Paper 11:

A Tele-seminar on Drawing with AutoCAD: Design, Production and Pilot Implementations

Dionysis.R.Rigopoulos PhD

Dionysis.R.Rigopoulos PhD
National Technical University
Of Athens

Summary

- This paperdescribes the design, the production of supporting software and the pilot implementation of a continuing education tele-seminar on drawing with AutoCAD, at the National Technical University of Athens (NTUA).

The seminar was completed at the end of December 1997: it was aprt of a two year innovative project on tele-education in CAD/COM/CIM (Computer-Aided Design/Computer aided manufacturing/ Computer integrated Manufacturing), co-funded bu the European Social Fund and the NTUA. Over two hundred and sixty 'students' registered for the seminar, the majority of whom were professional engineers and architects. Maore than half of the participants were from Athens. The distribution of the others covered all geographic departments of Greece. The author was responsible for the design material production and teaching of this seminar.

Three complimentary components were developed to support the tele-training:

a: Educational software on CD-rom.

b: A course-specific Collaborative environment and ...

c: an Evaluation and Grading tool.

All students were expectd to have access to both an appropriately equipped PC and an Internet connection. The later was solely used for communication purposes with the seminar server. Students needed to connect only to replicate new data between the server and their PC. As a result the telecommunication costs were kept to a minimum.

The actual experience frokm ths seminar, presented in this paper, is based on the seminar data and on the organisers' and students' comments, critiques and observations.

Indroduction

- The benefits from using Computer Aided Design (CAD) software for technical drawing are well known and generally accepted. CAD drawings can be absolutely precise, they can be modified and copied easily and they can be transmitted through the Internetof through simple phone lines to other computers all over the world. Moreover, parts of a drawing can be inserted in other drawings thus optimising time and performance. Because of these advantages the use of CAD is rapidly expanding and most design and construction firms and practitioners adopt the new technology.

Consequently, it is necessary for engineers to become familiar with CAD techniques. Employers often consider CAD proficiency to be a *sine non qua* skill for young engineers. CAD familiarity is also appreciated for senior engineers, as it shows that they follow the advancec in their field and facilitates their communication with their younger colleagues. Finally, CAD is essential for the self-employed because it enhances productivity and facilitates collaboration with their offices.

CAD was not part of the formal training of most Greek engineers and architects. Consequently, it is a very desirable subject for continuing education seminars, Furthermore, as the related technology changes rapidly, there is a continuous need for training in the new tools and techniques. The trainees are often professionals who, due to their busy schedule, attend traditional seminars with diffculty. There is also a fair number of professionals who do not attend continuing education seminars, despite tele-seminar for CAD. The seminar focused on the use of AutoCAD R13 [1], a widely used and highly demanded CAD tool.

Being part of a three seminar program, as stated in the innovative programme (of Article 6 of the European Social Fund [2] "Design and Pilot Implementation of Distance Learning in CAD / CAM / CIM"). The AutoCAD part had triple focus:

1. To teach the use of AutoCAD R13 for drawing in two dimensions.

2. To explore instruction principles and develop a methodology for teaching the use of software, and

3. To prepare the students of the seminar for tele-collaboration.

According to all indications, tele-training will be continuously expanding in the years to follow, especially for issues relating to computers. The use of software packages is a particularly suitable subject for computer-aided instruction. Its rapid development calls for frequent retraining of the users. In addition, the affinity of the subject with the teaching medium and method does not require the students to learn a technology beyond their reach and interests; on the contrary it helps them acquire desirable telematics skills. Traditional seminars are inadequate for individuals who would like to follow the evolution of their field but cannot afford the time and place constraints imposed by such seminars. It is thus essential to explore the particularities of computer aided instruction for the use of software and to seek the best way to organise such tele-courses.

Design Principles for the Seminar

- The author designed the seminar on drawing with AutoCAD from start to finish. In shaping the educational environment and in defining the form and content of the educational material, it was sought:

  1. To simulate seminar teaching and private tutoring in the instructional software.

  2. To minimise the connection time of the students' computers to the seminar server, and

  3. To encourage the communication between the trainees.

Simulation of actual teaching

The teaching of all subjects of the curriculum was included in the AutoLearn software for self-instruction. We liked describing this as 'putting teaching in a can'. The trainee can activate the teaching of each theme, by clicking on that theme. This starts a commented demonstration on the trainees machine, invoking locally his own copy of the AutoCAD software with the appropriate drawing. The voice of the teacher is heard, as he explains all actions and makes additional comments, in the same way as he would present the subject in the classroom. The AutoLearn software was included in the instructional CD-ROM that each trainee received before the beginning of the seminar. Details about the structure and the contents of the program are given in section "The AutoLearn".

Minimisation of connection time

When this seminar was designed, at the end of 1995, most Greek regional cities had no immediate access to the Internet. Therefore, users from these areas needed to connect via long distance calls to Athens or to the nearest town with an Internet provider. Tele-education, though, offers a unique educational opportunity to persons from remote areas, where conventional seminars are not feasible. We, therefore, sought to achieve minimal connection time in order to minimise the telecommunication cost.

