A Web-based Distance Learning System in Business Administration Experiences from an Inter-Nordic Course

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ABSTRACT The paper presents a specially constructed Web-based tool, WebGPSS, developed in Sweden, for teaching business students simulation. The tool includes a Java Applet that provides a Graphical Users Interface, by which the student can build a simulation model of a system, such as an inventory system. The model is then run on a remote server, which then sends result graphs and tables over the Web to the student computer. The paper furthermore discusses the experiences made when using this tool in a distance-learning course at the Norwegian School of Economics and Business Administration (NHH) in Bergen, in 2000 – 2002.

Introduction

I have for many in years been teaching simulation at the Stockholm School of Economics as parts of different courses in Business Administration, in particular Managerial Economics, Production and Operations Management and Use of Computers in Finance and Accounting. The original basis of the teaching of simulation was a software tool, called GPSS, developed originally by IBM. This software was, however, not sufficiently simple to be learnt well by business students within the limited time available in these courses. Trying to teach our students this IBM version of GPSS, we obtained, however, considerable feedback on what constituted the main problems of learning this language. Based on feedback from over 5000 students, some colleagues and I have gradually developed a much-simplified version of GPSS, called micro-GPSS. This started as a pure subset of IBM GPSS, but under student influence, the system was greatly simplified, so that teaching material that with IBM GPSS required 22 hours only needed 10 hours with later micro-GPSS versions (Ståhl 1996).

The use of micro-GPSS has spread to several other countries. In fact, teachers in over 40 different countries have asked for copies of this software.

The Web-GPSS system

Against this background, we obtained funding of 1,000,000 SEK (approx. $100,000) from the Swedish KK-foundation (Stiftelsen för Kunskaps- och Kompetensutveckling), which supports the development of didactic IT-tools, for producing a Web-based version of micro-GPSS. The interest in making a Web-based version stemmed from the advantages of providing simulation software on the Web, in particular as regards a system produced mainly with the aim that students should use it. The main four advantages of a Web-based version are as follows:

1. The users can always be assured of using the **latest version** of the software. This is an advantage for both the school, which need not worry about constantly updating the software, and for the student as a later user of the software in business.

2. The students can after leaving school or college be sure of getting **access to the software** wherever they are later going to work. It is not sure that the future employer is going to allow the software to be downloaded on the hard disk of a computer on the company's network.

3. In many cases, a student or a teacher might want to have a **first look** at a new software product **without** having to go to the **risk** and troubles connected with downloading it.

4. Getting a chance to run a program on the Web also increases the possibility of **connecting** the running of the software **with other net activities**, such as "chatting" with other users of the software.

We developed this software in cooperation with computer scientists from the College of Karlskrona-Ronneby**.** This new software, called WebGPSS, which was originally presented in 1999 and is available at the sites webgpss.hk-r.se and webgpss.com. It works as follows: A Java-based Applet is downloaded to the student computer's primary memory. This Applet provides primarily a **G**raphical **U**sers **I**nterface by which the student can build the simulation model of the studied system, e.g. a retail outlet, an inventory system, an engineering shop, etc. The student chooses, by clicking, among 16 different block symbols and builds the outline of the model in the form of a block diagram; see figure 1, depicting the block diagram of a simple barbershop example, a program example that the students can build up at the end of the first hour of GPSS class.

