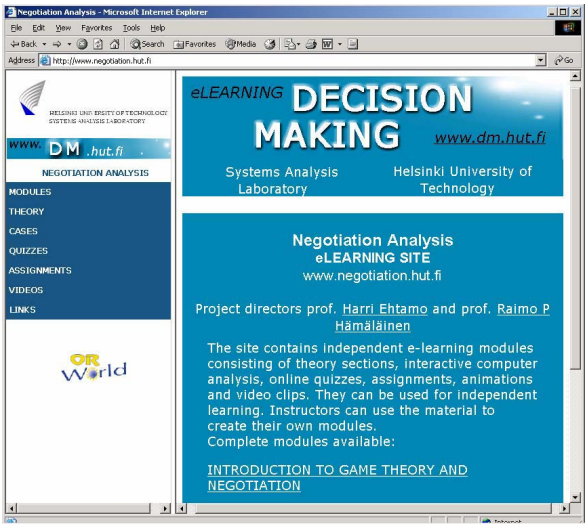

Figure 2. Negotiation analysis e-learning material front page

We divide the e-learning module into five main elements by following an e-learning material structure originally developed for value tree analysis e-learning modules[18] at Systems Analysis Laboratory [18]. The module consists of

1. theory
2. online quizzes
3. cases
4. assignments
5. video clips.

Each element of the learning module supports different learning objectives and presents the topic from different viewpoints. Each module has a front page, see Figure 3. The front page contains motivating introduction to the module and states explicitly what the students are expected to learn. There is a link list at the end of the front page, which guides the students to *navigate* in the material; for an overall view of the material, see Figure 4.

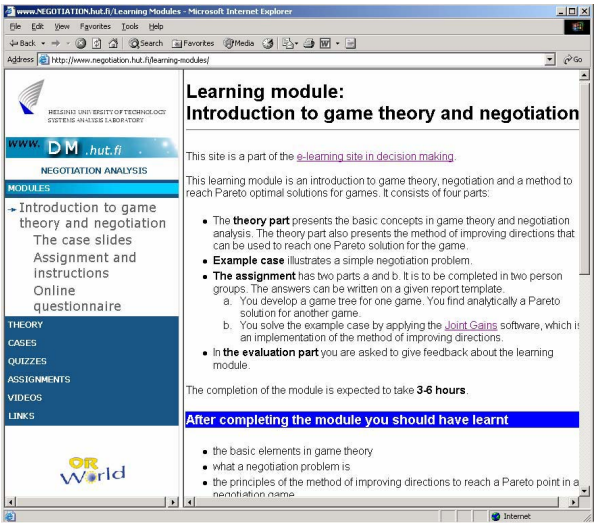

Figure 3. Learning module front page

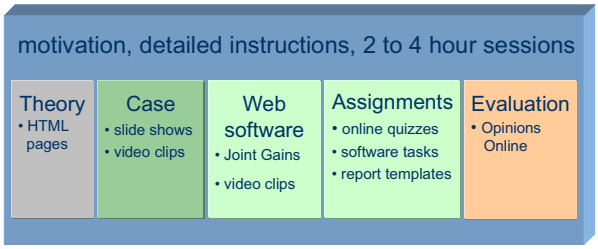

Figure 4. Overall view of the learning module

The *online quizzes* and the *assignments* are elements including interactive parts of the learning material. The *theory* sections and the *case* descriptions can be compared to an ordinary introductory textbook but they are designed to be on-screen readable. As noted by Weitl et al. [41], students' perception tires out when studying new information on a computer screen. Also the loss of overview, which is due to low amount of information that can be shown on a computer screen at a time, can appear a problem. We have written the theory in a format of a story telling about two friends, Harold and William. This story is complemented with frequent headings and introductory overview sections that point out the thread of the story and the core concepts of the theory.

It has been questioned whether technical topics, such as pure mathematics, are at all convenient to be studied through the web, see, e.g., Weitl et al. [41]. We

also decided to include only basic, high school level, mathematical definitions and analysis in the theory. Most of the presentation is based on colorful graphs and their interpretations. Further mathematical details were left to be found from articles and textbooks given in further reading sections.

