DILS 2001 Report
Implementing Scalable Course Environments

Pears, A.N.

Department of Computer Systems
University of Uppsala
Box 325, 751 05 Uppsala, SWEDEN
Ph: +46 18 4710000, FAX: +46 18 55 02 25
Email: arnoldp@docs.uu.se

Keywords

EDUCATIONAL RESEARCH, SCALABILITY, LEARNING QUALITY, NETWORK AND WEB TECHNOLOGY IN COURSE DESIGN.

Abstract. This study examines some aspects of a large scale project course in Computer Networking Design. In this course one of the aims is to use technology to supplement learning. This support takes the form of online learning material (online multimedia lectures, videoconferencing and telelecturing, WWW course site and discussion forum) with the intention of providing students with access to experts in several Universities distributed over two continents.

The fundamental statement addressed in this study can be stated as follows.

> Access to a set of technical and spatial support systems can facilitate the implementation of pedagogical methods which can enable one to scale up the number of student participants in a specific educational setting (scalability).

Data collection for the study is intended to capture the range of student and teaching staff experiences. The presentation of the data assumes that the interesting aspects of experience are both commonallity and diversity of experience. Through presenting a broad image of experiences in the course and the data gives insight into how staff and student perceptions might exist. Subsequent analysis attempts to create a map of the experiences relevant to the primary study object "scalability" thus gaining insight into the range of perceptions on scalability held by participants.

The study concludes that course scalability is not a simple objective. While much effort was given to developing distributed and web based information sources these had very high cost in both time and money. Web based lectures and multi-media content were not often used by students, and the relevance of some more innovative aspects of the curriculum (a video production deliverable) was not obvious to many students.

Staff time estimates indicate that the contact time per student was scalable (in the sense that a teaching assistant was employed to coach each group of approximately 6-8 students). The underlying funding model relies on commercial sponsorship of the groups and it is not clear that this can expand to support a much larger number of student groups. Some concerns were also expressed that some key staff members might become a bottleneck when attempts were made to scale the course to larger numbers of students. There were also some concerns over the ability to preserve personal contact and high quality interaction with the students if there were many more groups.

Given the constraints of the study it appears that course scalability is possible given the underlying funding model used here. However, concerns remain in appointing sufficient skilled teaching assistants and in the time demands on teaching assistants, which were perceived by many to be higher than in a normal course context. This time cost is offset by the fact that many projects were in teaching assistant's research areas, but the expected value to be gained from this was not reliably realised. An additional question that emerges is the question of preserving academic integrity in industry funded project based education where the sponsors have an active role in grading students.

1 Introduction

This study examines a course context where a combination of techincal support and sponsorship strategies are combined in an attempt to generate a scalable environment for project based learning. The basic concept is that combining distributed learning resources, including staff at remote locations, Web material, and peer learning opportunities can create courses that can support and arbitarily large student cohort. We define this as a "scalable" course.

The question addressed in the study is precisely which aspects of the proposed environment are scalable in reality. To address this we focus on the key scalability initiatives proposed, and the effects of these on the course from the perspective of the staff and students involved.

This report is structured as follows. Section 2 provides an overview of the course context in which the study took place. In this section we attempt to provide a complete description of the course in terms of interest groups, course objectives, and funding basis. This provides the background against which the experimental data collection methods can be presented and understood.

Section 3 discusses the methods and study questions that the data collection is designed to give insight into. The data to be collected, and the relevance of that data and how it contributes to an understanding of "scalability", is also discussed here.

In section 4 the data collected during the study is presented and contextualised. The discussion uses the data to identify four key areas relevant to *scalability*. These areas are staff engagement in the course (time and intensity of involvement), student perception of the course (academic benefits and quality of implementation), funding implications, and academic integrity. Discussion of the data occurs in subsections associated with each of these key areas.

General conclusions in each discussion area are presented together with a summary of the relevant arguments and data in section 6. This discussion leads to some general observations which are important lessons learned from the study. Final conclusions and general recommendations to practitioners attempting to devise scalable courses are presented at the end of the section.

2 Study Context

2.1 Scalability

The fundamental aims of the study are summarised by the following statement.

> Access to a set of technical and spatial support systems can facilitate the implementation of pedagogical methods which can enable one to scale up the number of student participants in a specific educational setting (scalability).