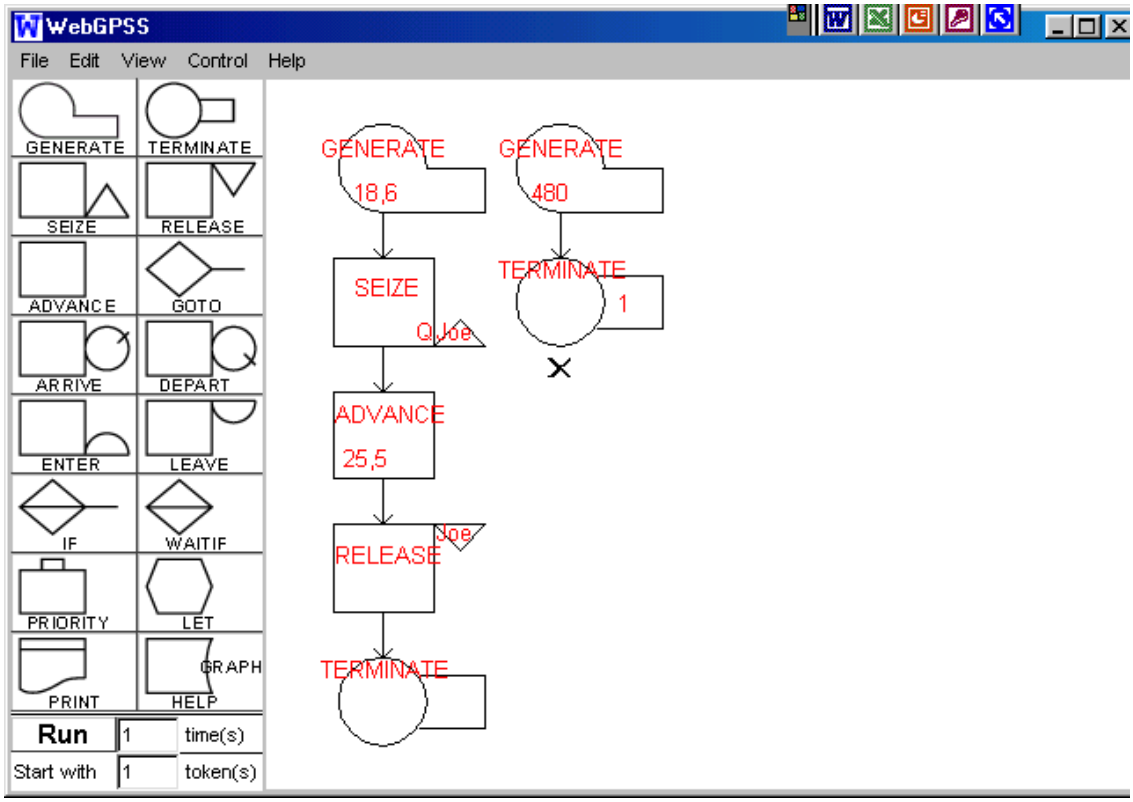

Figure 1. GPSS block diagram of a barbershop

Next, the student inputs the operands or parameters to these blocks by using dialogs, which also provide basic syntax information. See figure 2, which depicts the dialog of the SEIZE block, where the customers try to get service from a server (= a barber) named Joe and that we want statistics on the queue of waiting customers.

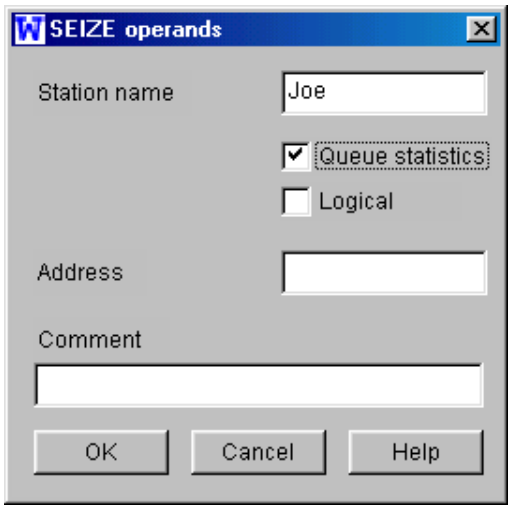

Figure 2. Dialog of the SEIZE block

When this block diagram, including the parameter values, has been completed, the student clicks on a Run-button and the program is sent over the Web to the central server, where the basic GPSS engine executes the program. This GPSS engine, GPSS.EXE, is virtually the same as the original text-based micro-GPSS system. GPSS.EXE produces results in the form of text files, which, within a fraction of a second, are sent back to the student computer and are then presented in a number of windows in the form of tables, graphs, histograms, etc.

Besides this Applet, there is a Web-based tutorial, in the form of HTML pages, consisting at present of 26 lessons (each with an exercise), 52 Web-based program examples that accompany the tutorial and an extensive system of Web-based HELP pages that explain technical details (see Ståhl & Hall 1999 and Ståhl 2000).

It should in this connection be mentioned that the WebGPSS system requires that a Java Plug-in from SUN be installed prior to running the system the first time on the client computer. This plug-in is needed in order for certain browsers to be able to run features allowed in the more recent versions of Java that WebGPSS relies on. The size of this Plug-in is roughly 5 Mbytes.

