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Networking for training

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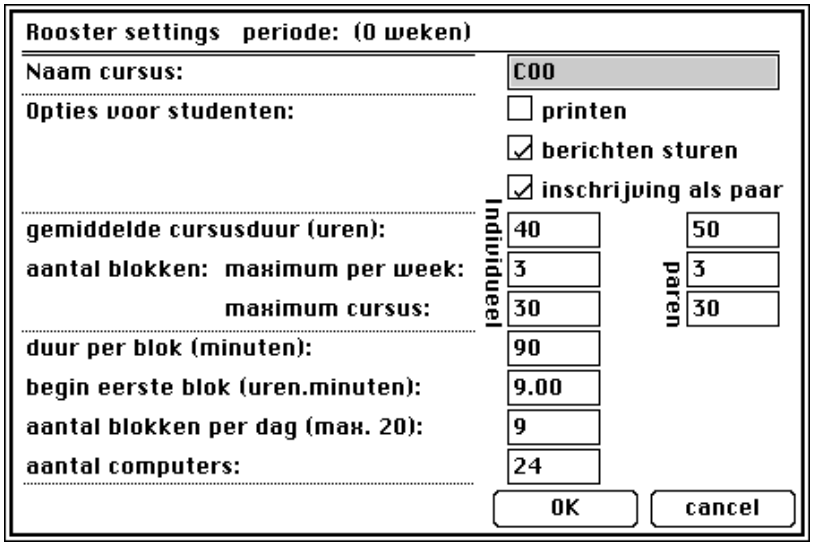
Introduction

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 (references). 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 (fig.1).

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.



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 elecetronic 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 then 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 occured 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

Figure 2 gives the frequency of usage through the first 10 modules of the course. It appears to be ...>>>>>HORST

Figure 3 gives a distribution of e-mail usage per student ...>>>> HORST.

It can be seen that the majority of the students do not use this facility. A small fraction is rather active. The usage of the option correlates (?) with certain personality characteristics as can be seen in table 1. >>>> HORST

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. Very rarely, completely unrelated items appeared: twice a member of the management team received a dating proposal. In the second year there was a shift towards more content-related messages. Thus the management task gradually shifts into a teaching task and 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.

>>>>HORST kunnen we nog wat meer over de inhoud zeggen?

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 the data 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 (reference). 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

1 Apple symposium

2 ABC

3 Models?

4 Collaborative

NETWORKING FOR TRAINING

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A 40 hour introduction course for statistics (descriptive, testing and probability) at the University of Amsterdam with integrated network facilities is delivered on a yearly base to 250 first grade students. Network facilities include a module for reservation of personal computer sessions by the student, integrated e-mail facilities (including the possibility to send simple program statements to the student that are interpreted and executed by the course), and total data storage, enabling post hoc decisions about data analysis. The course is delivered as a multi-user program.
Evaluation of logistic solutions, the use of network facilities, the effect of collaborative learning and related results will be used to improve the course and the network facilities. Preliminary results indicate that:
a) the reservation system can be delivered without assistance and is effective in planning the course. It could be integrated in the course for on-line reservations.
b) although only 10% of the student population use the e-mail facility it is usefull as on-line help and as an instrument for feedback on the courseware.
c) nearly 50% of the student populations favours collaborative learning compared to individual learning.
d) a research-tool enabling post-hoc decisions about data-analyses proves very helpful in evaluating large scale courseware.
General demands for network options in large scale courseware will be formulated; the options and solutions as used in the statistics course will be evaluated against these demands, and suggestions for adjustments will be made.

General points of interest:
- Description of Rooster
- Description of Dr.Stat
- Description of E-mail facility:
  - mail from students to trainer: direct mail, and central storage
  - mail from trainer to students:
    - at startpup time of each session (general messages, messages for a specific module, messages for specific students, messages selected by other criteria, messages as scripts that are evaluated as source-code, used for individual settings and settings that change during the period that the course is delivered)
    - when students are working (direct personal messages, messages as scripts that are evaluated as source-code, used for answering questions, changing the location of a student within the course and terminating sessions of students)
- Description of management aspects
  - who can access the course: limited registration period (with Rooster)
  - changes in registration and eservation: using Rooster after the registration period.
  - control on who's working
  - control on general (IO)errors
  - control on terminating a session without saving data (power shut-off)
- Customizing the course: individual settings
- Description of the infrastructure:
  - file server (Mac SE 30 (?). 150 Mb HD) Appleshare software
  - 24 workstations (Macintosh plus, 1 Mb, 1 internal FD)
  - 1 laser printer

Ad. a.
- A link between the courseware and the reservation system could make reservation more flexible. This is implemented at this time: the Rooster program can be accessed from within the course. A option is implemented in the course to enable students to jump to Rooster, and within Rooster the possibility to change reservations in the past is shut off.

Ad.b.
- Number of students registrated for the course:

- Number of students attending each module:
- Number of students using E-mail (per module):
- Mean number of messages per module:
- Total number of messages classified as either technical or content-related:
  + changes since version 1.0

Ad.c.

- Number and Percentage of students registrated as pairs vs. individual.
- Results of pairs versus individuals (PercentCorrect, Time, drop-out rate, no. of messages)
- Number of spliting pairs and their reasons

Ad.d.

- description of standard data: PercentCorrect and Time per module. From these data the drop-out rate can be calculated. Extra data using the research tool include the use of options.
- description of the research-tool: nearly all data (including number of answers for each question, last answer of each question etc.) are stored for each individual student. For analysis, only standard data are written to a central data-file using a spread-sheet format. To get access to the data that are stored for each individual student, a tool is used that restarts the course (using the name of the students), and the data specified in an external file are appended to the central data file.

General demands for network options within large scale courseware projects

- the course(modules) should be multi-user
- some datafiles should be accessible for all students. Consequently, these file should 1) be locked when a student is working with these files, 2) access to these files should be limited in duration, and 3) IOroutines have to be adjusted: the routine should try to access a datafile several times/for a longer period of time to prevent IOerrors from occurring when datafiles are locked.
- Network privileges should be cared for: who can read/write which files and folders.
- Data should be stored separately for each student, independant of the computer/workstation.This includes data for progress, results, messages, registration and reservations. As a result, data should be stored on a file-server instead of storage on the internal HD or FD of the computer/workstation.
- The infrastructure should be apropriate for all students. computers should be available all the time, reservations should be used to solve problems at peak-hours etc.
- Required management activities should be minimized.

Suggestions/evaluation:

- A classroom which several computers should give access to a library of courseware.
- Privileges could be done better: folders created by users should be acccessible for all group-members (especially the trainer).
- Arrangements should be made for re-using the courseware each are: cleaning up datafiles etc.
- A link between reserved and actual working hours could optimize the reservation system.