The aim is to enhance peer to peer learning activity in order to gain the outcome of maintaining the same teacher to student learning effort or even decreasing the student/teacher interaction. Thus allowing more students to be taught by the same number of senior staff.

This objective is to be realised in the context of a senior level computer communications systems design course taught at the Kungliga Tekniska Hogskola (KTH) in Stockholm (Sweden). The course consists of groups of students working in a problem based learning environment on projects sponsored by local and international companies in the computer networking and mobile communications area.

2.2 Teaching Approach

Each teams of six to eight students is allocated to work on a complex problem in the computer networking under the supervision of a teaching assistant (coach). Funding to support the activities of each team is provided by a commercial sponsor who proposes suitable problem and works with the students from idea to solution. Apart from the salary a perceived benefit for the coaches was that the teams were working on problems in the PhD research areas of the respective coaches. The idea was that coaches could benefit from the student programming effort to assist in resolving problems and the student groups would also help with gathering research resources relevant to both their own and the coach's studies.

In the 2001 instance of the course, which is the subject of this study, there were ten groups of students of which two groups included students from Sweden and USA while the remainder were composed only of Swedish students. Team work and peer learning are emphasised by the course administration, as well as the use of

The teaching model draws upon distributed teaching and learning resources drawn from three institutions on two continents. The universities involved are KTH and Uppsala (Sweden), and Stanford University (USA).

Lecturers from the institutes travel between locations to deliver some key lectures live. These lectures are recorded and packaged for placement on the course web site. Some lectures exist only as recorded performances and students are expected to access them through the web.

The courses is assessed based on the ability of the team to address the problem. Progress is measured and a grade for each student determined using a formula based around "project deliverables". As well as the final project product required by the sponsor deliverables include a video production exercise which presents the team topic to the wider public, and several reflection exercises which ask students to analyse their progress towards achieving their objectives.

2.3 Staffing

Three Stanford teachers are involved in the projects one teaching team management, one teaching video production topics. The last member of staff acted as a team coach. Of these instructors only one was involved over the entire course duration. At KTH the course was managed by one member of senior teaching staff assisted by six teaching assistants who were the team coaches. Uppsala Univeristy involvement was the execution of this study and limited student collaboration with four students involved in limited collaboration with one of the KTH teams.

Course adminstration, project specification and sponsorship negotiations are conducted by a member of senior staff at KTH, with some collaboration with staff at Stanford. Day to day course issues are mostly dealt with by the team coaches. The coaches are kept up to date and communicate with each other and Stanford staff via bi-weekly video conference meetings.

Final grading of the projects was conducted in a whole day discussion workshop involving input from all the coaches, the lecturing team, and sponsors.

2.4 Technical Support

The learning programme is implemented using technical support in the areas of wireless communication and using WWW information sources and innovative lecture techniques combined with project based team learning. The learning support can be classified in three different classes.

- Technical:-
  - Wireless network access is provided over the whole building in which the students work[].
  - Access to the internet is a basic learning resource
  - Virtual and physical interactive spaces are provided to assist students in collaboration. Virtual spaces include email, chat forums and web sites. Physical space includes laboratory rooms and physical equipment required to implement the projects.
- Spatial:-
  - Reconfigurable spaces which can be used for meetings presentations and consultations with sponsors and teaching assistants.
  - Group work spaces which are used as working areas.
- Pedagogical:-
  - Peer learning and enhanced peer interaction
  - Access via the web and special lectures to external experts and knowledge sources.
  - Web based learning resources including online streaming video recordings of lectures, reference documents and purpose built teaching modules in key areas (notably the video production methods required to complete the video deliverable).

The combination of these support forms is intended to create an environment where student learning is supported by non-traditional modes such as peer learning and web based learning, reducing the time pressure on senior teaching staff.

3 Research Method

Gaining insights related to scalability involved several factors that were clearly identified at that commencement of the study. It was clearly important to collect data that provided information about staff and student interactions, and the extent to which students used web and peer learning resources. However, while scalability was the study object in this case, it was also important to gain an impression of the perceived "quality" of the course from students. In achieving "scalability" it was also important that the perceived "course quality" should be maintained.

3.1 Data Collection

The study intent was to investigate the application of innovative technology to create new virtual and physical learning environments with which to support scalable learning.