Usage of WebGPSS in distance learning

This WebGPSS system is meant to be used not only in ordinary classes, but also, and in particular, for distance learning. Our first extensive experience with the use of WebGPSS in distance learning was in a joint effort of a distance learning course given from the Stockholm School of Economics (SSE) at the Norwegian School of Economics and Business Administration (NHH) in Bergen. This course, using WebGPSS, was run the first time in the spring of 2000, was repeated in the spring of 2001 and then again in the spring of 2002. It should be mentioned that the same type of course had earlier been run in Bergen in 1999 using only the text-based micro-GPSS system. This fact allows for a direct comparison between the Web-based and the text-based stand-alone versions.

The courses have consisted in covering first the material corresponding to the 52 program examples available on the Web, now covered in the Web lessons, but earlier covered in a booklet (Ståhl 1996), which was based on the stand-alone, text-based version of GPSS. The program examples deal to a large extent with business examples, like service in retailing, inventory and production problems, pricing and cash management. The courses have also involved a number of smaller exercises, which the students can solve on their own with suggested answers also available on the Web.

After this introductory part of the course, the students have solved a larger exercise, dealing with pricing, production and inventory decisions of a furniture dealer in a suburb of Stockholm. The task is to write a GPSS program that reads the input of values on price, production and inventory decisions and on the basis of this produces a profit-and-loss account, a balance sheet and a cash-flow graph. The aim is to maximize the profits of the operation while keeping the risk of going broke low. Since there are random variations in demand as well as production and supply times, a substantial number of runs are needed to determine the risk of bankruptcy. The size of the average student GPSS program has been a little less than 100 blocks. An important lesson for the students has been the exact specification of the events taking place, so that the increase in equity in a period according to the balance sheet is equal to the profit of this period in the profit-and-loss account. Many students have in this way for the first time learnt to grasp some fundamental principles of accounting. The student time needed to solve this exercise has, according to student answers in questionnaires, amounted to roughly 30 hours.

The remaining part of the course is spent on a student project, dealing with a real situation, out in business, which the students themselves choose This project has preferably been carried out by a group of two students, but also projects involving only one or three students have been possible. As a very approximate guide to the size of these projects, a two-student project would involve 200 – 300 blocks. To help the students with these projects, different students have been given different amounts of reading, usually an updated selection of sections from Ståhl 1990. This has often dealt with the use of what in GPSS is called parameters, i.e. attribute values that are specific for each transaction, e.g. each customer.

The author has given courses with similar contents in ordinary courses in classrooms for many years both in Sweden, at the Stockholm School of Economics, and in the US, at Hofstra University, NY. The experience from the distance courses given in Norway can also be compared with this experience.

It should further be mentioned that the teaching was not only done over the Internet, but that the class met a few times in Bergen with roughly three weeks' interval. In 2000, I flew four times to Bergen, in 2001 three times and again in 2002 three times. Each time I have spent roughly a full working day at NHH, mostly in the form of four hours in the evening and four hours in the morning.

At the first meeting with the students, I get them introduced to the WebGPSS system. This personal meeting is particularly important, since I can then ascertain that every student can continue with his/her studies using the WebGPSS system. At the same time, I have also distributed various papers with information that was partly not yet available on the Web. I have also checked that the Java Plug-in has been properly installed on the computers/network of the school. I have also helped some students do a similar installation on their own computers.

A second meeting is regarded as important in particular to get the students to decide on projects and to get them organized into groups. At the time of the first meeting, the students will not have enough understanding of GPSS and the time efforts involved in a project to do a final enlightened choice of project topic. A second meeting is also deemed important to ensure that the students are progressing at a reasonable pace with their studies of the WebGPSS system.

A third meeting was originally, in 2000, regarded as an opportunity to have the students present their finished projects and give the teacher a chance to ascertain that all members in the group had worked in the group projects by giving oral questions to all the parties in the group. As discussed below, the third meeting, and in 2000 the fourth meeting, which was scheduled after the start of the course, came to have a partly different main focus.

Experiences from the use of WebGPSS in the distance course

When doing the comparison with earlier courses, one must distinguish between two types of differences:

1. The difference between using the new WebGPSS system with a **GUI** and using the old stand-alone, only **text-based** micro-GPSS system.

2. The difference between running the course using WebGPSS either in a **distance** mode with a meeting with the students only three (or four) times during the class and the **ordinary** mode, meeting the students in class on at least 15 different occasions.