The theory is divided into subsections each of which consists of one HTML-page. The table of contents of the theory is presented for the students in a navigation frame on the left side of the body text to help the navigation and sharpen the overview. As an example, Figure 5 illustrates a part of the theory section presenting the prisoners' dilemma game.

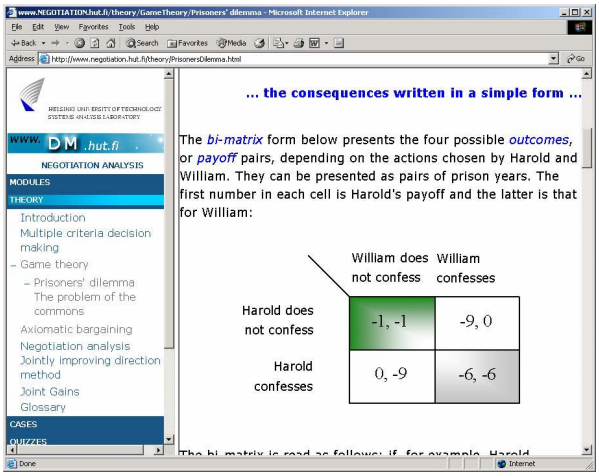

Figure 5. An example of a theory section presenting the prisoners' dilemma game

Online quizzes are web-forms stored in the Quiz Star server [1]. They contain multiple choice questions regarding the theory, see Figure 6. Their main purpose is to act as a motivating self-evaluation tool by which the students can interactively test the knowledge they have acquired. The quizzes summarize the core concepts of the theory and thus they also sharpen students' overview on the topic through presenting simple games and negotiation situations. After filling in and submitting a quiz a student gets immediately a response pointing out the correct and incorrect answers. In the case of possible incorrect answers, the student should refer to the theory and try refilling and submitting the quiz.

Cases are simple problems encountered in real life. In this learning module, the students study a description of a case, namely, buyer-seller problem. That problem represents a typical case in e-business, where a buyer and a seller negotiate about price and delivery time. The case acts as an example connecting the theory to real-life applications.

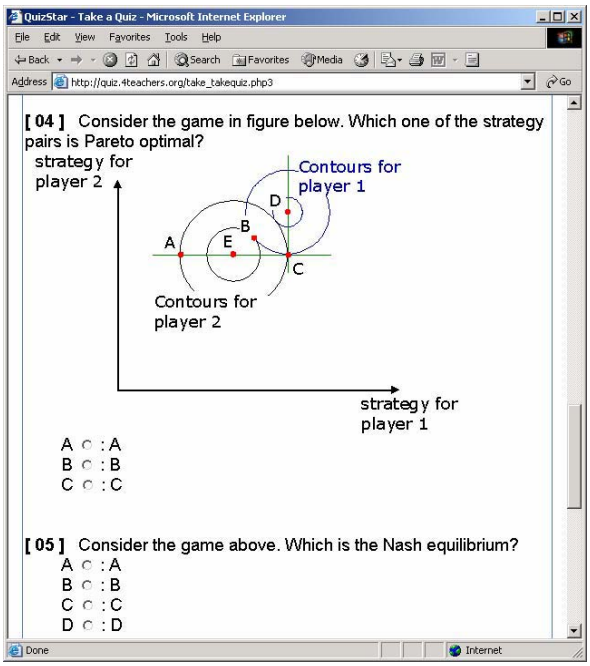

Figure 6. A part of the game theory quiz

The module contains two types of assignments: analytical and software assignments. The analytical ones ask the students to apply mathematical tools they have learned and thus familiarize themselves with somewhat theoretical concerns. In the software assignment, the students learn by doing and interactively solve the buyer-seller problem presented in the case description through role-plays. The role-plays have been realized a beneficial tool for teaching negotiations in literature as well, see, e.g., Winham [43]. The assignments are manually graded by an instructor, unlike the quizzes.