This design decision proved, during the realisation phase, to be important for Athens as well. Telephone charges and use of the line are, cumulatively over the period of the seminar, considerable factors.

The educational environment which was developed in Lotus Notes, was proven easy and functional for trainers and trainees. This environment will be reused in future tele-seminars within the NTUA. A more detailed description of this environment follows in section "The communication in the Tele-seminar".

Encouragement of communication between students

In addition to the communication between teacher and student, the communication of students among themselves is a very important aspect of a tele-seminar. A discussion on the value of this communication and the contribution of Groupware in tele-education can be found in [3].

Discussion areas were created, to support the communication between all the participants of the seminar, not only for issues related to the seminar but also for any other subject they would like to propose. Although physical connections resemble a star topology as shown in Figure 1, at a logical level the communication in the seminar was not limited to this pattern (teacher to each student and vice versa). There was a complete and generally visible 'all to all' communication network.

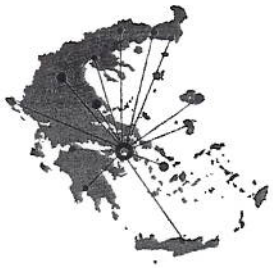

Figure 1: Geographic distribution of tele-trainees. The size of each circle is proportional to the number of participants at each point. The server, which all students were accessing, was in Athens.

In an ongoing 'Classroom Discussion', opinions on the current lesson were exchanged. Concurrently, an 'Intermission Area' provided an open forum, where postings on any subject were welcome. The trainees got to 'know' each other, mostly by exploiting this area. In a third area each participant could create personal pages and post personal data and other information.

These communication functions are part of the educational environment which was built in Lotus Notes.

Comparing conventional and tele-seminars for CAD

- Typically, in a conventional seminar for drawing with AutoCAD, the instructor introduces the subject by presenting basic principles of CAD. During the seminar he explains the different functions of the software and describes ñor demonstrates by using a data showñ alternative ways and procedures that lead to the desired outcome. Finally, he proposes drawing exercises to the students. These exercises are usually completed in the classroom, during the seminar and under the supervision of the instructor. Questions are answered as soon as they emerge, either privately on each student's drawing or at an open discussion with all members of the class.

In a conventional seminar the data show is a valuable instructional tool, as it allows all students to observe the teacher's computer which is projected on the large screen. Explanation of functionality is enhanced by visual presentation to all class members. In addition, possible doubts of the students are eliminated with an actual test. Finally, the data show helps the development of respect for the teacher, as his dexterity and knowledge of the subject are apparent to all during the teaching. The demonstrations in AutoLearn, which operated on the actual AutoCAD of the students machine have a similar effect.

In conventional seminars, the composition of the class happens automatically; in the tele-seminar it needed considerable effort from both students and organisers. Trainees were required to connect to the server and to form the 'Virtual Classroom' before the start of the seminar. Several trainees had no connection to the Internet, and no previous experience on computer communication. As a consequence, they had to make the decisions, to understand the basics and to face the smaller or bigger problems that appear in all phases of the connection process: selection of Internet provider, procurement and installation of hardware, establishment of communication, understanding of functional principles and experimentation with electronic mail and the exploration of the World Wide Web. An introductory set of notes regarding the use of the Internet and its services was written specially for the seminar and was given to the trainees upon their subscription to the seminar, with the educational CD-ROM. Especially for the Lotus Notes environment, the instructions for their connection were posted in the Web page of the seminar.

Incompatibilities in hardware and software created serious problems, even to experienced users. Some of the trainees had difficulties that they could not face alone; they brought their computers to the NTUA where the seminar staff set up their software. Unfortunately this could not be done for trainees from other towns. It is worth mentioning than in some cases ñfortunately very fewñ the trainees achieved their connection with the rest of the 'class' after the seminar started.

In traditional seminars on the use of software, teaching and discussion are not clearly distinguished because they typically happen at the same time. The contents of the tele-seminar were distinguished in 'constant' and 'dynamic' components. The teaching, i.e. the presentation and explanation of the AutoCAD's command set and its use for technical drawing, was considered constant. It was assumed that the same teaching could be delivered at several seminars. The corresponding recordings (sound and actions of the teacher) were, therefore, included in the instructional program AutoLearn. The dynamic component of the seminar was the communication between students and with the teacher, which was supported by the 'Virtual Classroom' in Lotus Notes. The active participation of students was critical, as this component evolved during the seminar.