For the first comparison, we can rely on the experience from running micro-GPSS based courses at least thirty times in the 80's and 90's with not only the three distance learning courses with WebGPSS in Norway, but also three ordinary classroom based courses with WebGPSS at the Stockholm School of Economics in 2000, 2001 and 2002. We can also base our conclusion on a comparison between the three Web-based distance courses in Bergen 2000 - 2002 and a similar distance learning mode course in Bergen in 1999 (with three meetings), based on the old stand-alone text-based version of micro-GPSS. For the second kind of comparison we can make comparisons between the mentioned three pairs of courses using WebGPSS, three in Bergen and three in Stockholm during the years 2000 – 2002.

From the first comparison a very clear conclusion can be drawn: the students really prefer the GUI-based WebGPSS to the text-based micro-GPSS. A proof of this is that in the cases discussed below, when WebGPSS was not available, but the students were offered to use the old stand-alone text-based version, virtually nobody did so, but preferred to wait a day or so until WebGPSS came up running again. The main advantage of WebGPSS seems to be that no learning of syntax is necessary, but all the needed syntax is explained in the dialogs.

As regards the second comparison, a main conclusion is that the result, measured in terms of the successful completion of the larger exercise as well as the individual projects, and the quality of the individual project work, does not seem to have been greatly influenced by the switch from the ordinary classroom method to the distance-learning format. At least, after a delay of a week or so, the participants in the distance course appeared to do just as well as the participants in the ordinary type of course had done. The delays had mainly been caused by technical problems with the Java-based software, which will be discussed in the next section.

Technical problems encountered when using the Java-based software

The main disadvantage with WebGPSS was that we during each of the courses with WebGPSS during 2000 and 2001 had two or three cases when the server with WebGPSS was down or malfunctioning. The server was then placed at the University College at Ronneby and has service personnel only during working hours. In some cases, when this breakdown occurred during office hours during a workday, I could report to the people at Ronneby as soon as some student reported the error and the server could be up running again within the hour. If the server went down in the evening or during the weekend, the students could in an extreme case have to wait more than two days before they could run the program again. Due to these downtimes, we could not stick to the original deadline dates.

Another technical problem that we encountered was with the Java plug-in. The problem occurred in 2001 in Bergen. While there had been no problem loading the Java plug-in to individual client computers in 2000, when I arrived in 2001 in good time before the first meeting, I found out that the central computer service had changed the policy and had not allowed the installation of the plug-in. Fortunately, there was an experimental computer lab outside of the realm of the computer services, where we could install the Java plug-in, so we moved the classes to this lab. The only disadvantage was that the lab was at a ten-minute distance from the main building, the place where the students would normally be.

Another problem that we experienced was that many of the students who wanted to run WebGPSS at home on their own computer found this too slow and preferred to travel to the NHH campus to run the programs in the NHH computer labs. In this regard the distance course was not truly "place independent". The main problem that the students using modems mentioned was that the downloading of the Applet was experienced to be too slow. A normal time for the download of the Applet, which is 0.5 Mbyte in size, is around a minute with a 56K Modem and it should "never" be more than 5 minutes. Although you need to download the Applet only once in each session, this was by some said to be too time consuming. It should be mentioned that the students at the same time had other courses at NHH and that they probably seldom traveled to campus just to run WebGPSS on the computer. It could also be that running the program over telephone lines was regarded as expensive.

Both the problem with server downtimes and with slowness over modems can be remedied by a stand-alone Web-GPSS system, i.e. a system that in its entirety is installed on the hard disk and hence does not require any net access.

Another problem, though not encountered in this course at Bergen, has also implied a demand for such a stand-alone system. This comes from the fact that WebGPSS has also been used by other teachers in many different countries, since it has been generally available without cost. It had also been used by some as a "Web-based software tool for decision technology" (Geoffrion and Krishnan 2000, p. 23). We have, however, even at times when we know with certainty that the server has not been down, received E-mail messages that the users have not been able to get into the WebGPSS system. None of these messages have come from northern Europe, but instead from southern Europe, from America and from Asia. Some of these complaints have come from universities which themselves have fast inter-net access. Although we have not been able to determine the source of this problem with certainty, we guess that the Java Applet, which, as mentioned, is around 0.5 Mbyte large, somewhere on the way from the far away country gets stuck in a queue at some transmitting node, with the Applet probably being transmitted in parts.

Due to this fact we have warned some US universities from using WebGPSS from the Swedish server. One alternative remedy would be to have servers located in different countries, but a stand-alone WebGPSS system is a more readily available solution.