In the software assignment, the students apply the Joint Gains, which is an implementation of the jointly improving direction method, see Chapter 3. The students first create a negotiation case by defining the negotiating parties, a buyer and a seller, and the issues they negotiate about, i.e., price and time, see Figure 7.

After creating the case, the students take their roles and start the negotiation. In the negotiation, the Joint Gains gathers local preference information from the parties with simple pairwise comparison tasks and makes new jointly preferred proposals for the parties, who may either accept or reject them. Figure 8 shows how the students interact with the mediating software by answering the questions and interact with each other directly by using an online chat for verbal communication in the Joint Gains.

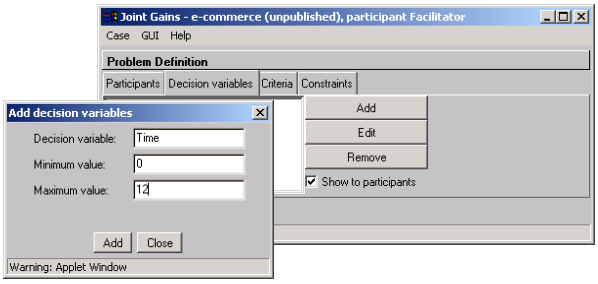

Figure 7. Creating a case in the Joint Gains

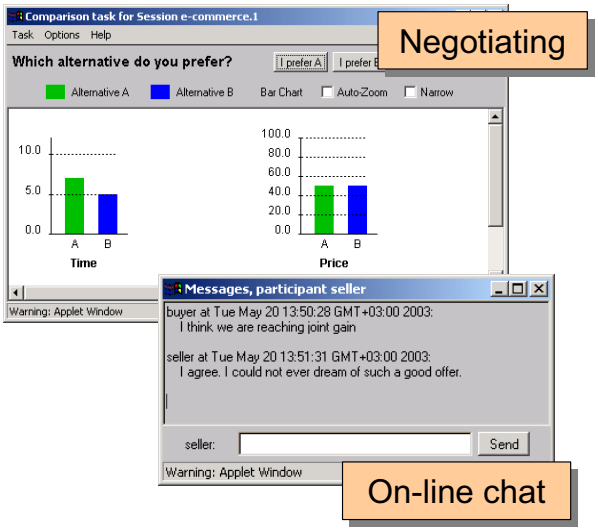

Figure 8. Negotiating with the Joint Gains

The assignments are delivered both as HTML and MS Word documents for the students. Those who are able to use MS Word can apply the assignment document as a report template and fill their answers directly in it. Besides the questions, the assignment document contains detailed instructions so that the students need not to open a separate window for writing a report, for reading the assignment and for reading the instructions.

There are also some video clips that are recordings demonstrating the use of the Joint Gains at a "click the OK-button"-level. The clips are available in three formats: AVI with audio, AVI with no audio and GIF-animations. AVI-format was chosen because it allows including audio, pausing, stopping, rewinding or fast forwarding the clips. Nevertheless, viewing AVI-files needs a media player to be installed. Therefore, GIF-animations are delivered, as well, because they can be viewed by an ordinary web-browser. Their usability is, however, poorer because they can only be played and restarted and they may not contain audio. AVI-files with no audio are included in the material to serve the students who have slow internet connection and find the versions with audio too large.

The main purpose of the clips is to reduce the need for personal instruction and communication between the teacher and students by e-mail or face to face directly. The clips are mainly intended to help the students who consider themselves unfamiliar with computers and encourage them to start working with the software assignment.

After completing the module, the students evaluate it by filling in an online questionnaire about their subjective experiences. The evaluations are accomplished with the *Opinions Online* software [19], which is an online-platform for voting, surveys and group decision making developed at the Systems Analysis Laboratory.

5. Discussion

5.1 Experiences of Use

The learning module was used in November 2002 in an advanced web-course on mathematical modeling organized by the Finnish Virtual University [14]. The course consisted of eleven learning sessions and our module was one of them.