Methods and Approaches

Conventional CAD Seminar	The CAD Tele-seminar
Familiarisation of the trainees with the computers of the seminar. (Simple procedure, typically part of the first session)	Installation of the educational software (educational program AutoLearn and Virtual Classroom) on each trainee's computer. Connection to the server at NTUA and establishment of communication. (Some trainees completed this task very easily while others had much difficulty. We observed that the ease of connection was not always proportional with the knowledge and the familiarisation of the trainee with computers. Related notes were distributed in printed form and posted on the Web).
Instructional material: usually notes or book	Software for self instruction on CD-ROM and Virtual Classroom environment. Also software for examination of corrected exercises. During the seminar posting of notes that the trainees could print.
The effort for the preparation of the seminar is comparable to the teaching effort of the instructor during the realisation of the seminar.	The preparation of: the instructional software, the educational environment, the exercise correction tool, the notes and teh exercises, requires much greater effort than its teaching. The success of a tele-seminar heavily depends on the quality of the educational material that has been prepared before the start of the seminar.
During the realisation of the seminar there is flexibility for changes in the contents of each lesson.	Teaching is mainly the application of the prepared program which exploits the educational material. The free discussion in the Virtual Classroom can lead to interesting issues that can eventually be included in the curriculum of subsequent tele-seminars.
At the beginning of each lesson or module the instructor makes an Introduction with a brief description of its contents. (Sometimes this 'formal introduction' is omitted; such ommission may confuse the trainees about the subjects to be covered).	The study subjects and the deadlines for each lesson are posted in the Virtual Classroom. Each lesson consists of its title, the themes that the students are expected to study from AutoLearn, notes (a table with questions and answers) and related exercises.
Teaching of CAD principles and live demonstrations with the use of a data show.	Self instruction with AutoLearn (on CD-ROM) by viewing commented demonstration of functions, similar to the ones the teacher presents in a classroom using a data show.
Practice. The trainees individually experiment on their computers, trying the subjects that are being taught.	Practice within AutoLearn. The trainee chooses the theme which he wants to practice; the program then brings up the drawing of the corresponding demonstration and lets him experiment on it.

Methods and Approaches

Conventional CAD Seminar	The CAD Tele-seminar
Exercises for better understanding of the subjects. These are typically completed in the classroom during the seminar time, not only because the trainees rarely can devote time for homework, but also because not all of them have the necessary hardware and software.	Exercises are delivered with the lessons. Students get them from the Virtual Classroom, solve them and send their solutions using the mechanism provided in the Virtual Classroom to the teacher. Access to appropriate equipment was a prerequisite for participation.
The exercises are presented by the teacher and their data may be written on the blackboard, or they are printed and distributed.	Analytical description of each exercise is posted in the exercise section of each lesson. The exercises contain a file to be used as starting point, and a detailed description of the solution course. Illustrations show intermediate phases and the expected final outcome.
Open discussion on the exercises. Commentaries, clarifications and presentation of interesting points by the teacher.	Open discussion on the exercises in the Virtual Classroom. Students participated actively. Some posted detailed and illustrated answers and comments.
Sample evaluation of solved exercises by the teacher and discussion.	All students' exercises are thoroughly examined and graded by the automatic correction tool. Personal comments of the student or the teacher can be included in the exercise they exchange. Meanwhile, the discussion in the Virtual Classroom addresses subjects of general interest.
The trainees typically cease trying to solve an exercise, as soon as they believe that they have solved it. They often do not know their mistakes; some mistakes are 'hidden' and therefore sometimes are not discovered and pinpointed by the teacher.	Trainees were provided with special software which helped them view and analyse the corrected and graded exercises that were returned to them by the teacher. They could see which entities in the drawing were incorrectly drawn and could compare them with the corresponding correct solution.
The time and place for each lesson are defined in the seminar's programme.	A common pace was sought, so that all trainees focus on the same topics during the same period. This did not allow the complete liberty in time that often characterises tele-training. It allowed, however, the students to choose the more convenient hours or days of the week for their study. At the same time it helped the discussion in the Virtual Classroom to be focused.
When there are more than one trainees per computer, there is a risk that some trainees do not get hands-on experience, but merely observe their colleagues' operations.	All trainees had to use AutoCAD, in order to perform the requested functions and solve the exercises. They were also gaining additional experience by using the self-instruction software. Finally, they were becoming familiar with means and techniques of communication and tele-collaboration.

Conventional CAD Seminar	The CAD Tele-seminar
Absent students cannot usually replace the courses that they miss; the substitute for these courses is sometimes limited personal discussions with the teacher and fellow students.	Several times students that had missed some lessons studied them later and sent their assignments, which they were not able to complete on time. These assignments were corrected and returned like the ones that were promptly submitted (it is possible to have some grade reduction depending on the date of submission). Therefore, the trainees had the opportunity to never miss any of the activities of the seminar.

The preceeding table presents analogies between conventional CAD seminars and the tele-seminar described in this paper:

Preparation of the Seminar

- The preparation of the seminar was the larger part of this project. It took more than eighteen months, from design to production. During that phase the following were produced to support the realisation of the seminar:

  1. Educational material (the AutoLearn self instruction software, Notes and Exercises)
  2. The Virtual Classroom (programmed in the Lotus Notes collaborative environment)
  3. Exercise evaluation procedure and related programs for the teacher and the students.

  The preparation of teaching material is known to be a team effort. In [4] this multi-person effort is compared with the single-person teaching of the classical seminars and noted as one of the differences between classical and tele-seminars. However, that comparison is applied on different things. The preparation of quality material, both classical and tele-seminars, is commonly a collaborative work of the instructor with graphic designers, printers, etc. The composition of the team differs in tele-seminars: programmers, computer artists and technicians replace the printers, typesetters and traditional designers.