The variables related to scalability and quality are numerous, so we chose to focus on a few that we felt were the most important. This was a deliberate strategy to try to reduce the data collection overhead, since we felt that high data collection overhead would result in poor response rates from all parties involved (staff, students, sponsors).

Evaluation of the methods employed was to be conducted via an analysis of student and staff time use, evaluation of the quality of the student's learning experience, and staff perception of the effectiveness and level of understanding achieved by the student cohort.

To do this the study focuses on the following major variables.

- time investment (both staff and student)
- funding (available course budget per student)
- quality/relevance of learning activities and outcomes

To measure these variables the following techniques were used.

- Time usage perceptions of faculty, (lecturer, TA's, etc)

- Funding basis, in SEK/student.
- Time study of students in weeks 4, 8 12. Based on time usage categories tailored to student time use.
- Interviews to determine perceptions on learning outcomes based on samples of the student and teaching staff populations in the study context.

3.2 Analysis Techniques

The evaluation intended to use statistical analysis of time data to draw conclusions about the time use of staff. Average time use per week was of interest, as was the amount of time allocated to face to face and one on one interaction with students. We also wanted to study the trends in that data in terms of time use per category over the course duration. Due to the failure of the time logging process this data analysis was not possible. The resons for this failure in data collection are discussed in detail in the next section of this report.

A number of qualitative analysis techniques exist[4] which can be used to structure interview data and use it to investigate a study context. One approach is to code interview data based on content and enter it into a computer based analysis tool such as Nud*ist[5] or NVivo[2] from QSR Systems. This type of approach is very common among social science researchers and allows the analyst to analyse the complex themes in interviews. Among other things such an approach allows the researcher to extract and compare similar statements from interviews with a number of individuals.

In this study it was felt that an approach that tried to characterise the breadth of experience of participants in the study was also interesting. Such a study would investigate the total spread of experiences of those interviewed and give an indication of the types of experience that might be created by the course context.

Consequently the data analysis in the next section draws on both commonality and disparity of experience. Trying to give an overall picture of what the community has experienced draws on the theory of phenomenography[6] to use quotes drawn from interview data to characterise points of view. This approach has been successfully applied in earlier studies of computer science and physics course contexts in Sweden[3] and South Africa[1].

4 Results

4.1 The data

The initial project plan included time logging by all staff and time surveys of student activity. Time use was to be recorded weekly and categorised using a time logging data matrix in which staff could record activity in teaching categories on a weekly basis.

The categories specified were lectures, tutorials, work with groups of students, work with individual students, lab correction, preparation of teaching material, marking exams. These categories were further subdivided into *face to face* and *virtual* communication categories, since one strategy for time management employed in the course was to encourage electronic communication and interaction via a web based *course site*.

This type of data collection was ultimately unsuccessful, since the perceived overhead associated with the logging process was very high. Staff were not motivated to fill in data, and consequently no usable data was collected. Customization of an automated time logging tool that functions under Linux (the prefered computing platform for the staff involved) should be investigated for future attempts to collect time data. One of the key reasons for failure of the time matrix identified by staff was that it was an Excel spreadsheet. An overview of this data form can be found in html format in appendix A.

The importance of estimating the data collection overheads and choices of data collection format was brought forcibly to my attention at a coaching meeting. I asked if people had received and read my email on time collection, and if people had been able to fill out time use data.

"Give it to me in a format I can use and I promise to fill it out!"

said one coach.

Interview data was collected on two occasions from both staff and students. Almost all the senior staff involved were inteviewed between January the 10th and 19th 2001, and again between May 31st and June 7th 2001. A sample of the coaching staff were interviewed on May 31st at KTH in Sweden, and on June 6th in the USA. Students at KTH from a selection of groups from different topic areas and national compositions were interviewed on May 30th.

The first of these interview periods was about two weeks after the commencement of the course. The second interviews were conducted over a week period directly after the end of the course. This data collection resulted in approximately ten hours of interview data, and five pages of typed notes taken in meetings and when talking to senior staff.

Students were selected for interview based on the success level of the group, the size of the group and the multi-national nature of the group. Seven students from KTH were interviewed and three from Stanford. One student at Stanford was a Swedish student on exchange to the USA. These samples represent about 50student cohort in the USA and 10cohort in Sweden. The limiting factor in the Swedish interviews was time, since students were about to go on summer holidays and interview slots were limited.