There were nine one or two student groups from different Finnish universities completing our learning module. The students were mainly graduate students in industrial engineering, systems engineering, physics or other engineering. They considered themselves quite experienced users of web and they had some familiarity on e-learning from the earlier learning sessions of the course but not on an e-learning format similar to ours. The course was not compulsory for the students and hence our results are not general but refer to students who had chosen an e-learning course voluntarily.

We measure the students' skills based on their performance in the assignments. There is not a way to assess how *much* the students actually learned during the session.

The results of the student evaluation were positive. Some of the students stated in the free-form feedback that our module provided refreshing activities. The students found our format of e-learning convenient despite the fact that the format was new for them. Most of the students stated that they are willing to work in similar e-learning environments in the future and that they are also willing to recommend their experiences for their peers. This kind of positive attitude has been reported in literature also earlier, see, e.g., e-learning experiences presented by Benbunan-Fich and Hilz [2].

As in our case, the students had voluntarily chosen an e-learning course in their experiments.

The lack of face to face interaction between students and teacher, and among the students, has been a problem recognized in e-learning [42]. The same problem was also reported by our students. Nevertheless, the students were able to work with our learning module completely independently; they did not communicate with a human instructor either personally, through e-mail or the newsgroup system. This is probably due to two reasons. First, the students had an option to work together with a pair and hence they had possibilities for social contacts during their learning process. Second, the instructions in our material were intentionally very detailed, e.g., through the use of the video clips.

The students succeeded well in the analytical assignments but they had more problems with the software assignment. Seven groups out of nine negotiated by two negotiation sessions and hence 14 negotiation sessions were completed in total. The negotiation converged reasonably towards a Pareto optimal solution only in case of three sessions. The students were confused with this. They realized that there was something wrong with the convergence but they were unable to explain the reasons. Later, the analysis of the negotiation sessions indicated that the students experiencing problems had entered irrational answers in the Joint Gains software during the negotiations. This is likely due to the fact that role-playing is quite difficult and that lack of face to face communication may appear a problem in electronic communication [20], [8]. The students would have needed a personal instructor verifying that they actually understand their roles and explaining how to work with the software. Moreover, four students negotiated alone by playing the roles of both parties, even if we recommended them to form two person groups. This makes role-playing even more difficult because the students may confuse the roles they should represent.

The overall structure of the other learning sessions in the mathematical modeling web-course was quite different from that of ours. For example, they consisted of video lectures, lecture slides and assignments. Yet, most of the students reported in the student evaluation that they are relatively indifferent between the format of the other learning sessions and that of our module. Hence, they did not miss the video lectures, which were the way the other modules in the course were done. One could interpret this so that different formats of learning have their own advantages and disadvantages. According to the opinions of our students, the greatest advantage in e-learning is the freedom of learning almost everywhere and any time. This freedom has the other side of the coin, too. Namely, e-learning requires strong commitment and self-motivation from the students.

5.2 Future Work

Our aim is to provide new ideas on web-based decision making and e-negotiations not only for students of OR/MS but for other students as well. For instance, the students in environmental decision making could go through our module and have new visions on how environmental problems could be solved by using methods of negotiation analysis and NSSs. Moreover, we plan to develop the Joint Gains software and the jointly improving direction method through the experiences gained from the users of the e-learning site.

We foresee that potential users of our site could include experts and students in e-business. Moreover, it could be useful for the training of professionals involved in environmental and political decision making. This is taken into account when choosing the examples and cases presented in the material. For instance, the problem of the commons provides perspectives from the environmental decision problems, and our buyer-seller case is a problem emerging frequently in e-business and supply chains between suppliers and their customers in one form or another. For recent studies and possible future cases in e-business, see the special issues on e-negotiations [3] and on e-business and supply chain management [33].

According to Meerts [30], if a student already has some real-life negotiation experiences it is beneficial to let her learn by doing role-playing experiments and analyzing them afterwards. Since role-playing experiments play a central role in our e-learning module, it could be even more successful when training mediators or negotiators for web-based negotiations than merely training university students. Nevertheless, in the training of real negotiators one should provide modules on applying the Joint Gains software to themes at hand.

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