The AutoLearn program for self instruction

- The educational software AutoLearn is a tool for self instruction. It contains chunks of teaching, split in brief sessions, each of which refers to one very specific theme. The themes are hierarchically organised; in addition, AutoLearn allows the students to practice all themes, working on theme-specific examples in an actual AutoCAD session. AutoLearn was designed not only according to the aims presented at the beginning of this paper, but also according to the following principles:

  1. Written text should be minimal
  2. The student's AutoCAD software should be used for the demonstrations

  It was not our purpose to create an electronic textbook by putting some traditional book or notes on a CD-ROM, even though this electronic book could be enhanced with hyperlinks, animation and demonstrative videos. A book or set of notes is a study and reference material complementary to the actual teaching. Besides, reading or studying a book is much easier and less tiring for the eyes than performing the same functions on the computer screen. Even the newest displays, although they have higher resolution, less flickering and better visual quality than their predecessors, they are not

yet as comfortable to view as a well printed book. In our seminar we used text in the short explanations of the glossary terms, in the postings and the messages, and in the notes which were in the form of brief questions and answers. All the instruction captured in AutoLearn is a set of commented demos; the voice of the instructor explains the functions that the student can watch happening on his computer.

Figure 2: The three Parts of AutoLearn (Introduction, Drawing in 2-D, Drawing in 3-D)

It must be stressed that the demonstrations are not videos that are played back, but actual repetitions of a series of actions that the instructor performed on his machine during teaching. Each such repetition is applied to the corresponding software which runs on the student's machine. To make this design choice we had to judge the advantages and disadvantages. We believe that the advantages are more important than the disadvantages; this is why we decided on this implementation.

In brief the advantages are:

1. The student is convinced that whatever is in the demos can be done at his very own machine with his installed software; it is not something that was achieved on the teacher's computer (because that computer was more powerful or better tuned).

2. The student can experiment, using the same files and means that were used by the teacher for the instruction and the demonstrations.

3. If any incompatibilities of software or hardware differences appear, these do from the beginning, since the program does not function properly.

Disadvantages are:

1. AutoCAD must be installed at the computer that is being used for learning. This is hardly a disadvantage because training in the use of software, typically requires hands-on practice.

2. The software and the computational environment at the student's computer must be exactly the same with that of the teacher's machine, where the demonstration was done. Any deviation may lead to unpredictable results; in that case, the explanations do not correspond to the 'strange things' that happen as the mouse or the keyboard continue sending their signals, which do not produce the expected results.

3. A demonstration cannot be interrupted and continue from where it paused, because it combines the repetition of the teacher's actions with the playback of his comments. When a demonstration is activated, it has to complete. Given that each demonstration has a duration from 15 seconds to 4 minutes, this disadvantage is not that crucial. Moreover, pause or stop functions could be added in a future release of the software.

Structure of AutoLearn

AutoLearn is hierarchically organised in four levels: Parts - Chapters - Sections - Themes. From the three parts shown in Figure 2, the first two were used during the seminar.

The first part includes demonstrations of the elements that form the drawing environment of AutoCAD. It was intended as a gentle introduction to the program. The demonstrations were very analytical, explaining even simple and well known to all Windows' users functionality such as pull-down

menus and button toolbars. This was done to cover the needs of trainees with little experience in computers. This introductory part contains only teaching and does not support experimentation. The trainees can simply watch the demonstrations and listen to the teacher's narration.

For each theme of the other parts, the program allows experimentation (see Figure 3). Experimentation is very valuable for better understanding of the drawing functions. During experimentation the trainee is unrestricted; he has the opportunity to rehearse what he saw in the demonstration or to freely try alternative approaches or other functions. Experimentation mostly solves doubts but also, sometimes, it generates questions. The trainees could post these questions at the Classroom discussion.

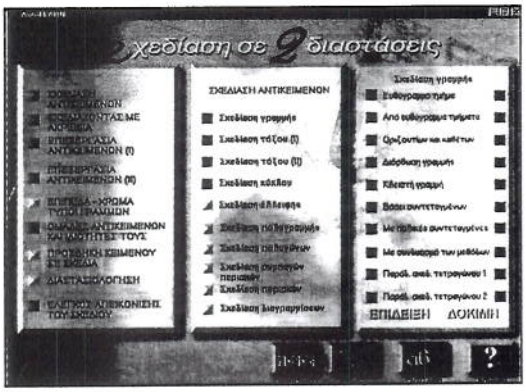

Figure 3: The hierarchical presentation of Chapters, Sections and Themes in AutoLearn. The Theme plate is divided in two columns. If a theme is clicked in its left part, its demonstration starts. If it is clicked at the left part, the experimentation screen is activated.

AutoLearn was built with the Toolbook [5] software. Additionally a 'recorder' for the teachers input was programmed in Delphi [6, 7]. These actions were played back during the demonstrations. The environment variables of AutoCAD and the interpreted programming language Autolisp, which is always available at the command line, were also exploited.

