

## NETWORKING FOR TRAINING

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### INTRODUCTION

One could distinguish two educational approaches to the delivery of courseware. If courseware is seen as some addition to the regular curriculum, e.g. some on-line exercises with direct feedback, the appropriate approach might be to deliver it on student-disks which the students can take with them and run either on their home-machines or on public facilities. These public facilities might be networked or not. If courseware is however intended to replace major parts of the curriculum the approach must adapt to the sheer amount of the courseware and to the fact that this courseware should be maintained. For instance the statistics course at the UvA consists of 20 Mbytes of courseware (plus 100 Mb for data). Each year about 250 students take this course. So the number of student disks to handle would be in the order of 5000. Because maintenance results in yearly upgrades this would be a recurrent task. Therefore it appears logical to deliver this kind of large scale course through a network. Other aspects in favour of network delivery are interaction aspects (direct contact with the trainer using an integrated electronic mail facility) and central storage of results. This paper deals with the management and course-design aspects of large scale delivery in a network environment.

Most of the data presented in this paper concerns a 40 hour course in statistics called Dr.Stat. which has been created after extensive analysis of educational problems that students encountered in the regular courses. It uses a consistent educational and graphic design throughout the course <sup>1,2</sup>. The course is delivered within one zone of a 10 zone Macintosh network. The total network has over 250 machines and more than 10 servers. One fileserver is dedicated to CAL.

### RESERVATION FACILITY

For the statistics course about 10000 student contact hours must be delivered in a period of 3 months (60 days). So about 170 coursewarehours must be delivered per day. There are 24 CAL machines available. This would imply that each machine has to deliver 7 hours per day. These machines however are also used in more regular courses. It is therefore mandatory to have a reservation facility. The reservation facility that has been developed does not assume any experience with computers. It

allows the course-manager to specify the weeks that the course will run, the number of computers available, the maximum total number of sessions, the time for one session, the maximum number of sessions per week for a student and the maximum number of sessions per week for a pair of students (fig.1).

Rooster settings periode: (0 weken)	
Naam cursus:	STAT
Opties voor studenten:	<input type="checkbox"/> printen <input checked="" type="checkbox"/> berichten sturen <input checked="" type="checkbox"/> inschrijving als paar
gemiddelde cursusduur (uren):	40
aantal blokken: maximum per week:	5
maximum cursus:	30
duur per blok (minuten):	90
begin eerste blok (uren.minuten):	9.00
aantal blokken per dag (max. 20):	9
aantal computers:	24
<input type="button" value="OK"/> <input type="button" value="cancel"/>	

fig.1 Settings window for reservation facility

The manager can exclude specific hours and /or days from reservation.

General student options for the specific course like permission to print, to use electronic mail or to register and work in pairs can also be specified. When the manager has specified all criteria for the course the reservation program is made available through the network to the students.

The student has to enter his name (the name is essential to have access to the statistics course and to have the course resumed at the point where the student left off). Then the student can make reservations of specific hours for the whole course all within the constraints defined by the course-manager. At the end a list is displayed showing which machines are allocated at what times. This list can be checked against the student's agenda. The reservation system is run for two weeks before the course starts. The student can change his reservation scheme during these weeks. Then the reservation facility is hidden from the network for direct usage. During the first year lists were produced which indicated which machine was to be used for which student at which times. These lists were posted near the public computer room. They were supposed to resolve potential conflicts between students and they probably did so because no conflicts arrived at the management during that year. However in the

weeks following the initial reservation period many students bothered the management because they still wanted to make changes. In the second year it was therefore decided to make the reservation program accessible from the courseware. Potential conflicts can now be resolved using this feature and paper lists and management involvement are unnecessary.

#### CONTROL ON WHO IS WORKING & I/O ERRORS

A logging system keeps track of which students are currently working. If a student quits a course in an improper way, e.g. by switching off the power in the middle of the course, his name will stay in the log-file. The next time this student will get a warning that he did not properly quit the session and therefore might have to redo (generally small) part of the course. This feature was implemented after a first year where students complained about having to redo parts of the course (but claimed that they quit the lesson properly).