Since WebGPSS was written in Java, it was a fairly straightforward task to turn this Web-based Java-Applet into a stand-alone Java Application. The total cost was in this case roughly 10 percent of the original cost of the system. With the aid of the people in Ronneby we started this task in the spring of 2001, just after finishing the distance course in Bergen that year, and in September 2001 we released a CD with the WebGPSS system as a stand-alone product. When installed on a PC running under Windows NT or Windows 2000 or on a central server with these operating systems, it will run exactly as on the Web. For a PC running under Windows 98 or 95, only the block diagram GUI part will, however, run in the same way as on the Web. One can here use the GUI for constructing the program, which will then have to be saved on the hard disk and next run by invoking GPSS.EXE, which will provide a single result file for all text output. Graphs will be obtained by invoking special programs.

It should be noted that with this stand-alone version of WebGPSS, the four advantages mentioned on page 2 are lost. The stand-alone version should hence rather be seen as a complement, to be used mainly in the cases when the server is down or when the net-access is too slow.

This stand-alone version of WebGPSS was first tested in our ordinary GPSS course in Stockholm in the fall of 2001 and was then tested for the distance-learning course in Bergen in 2002. It has also been used in courses in the spring of 2002 at Northern Illinois University.

A problem encountered when using this version in Stockholm in the fall of 2001 was that, although, the computer lab used Windows 2002, the same problem occurred as for Windows 95/98, namely that WebGPSS could only be used for the construction of the program, but not for running it. This appears to be due to the fact that running the server part of WebGPSS on a net installation, like in a PC lab, requires administrative privileges that cannot be given to individual students. For this reason, it was important to develop a special run module by which the students after saving the program developed in WebGPSS could run the program in a reasonably simple fashion. For the fall of 2001, I had only time to develop a very simple version of such a run module, in which all text output is obtained in one single file, which then had to be examined in Notepad.

For the course in Bergen 2002, a more advanced version of this Run-module was developed, such that the various forms of text output was presented in separate windows, like in the “full” version of WebGPSS. Compared to the “full” WebGPSS, this new run-module still proved to be slightly inferior, making it a priority to develop an even better run-module in the future.

Need for physical meetings

We shall next turn to the question of how many times the students have to meet physically with the teacher to have the teaching efficient with regard to both student and teacher time. As mentioned above, we had envisaged a need for at least two meetings, but in 2000 we really had four meetings in class and in 2001 and 2002 three.

The first two meetings did in fact prove to be necessary in 2000 - 2002. It is my strong conviction that it would have been very difficult for **all** of the students to use the system in an efficient manner without having been shown how to do this at our first meeting, At this meeting I had the chance, by giving simple exercises to the students, to really find out that nobody was left in the dark. I am also convinced that the general discussions with the students on the project topics could not have been so efficiently carried out over the net as in personal conversations. For example, it is more difficult to convince a student in an E-mail that the project plan is unrealistic than to get him or her to modify the plans in a discussion with eye contact, by e.g. gradually asking the student about time plans.

It should be mentioned that the final meeting, where I initially in 2000 had planned to have the students present their finished projects to the whole class did not, due the delays, turn out as I had planned it. Since most students had still not finished their projects, this part of the meeting took more the form of me discussing with the participants of each project what had been accomplished this far. Some time was also spent on various aspects of GPSS that would be of interest for various projects. Since I got to talk with all members of each project team, I had a chance to secure that all students had worked on the projects. The final grade on the project was then set by two independent professors, one at NHH in Bergen and one in another Norwegian college at Molde.

As regards the additional, fourth, meeting taking place in 2000, it came about due to the fact that so many students still had not been able to get their program for the furniture exercise correct. I found out that it often took a lot of E-mail correspondence to get a program correct. With a great many students still not having finished their program, I guessed that it would be more time saving, both for me and the students, to fly an additional time to Bergen. This guess proved correct. I tried to measure the time I spent with the students in personal sessions and the time I spent on doing the same over E-mail, and I can with certainty say that getting the students to write their programs correctly took more than three times longer time for me when doing it over E-mail than doing it in personal conversations. Sitting together in front of the same computer we could interactively debug and correct the program, step after step, without having to close down the systems each time. When doing the corresponding thing over E-mail, I would, when a student had done one correction, have to download the new version of the program from the E-mail system to the GPSS system, start the GPSS system, run the program, find another error, report this new error and ask the student a new question about this in a new E-mail, etc.