The contents of AutoLearn

The subjects of the seminar were presented in 360 themes within AutoLearn. The trainee could access these 'chunks of teaching' at the lowest level of a hierarchically structured catalogue. They were accessible through a hierarchical catalogue with 10 chapters and 59 sections. The total duration of the demonstrations was in excess of 15 hours. Given that the trainees were watching each demonstration more than two times on average and were searching terms in the glossary, we can assume that only the teaching of the program exceeded 40 hours per trainee. The time devoted to experimentation can be assumed equal to the time of teaching; during this time trainees could also use the on-line help for additional details of certain functions. Therefore, the total time of their involvement with the AutoLearn self instruction program is estimated to be more than 80 hours.

A glossary with more than 300 terms was included to help the trainees in understanding the English terminology. A successful translation of computer terms is a very difficult task; we attempted a first approach in this pilot implementation and plan to improve it in future editions.

An on-line help for the use of AutoLearn was continuously available, except when a demonstration or experimentation session was active.

Use of AutoLearn

AutoLearn can be used by many students on the same computer. Every student creates his own login name and his 'account' is protected by a password. Each account keeps track of the themes that the student has seen. In Figure 3, all themes were visited and therefore their pyramid symbols are red; consequently the first section's pyramid is red. The rule is that a chapter's or section's pyramid becomes orange as soon as one of its themes is viewed and red when all its contained themes are viewed. This helps the student visualise the extent to which he has seen the themes of AutoLearn, at each of the three hierarchical levels.

The support for multiple users during the same seminar was important for participants who share the same computer (colleagues, family members,

etc.). The password was not intended to protect some 'secrets' of another account. It merely helped in distinguishing one person's work from another's thus preventing misuse of another person's account, because that would mess the separate record keeping of viewed subjects for each user.

The communication in the Tele-seminar

- No matter how many students are concurrently trained at a distance education programme, they cannot be considered and have the spirit of a 'Class', if they cannot communicate with each other and all together. We know that all distance learning programmes, even those delivered with television or radio shows, would not exist without the 'Teacher to students' communication. This communication permits students to watch or receive the lessons and exercises. Most programmes offer also a 'Student to Teacher' communication which allows students to ask questions to the teacher and send completed assignments which are usually graded by the teacher and returned to the senders. This type of communication allows the teacher to verify how many students follow the course.

  In this tele-seminar we focused on an 'All to all' communication. This also helped the educational process, since a large number of persons contributed to the discussion. It also helped psychologically the trainees to know that they were not alone in this effort and that some of their 'fellow students' had (and were overcoming) similar problems.

  The collaborative 'Virtual Classroom' was developed in the Lotus Notes [8] environment. It supports the posting of the Lessons and related exercises by the instructor. It also supports the student-teacher communication for the transfer of exercise solutions and their commented grading. Three discussion areas set the scope for the virtual classroom, the virtual cafeteria or intermission lobby, and the collaborative help desk (devoted exclusively to functional problems).

The following areas were created within the Lotus Notes environment: The Lesson, The Class Discussion, The Intermission Chat, Functional Problems, and, Personal Data. Special functions and a friendly user interface helped even the trainees with minimal experience in computers to effectively participate. In addition there were detailed descriptions and instructions for the purpose and the services of each space.

The Lesson

In the lesson area, all the activities of the delivery of the course take place. The lessons are posted by the instructor; they include a descriptive title, the themes from AutoLearn that the students are expected to read, short notes and related exercises. The students use the same area to submit their exercises for evaluation. The exercises were reviewed and graded, and resent to their senders

The notes for each lesson were a set of short and simple questions and answers, so that they were easily readable on the screen and could be memorised. The exercises contained a basic drawing file with detailed and commented step by step instructions for its completion (see Figure 4). Illustrations of the intermediate phases and of the expected final drawing helped the students verify the results of their actions.

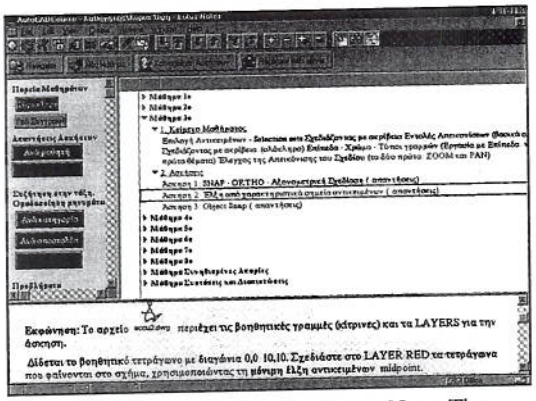

Figure 4: The Lesson environment in Lotus Notes. The titles of Lesson 3 Notes and Exercises are expanded. Exercise 2 is selected.

The exercises were easily sent to the teacher with the pressing of a button. The teacher was examining, annotating and grading them, using the special software that we built for this purpose. When the student received the graded exercises, he could use his software to view his grade, an analysis of his mistakes and to examine all errors in the drawing. This procedure is described in section "The Correction of Exercises".