Because in the networked environment many file I/O operations occur the probability of I/O errors is higher. In general the software trying to write to a busy file will wait and retry. However if a file is damaged or if another persistent I/O error occurs not only is the student warned, but also an automatic electronic mail message is sent to the manager.

#### E-MAIL FACILITY

Within the course an electronic mail facility is integrated. Integration was preferred over supplying a commercially available package due to the following reasons:

1. Commercially available packages generally have some unnecessary functionality which results in a more complicated user interface.
2. Site licence costs of the commercial packages are considerable larger than implementation costs of the integrated facility.
3. For registration purposes and in doing research on the use of e-mail within the context of CAI it is better to have the e-mail facility implemented in such a way that all transactions are registered automatically. These include name and position within the course of the student, id of the computer used, date and time.
4. The integrated facility allows for the change of the courseware on line.

The mail sent from the teacher to the student can be directed either directly to him or to all students following the specific course or to students in a specific phase of the course. The messages to the student can contain interpretable code which is executed when the

student starts up the session or during the session.

Activation of the e-mail option by the student is accomplished through the 'message to teacher' item in the options menu. The exact location in the course and the time & date are automatically added to the message. Without this context indication some messages are difficult to understand (e.g. I don't understand this question). Each message is also automatically appended to a general message database which is used for the yearly revision of the courseware.

#### THE E-MAIL INTERPRETER

One of the most powerful features of the integrated e-mail facility is the possibility to add code in the message to the student. This code is interpreted as soon as the message is read at the student station. Since the courseware checks for mail in each wait state this implies that it is possible to change the behaviour of the courseware at any time.

A most dramatic example occurred when it was noticed from the log-file that one student was using two machines. First a message was delivered that requested him to quit one machine immediately. When no action was observed a second message was sent with a last warning and code that was interpreted as a command to shut down the system.

The feature is also used to place students in other parts of the course or to change the values of several course variables. For instance a course variable is used to indicate if a student is allowed to use the computer-delivered examination. Normally this variable is set through internal algorithms. But by using the interpreted e-mail, code can be sent to specific or all students that enable them to take the exam anyway or to change the algorithm.

#### QUANTITATIVE USE OF E-MAIL

About 634 messages were transmitted in 2313 courses. In about 30% of the lessons there was an interaction with the teacher. Figure 2 gives the frequency of usage through the modules of the course (corrected for the number of students that had worked on the module). The percentage of students using e-mail is plotted as a function of lesson sequence number in the course. As can be seen student's use of the mail option increases in the first modules but declines in the second part of the course. Since not all student finished the 19 modules in time it is possible that a more consistent increase will appear when the frequency of mailing is corrected for drop-outs.

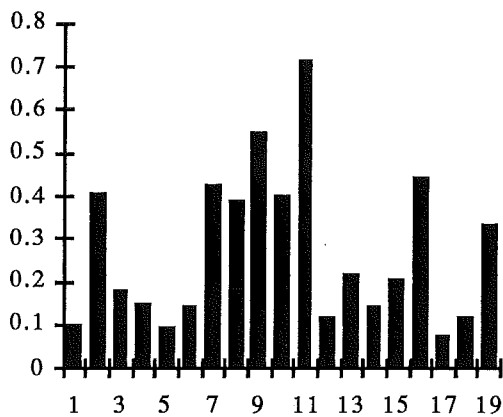


fig.2 The use of e-mail per module

Figure 3 gives the frequencies of students using e-mail 1, 2, 3, etc. times. It appears that most messages were sent by a few active students. 40% of the student used the mailing facility only one time when they were forced to do so in the introduction course.