Already for 20 students it saved me time flying to Bergen to do this. At the same meeting I could also go into renewed discussions about the project work. In 2001, when there were fewer students, it was on the other hand not time economic for me to fly an additional time to Bergen for this kind of task.

The immediate solving of the student's problem when sitting down with them in person and being available to them for a full day also saves a lot of **student** time. I have, in contrast to some American colleagues (like Pasternak) not been able to give the service of answering E-mail messages within the hour. I have, due to other commitments, not been able to promise anything better than an answer within 24 hours.

In the spring of 2002, we had considerably more students than in 2001, almost as many as in 2000. Yet, no fourth meeting was required. The students were better in solving the furniture exercise. One possible reason for this could be that we in the spring of 2002 in Bergen could

test a CD with PowerPoint slides, containing 36 lessons, each with on average roughly a dozen slides, for the learning of WebGPSS (Born and Stahl 2002). These slides became available just as the course started. According to several students, this facilitated the learning of WebGPSS out of class greatly. With these PowerPoint slides as a powerful complement to the booklet (Stahl 2002), it might very well be that two meetings will be sufficient in the future.

Other issues

As mentioned above, it was my experience that the student preferred to have a paper version of the lessons (Ståhl 2001) rather than reading it on the computer screen. The main reason for this is probably that these computer lessons have only a small number of hypertext links and that the computer tutorial lessons on the PC hence do not offer very much more than the paper version, while the paper version is easier to handle and to read. The electronic version would be more attractive if there were a high number of hypertext links, so that one in each lesson, where an earlier introduced concept is referred to, could go back to the lesson where this concept was discussed in detail. The time and cost of doing this insertion of hypertext links properly seems, however, to be at least equivalent to the 200 hours that were used for the present electronic version of 26 lessons. Due to lack of time and funding, we have therefore not yet been able to carry out this hyperlink job. It is, however, my belief that the use of such hypertext links is one of the strongest advantages that electronic teaching media have over traditional paper media.

Final comments

In the media there has in recent years been a lot written and said about the great benefits of Web-based distance learning. There has, however, not been a corresponding discussion about the problems and costs involved. There should hence be an interest in reports on actual implementations and on both the accomplishments and the problems involved. Since a great many types of Web-based distance learning systems are possible, it should be of interest to have a great many reports on different types of such activities.

The report above should be seen in this light, i.e. as only one example of a great many possible ones. Although it would be premature to try to generalize, I still want to stress two particular lessons that I think have a more general application:

1. It is not sure that the Web should be the only electronic source of the learning system. Availability on a CD is likely to be either a substitute or a valuable complement.

2. Some personal interaction between the teacher and the students is most probable necessary. In many cases, such personal interaction is also time-efficient compared to trying to solve problems by the way of E-mail.

References

Born, R. and I. Ståhl. 2002. *Slide Presentation to accompany Ingolf Ståhl's Simulation Made Simple with WebGPSS,* Northern Illinois University, DeKalb.

Geoffrion, A and R. Krishnan. 2000. Prospect for Operations Research in the E-Business Era**.** *Interfaces***,** Volume 31, Issue 2. Also available as electronic paper at http://pubsonline.informs.org/feature.

Pasternak, B. 1999. *The Trials and Tribulations of Developing and Teaching a Distance Learning Course.* Paper presented at the 30th Annual Meeting of the Decision Sciences Institute, New Orleans.

Ståhl, I. 1990. *Introduction to Simulation with GPSS: On the PC, Macintosh and VAX.* Prentice Hall International, Hemel Hempstead, U.K. 1990

Ståhl, I. 1996. *Simulation Made Simple Using micro-GPSS.* SSE, Stockholm. 1996.

Ståhl, I., 2000. *Learning micro-GPSS over the Web*. In Rik van Landeghem (ed.) *Simulation and Modelling: Enablers for a Better Quality of Life.* SCS, Ghent.

Ståhl, I. 2002. *Simulation Made Simple with WebGPSS.* Mimeo. SSE, Stockholm.

Ståhl, I. and F. Hall. 1999. Principles for a Web-based Micro-GPSS System for Swedish High-School Students. In H. Szczerbicka (eds.) *Modelling and Simulation, A Tool for the next Millenium.* SCS, Warsaw.