The Classroom Discussion

The 'Classroom discussion' was structured with predefined categories (including a general one) according to the contents of the course. The trainees could post there their questions or their answers to questions. This 'dialogue' was threaded, so that one could easily see all answers to one question, or the main question to which an answer referred. Observations and comments for the lessons or the exercises were also posted in this area. The instructor was following the 'conversation' and was intervening whenever this was needed.

The aim of the 'Classroom Discussion' was to encourage open communication between all students, so that they could resolve problems via telecollaboration. This is why sometimes, when the questions were not that difficult but still were unanswered for one or two days, the instructor would not give an answer but would rather prompt the students to answers, possibly with some hint.

Intermission Chat

In parallel with the 'Classroom Discussion' an open forum was active: the 'Intermission Chat'. This was the 'meeting place' of the seminar, with no predefined structure. Everyone could propose new categories and initiate new subjects. This area worked very well; pictures, sounds, songs and jokes were frequent here and contributed to a friendly atmosphere where people got to know each other.

Functional Problems

A separate space was devoted to the report of functional problems and their solutions. The two categories in this space corresponded to the software to which each problem related: AutoLearn and Lotus Notes. This area worked effectively as well. Questions were typically answered within a day, and not rarely someone would find that the answers to his problem were already there.

The usefulness of data bases with information on issues of common concern is recognised. A well known example are FAQ compilations, which are effective although their contributors do not belong to 'formal groups' but they are linked by their common interests. In closed communities this model works even better, because of the team spirit which strengthens mutual trust.

Another similar example from the mid '80s is 'Dr. Bovik' of Carnegie Mellon University (CMU). A data base was created for general information to be retained as members of the CS community learned things about living in Pittsburgh and wanted to share them with others. It still functions. A fictitious person, Dr. Harry Bovik, is receiving opinions that members of the University community send to 'him' by e-mail. Dr. Bovik stores these messages in such a way that a user of any local computer can read them. It is common for members of CMU to 'ask Dr. Bovik' before buying a product, going to a doctor, etc.

Personal data

This area was inspired from the traditional .plan files of the Unix systems, or of the current personal Web pages. It was not initially included in the collaborative environment, which was to be kept as simple as possible. However, by popular demand, it was activated, so that the students escape the anonymity of their 'userN' (N was an integer) user ids. Personal interests, personal and family information and pictures, and generally data that composed self-portraits of the students were posted there.

The Correction of Exercises

- Grading of assignments was also computer assisted; this was a must because in CAD mistakes are often difficult to spot visually. Two programs were written in Autolisp, an evaluating program for the teacher and a corrections examination program for the students.

  The evaluating program was run by the teacher (who thus supervised the evaluation) within each submitted drawing. Besides an accurate grade, it generates files containing comments and a catalogue of the erroneous entities. The corrections examination program, is run by the student within the corrected drawing. It lists the comments and grade (Figure 5), highlights the mistakes and it presents the correct solutions. The student can thus interactively recognise and correct the mistakes.

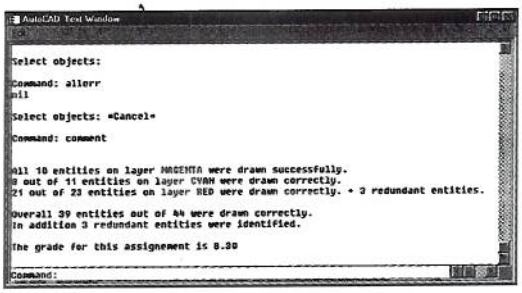

Figure 5: The automatically generated comments and grade, as viewed by the student.

A detailed description of how this software was built is beyond the scope of this paper. We must, however, acknowledge the elements that were exploited in building it, as they may be useful to similar undertakings:

1. The expected result (a drawing) is predictable and unique for each drawing exercise.

2. Each AutoCAD Drawing is a Data Base of drawing entities

3. AutoCAD is Programmable (in Autolisp, C++, etc.) and supports scripts

4. Initialisation files and Environment Variables allow control of the AutoCAD environment.

It should also be mentioned that the correction tool could not correct any exercise. The exercises had to follow some principles. Some of them were to exclude some initial mistakes, for example the placement of the drawing at some other starting point, that would lead to a zero grade, even if all subsequent actions were done correctly.

Hardware

- The minimum hardware requirements was a decision that had to be made early in the project. The subject and the rate of advancement, both in hardware and software were taken into consideration. The requirements for the student hardware had to be above average, since the subject of the seminar was CAD. AutoCAD and the sophistication of the instructional software (which needed to run AutoCAD within Toolbook) demanded much more powerful computers than the minimum estimated for the students of the Open University for that period [9]. The course was designed to be run on a Personal Computer with Pentium 133 processor, 32 MB RAM, screen resolution 800x600 with 64K colours, sound card with speakers or earphones, Win95 and AutoCAD R13 installed and 25 Ã¬ free hard disk space.