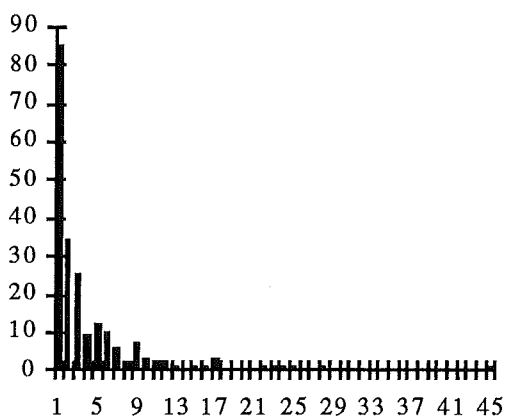


fig.3 Number of messages send

One student used the option 44 times! We are currently investigating if the mailing frequency correlates with certain personality characteristics (see also qualitative usage). Results will be available at the conference.

**QUALITATIVE USAGE**

All messages sent by the student are answered by the management team. In the first year of the course many messages were not content-related but concerned problems of usage. In the second year there was a shift towards more content-related messages. 40% of the messages were about statistical problems, 20% related to handling the computer and using the program, 12% was about administrative matters as

canceling hours, or request to stop working as a pair.

In Fig. 4 the percentage of either content related (black) or program-handling related (white) messages are shown for the different modules. As is to be expected, since the statistics gets more complex and the student gets more used to the program, there is an increase in content-related and a decrease in program-related remarks. Remarkable was an 8% of social talk-messages that hadn't anything to do with the course. For example there was a couple of students who wished Dr.Stat Good morning (or evening) at the beginning of every session. Twice a member of the management team received a dating proposal. We are further investigating this phenomena (correlates with certain personality characteristics) because it might be that proper handling of the social interactions might decrease the dropout rate.

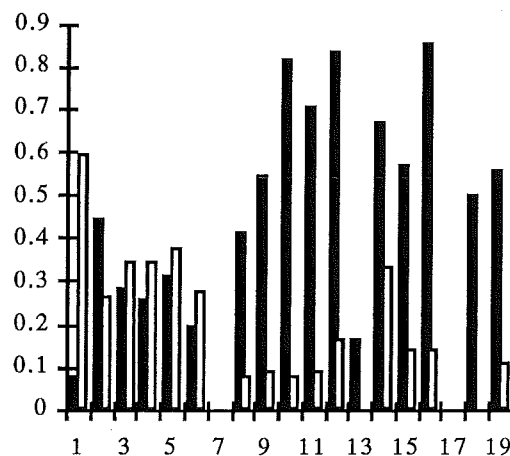


fig.4 Content and program-related messages.

Over the years the management task will more and more shifts into a teaching task. Therefore it will be investigated what procedures can be implemented to channel the content related messages to the appropriate teacher. For instance the latter might not be willing to receive direct mail but only wants to see the harvest of 1 week. In that case there should be an automatic reply option from the teacher telling the student, for example, that the issue will be treated in some lecture.

**RESEARCH**

For each module in the course pre-specified performance measures for each student are stored in a database. These data are used for correlational studies where they are combined with personality measures and the scores on the final exam. Specific research questions concern for example the comparison of individual with collaborative (pairs of students) usage of the

courseware<sup>3</sup>. Not all research questions can be specified in advance. Some of them might arise after the course is finished. An example was the question about the use of different options more or less triggered by the contribution to this conference. The courseware is designed in such a way that it is possible to answer almost any research question *ad hoc* without having to store all needed data explicitly. This is possible because an important feature of the particular authoring environment is that courses may be resumed at any point. The next time the course will start right from the point the student left off. This is only possible if all relevant student actions are stored. Each module is implemented in such a way that if the student has reached the end of a module, the module is not really finished. So the student performance record which contains ALL relevant data is still available.

A program called *DataBoss* was developed which simulates a student restarting one (or more) module(s). Once the program has entered the course it evaluates code that is specified in a separate textfile. This code might inspect course-variables (which are still implicitly available) and write those to the database for statistical analysis.

#### REFERENCES

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