  The preparation of the material was also done on Pentium 133 personal computers, with 32 and 64 MB of memory. The server of the seminar was a dual processor Pentium 166 with 64 MB RAM. ¡ second server that was available, as a backup, was not finally needed.

Observations

- The advantages and disadvantages of Teleeducation are generally known and typical to most tele-seminars. Even the age distribution of students, the percentage of dropouts and other statistics were similar in this seminar to similar data around the world (A detailed comparison is given in [10]).

The positive aspects that we observed in our teleseminar were:

1. Elasticity in time. Some trainees studied the subjects with a delay, due to professional obligations

2. Full 'attendance'. People that had not been able to complete some requirements, they were studying the subjects and submitted solved exercises at some later time. These assignments were treated like the ones submitted on-time. The system could impose some grade penalty, depending on the day of the submission.

3. More careful expression of thoughts. The trainees had to express themselves in writing and this made them more careful. Both questions and answers were frequently detailed, structured and illustrated.

4. Students were exploring the use of different techniques and media. Hyper-links to other documents of the discussion and images were common in the students postings. Rarer were sound files.

Some negative aspects were:

1. The lack of immediate personal contact. Through the communication environment, however, the students established several links and friendships.

2. The degree of participation was related to the ease of use of computers.

3. There exist serious software and hardware incompatibilities. This was mostly a problem with experienced users, who overloaded their computers.

During the seminar we also had the opportunity to observe the behaviour of students. The group formed a small community with the diversities in skills and behaviour that appear in most groups. Despite their common interest for CAD and a common technical background (for the majority of the students) there were noticeable differences between the students, in the effective use of their computing equipment. Also, depending on how busy they were, some students merely completed the course requirements, while others were very active in discussions, and would motivate others as well.

Another interesting phenomenon, was what we called 'participation in waves'. Some students would disappear for some time, and then, suddenly, send exercises from several lessons together. This was particularly obvious during the Christmas vacation: the next day of Christmas the traffic on the server was fairly heavy.

The incompatibilities of equipment were more frequent than we initially expected. There have been problems with software that was running on one machine, but would not run on another of the same type, just because of some unidentified software difference. The problem in Greece is more complex because of the Greek versions of the software (Windows, Office, etc.) that sometimes have undeclared differences from the English versions.

Finally, we, also, had our terrorist. Being in a friendly environment we had not placed much emphasis on security. Some student once broke the security of the system and put a fake 'Exceptional Lesson' threatening that he could blow up the whole course. We were not able to identify the intruder, and were wondering how we would continue, when a unanimous reaction made him retract. He erased the 'Exceptional Lesson' and put a posting (using some other account) explaining that the role of the 'benevolent hacker' is to identify security holes, before some hostile hacker does so. The event ended without further complications, but we learned that in the next seminar we must be more careful about the system security.

Students opinions - Comparison with other methods

- AutoLearn was very well received by the trainees. Positive and enthusiastic comments ("O-U-T-S-T-A-N-D-I-N-G", "exceptional", etc.) were common and very encouraging. Fewer were documenting

the opinions expressed. Excerpts from one trainee's insightful comments [11] are worth translating. They were posted at the Class Discussion and contain a fairly accurate description of many conventional seminars; they also indicate the spirit of camaraderie that had developed between the students in our tele-seminar (I think because each knew what the others were experiencing and saying).

"I consider AutoLearn an excellent method of learning AutoCAD. I would even say that with the necessary improvements which have already been proposed by other users or better 'fellow-students' , AutoLearn can rightfully get at the first place of learning AutoCAD." Note: the trainee refers to the needed correction of technical problems with some of the recordings, which did not perform as expected. She continues: "For now, as a 'non-specialist' but having some experience from previous attempts to learn AutoCAD, I would say that I consider it as the second best method! At the first place I would put the 'Private Lessons' and at the third place the 'Conventional' seminars, which are organised at specified place and time with a limited number of participants (usually, at most 20).

The 'Private Lessons' have a high return, only when the teacher has a good and broad knowledge of the 'Program' and the interested student is very willing to learn and very hardworking. On the other hand there are disadvantages: Usually very high cost. Practical difficulties from the teacher or the student in accurately following the programme, because of the time and place constraints. Absence of all 'goods' of the spirit of common participation in the educational process, like the 'Class Discussion', 'Comments and Subjects' posted by each student, 'Group spirit of collaboration, solidarity and exchange of knowledge', 'Possibility of creating broader social relationship with colleagues', 'Getting to know new people', etc.

Now, the seminars for AutoCAD that are undertaken by diverse organisations ('related' and 'unrelated'), have (I can assure you from personal experience) many deficiencies. I mention a few:

If and when the Educational Centre provides a computer per up to two participants, the normal course and evolution of the lesson, based on everyone's attention during the explanation from the instructor is unattainable and impossible: some are 'stuck' or do not understand what goes on because they talk to each other like first grade kids; the instructor is frequently obliged to interrupt the presentation and to run from computer to computer, to show what exactly they should understand and do, so that he can continue. When this happens all the time, no matter how knowledgeable the instructor is, he cannot perform his job correctly. In addition, these interruptions and waiting tire all the class, which cannot understand the problem of that single student who seated, for example, at the back of the room asks for the tutor's help! It is OK for the tutor to help but only if he finds the time to explain to the class the difficulty of that particular student.

The curriculum is condensed to a minimal number of hours, 1/4 of which is commonly lost because of delays at the start of the lessons or the intermissions. Often, due to 'traffic jam' a significant amount of time is lost in the streets going to and coming from the seminar, and this rough time especially in the big cities (Athens first!) exhausts teachers and students.

The cost for these seminars is not small, and often the organisers are not even professionals!

For all the above reasons, my friends, I think we should consider ourselves very lucky that we participate in this 'Innovative Programme in Distance Learning', and especially to the AutoCAD seminar..."

It was even more encouraging that these comments did not come from a computer expert. That student liked using computers but had basic knowledge about them. At the beginning of the seminar she had to bring her computer to our Centre to set up the program and establish its communication with the server.

The other element of the seminar that was very well received was the 'Virtual Classroom'. Comparisons with other seminars that had no 'Virtual Classroom' were expressed; they emphasised the group spirit that developed and the mutual contribution for the development of a 'knowledge repository'. This helped students face problems from software installation to difficulties with some drawing.

Conclusions

- The combination of the 'canned instruction' of AutoLearn with the active 'Virtual Classroom' worked well. Its principle could be applied for training in the use of other software, provided that this software can be successfully manipulated from within the instructional software.

The seminar was instructive for both students and teachers. We all experimented with an interesting and effective technology and methodology for teaching and learning. The spirit of the class was created and the progress and quality of the seminar were affected by both students and teachers. In that sense the tele-seminar was very similar to a conventional seminar. An additional characteristic was that we all enjoyed the novelty and the interest of exploring new promising grounds.

We also had the opportunity to note things that should be improved in the next tele-seminars:

More time should be provided for the initial connection of all students to the server. It is frustrating for students to know that the seminar has started and they have not solved some connection problems yet. We therefore need to verify that students can reach the 'Virtual Classroom' at least one month before the actual beginning of the seminar. During this phase students could introduce themselves; this proves their connection to the server and their ability to use the environment. It also helps the development of team spirit.

The pace of the seminar should be slower. Several professionals are expected to participate, who sometimes cannot follow an intense rhythm. Optional exercises and special issues can be introduced, so that the 'fast' students do not loose interest.

The deadlines should be more strict. The introduction of some grade reduction mechanism for late assignments can help in this direction.

This tele-seminar was a prototype implementation. Meanwhile, a new version of AutoCAD was released. Based on this experience we consider it a worth while task to rewrite some of the infrastructure of AutoLearn and to extend some of the themes.

Acknowledgements

- Special thanks are due to Prof. G. Tsamasphyros, ex Vice Rector of the National Technical University of Athens, who created the Centre for Continuing Education and struggled with passion for its establishment and expansion. Prof. Tsamasphyros was responsible for the whole programme "Design and Pilot Implementation of Distance Learning in CAD/CAM/CIM". I thank him for entrusting this seminar to me and for giving me complete freedom in its design and development. I also thank him for providing all the necessary help and equipment for the development and realisation of this seminar.

The contribution of Damianos Demetriades and John Courtis in the development of AutoLearn and the Virtual Classroom should also be acknowledged. Special thanks are due to Dimitrios Theotokis for his insightful comments during the course of this work.

References

Autodesk (1995) AutoCAD Release 13: (1) User's Guide, (2) Command Reference, (3) Customisation Guide.

EEC (1988, 1993) Article 6 of the European Social Fund (ESF) (Council Regulation (EEC) N 4255/88, JO L 374 of 31.12.1988, modified by Council Regulation (EEC) N 2084/93, JO L 193 of 31.7.1993.)

Massicotte, Guy (1997) Groupware as a Way of Integration of Classical nad Distance Learning Models in Higher Education. European Journal of Engineering Education, Vol. 22, No. 1, pp 3-9

Forte, E, Wentland Forte, M, and Duval, E (1997) The ARIADNE Project (Part 1): Knowledge pools for computer-based and telematics-supported classical, open and distance education. European Journal of Engineering Education, Vol. 22, No. 1, pp 61-74

Asymetrix Corporation (1994) Toolbook User Manual, Asymetrix Corporation.

Calvert Charles (1995) Delphi Unleashed, SAMS Publishing.

Borland International (1995) Delphi 1.0 Developer's Guide, Borland International.

Lotus Development Corporation (1996) Application Developers Guide. Lotes Notes: the power of people working together

Crecraft, D. (1995) Engineering Studies at the Open University. European Journal of Engineering Education, Vol. 20, No. 2, pp 201-210

Tsamasphyros, G. (1998) Design and Pilot Implementation of Distance Learning in CAD / CAM / CIM. Final report. (In Greek)

Tzagkaraki, N (1997) Personal opinion for AutoLearn - Comparisons. Posted on the Classroom Discussion on 7-12-97