The intention was to try to capture expectations of staff and students in the first set of interviews. Impressions on quality and scalability, as well as time allocation and related issues were explored in the second interview. The general framework of topics used to conduct those interviews is given in appendix B.

4.2 Course quality

Staff Perceptions Staff quality expectations were high, all the senior staff had invested a lot of time in the course. Web material had been prepared, and this was taking quite a lot of time for some staff. The administration and grading processes had been defined in considerable detail, and a lot of effort had been put into finding sponsors and determining the project topics.

Most staff were not comfortable giving estimates of the time that they were putting into preparation. One staff member commented that they were investing a considerable amount of time at that point in the program, but that they considered the materials that they were developing to be re-usable, and also scalable to very large numbers of students since they would be available from the course web site.

Data collected from observation of the grading meeting on 31st May 2001 and discussions with the senior staff and teaching assistants at that meeting identified several problems in the final grading process and the definition of the projects themselves. These can be broadly categorised as follows.

- Correlation between marks and perceived quality of group effort by coaches and staff. A significant proportion of the marking day was spent discussing whether the marks achieved by applying the marking scheme accurately represented the actual achievements of the group. There are several factors that I believe contributed to this outcome given the discussions I observed.

- It appeared that the marking scheme was rather complex, and not all the coaches had the same understanding of the marking process and how it should be applied. This was complicated by the fact that the coaches were graduate students from a range of countries and the meaning of grade levels in the country of origin coloured the coaches approach to assigning grades to their student groups. One possible reason for this outcome is that the marking scheme did not capture the activities that the teaching team wished to reward in quite the correct proportions. For instance it appeared that too much weight might have been given to self reflection exercises where students explained the lessons they had learned from their project efforts. Certainly it appears that the marking formula should be revisited and revised to simplify the marking process and make it more transparent to the coaches.
- Academic integrity of the course, and the role of sponsors was discussed at length, since the team sponsors had been allocated a significant proportion of the final team mark. It appeared that the industry members who had been involved in allocating marks were not used to that process at all, and the marks allocated were often one hundred percent. A figure that was hard for the marking meeting to take seriously. Other sponsors had not given a mark, despite continued attempts to contact them to obtain one. The wide variations in marks, and the lack of correlation between the sponsor grades and the coach's assessment of team ability, lead to suspicion over the academic integrity to the sponsor allocated marks.
- Definition of project topics was also discussed in detail. It was felt that better quality projects would result if students had a better idea of the objectives early on, and the equipment needed was obtained from the sponsor in advance. There had been a number of teams that had been more or less forced to change topic focus due to delays in getting equipment promised by a sponsor. In addition amalgamation of several teams into a single larger team had produced problems also. Consensus seemed to be that this should be avoided in the future.

– The projects had very dense schedules and a large number of deliverables, many of which were due in quite a short time frame. To address this problem, and also reduce some of the problems with the grading scheme, one of the "lessons learned" exercises could be removed. There was also a conversation about reducing the load of the video production deliverable. It was suggested that the "storyboarding" exercise should be omitted. Conversation with the Stanford member of staff responsble for that aspect of the curriculum in a later interview indicates that it would be preferable (in terms of quality) to omit the "rough cut" video submission instead.

Independent interviews with staff concerning the quality of other aspects of the course materials were uniformly fairly positive. Online modules for teaching had been deployed and proved useful, and the web site was considered to be of good quality though some aspects were seldom used.

Coaches reported not using the online message forum to distribute messages, preferring to use electronic mail from their personal computer accounts instead.

Student Perceptions Student expectations at the start of the course were overall pretty positive. Some students appeared not to have a clear idea of what they might expect throughout the course. This topic was introduced by a US student in the course in the interviews at the start of the program.

The interviews with students focussed on quality in general, enjoyment and value they got out of the course, usefulness of the online materials and communication tools, and the relevance of the things that they were asked to do as deliverables.

Most students commenced the interviews by stating that they had found the course very rewarding and engaging. They then tended to comment on the high workload. Many students also commented on the video prodution deliverable. Some comments were of a very positive nature.

> "Took time away from the real course focus, which should be computer networking.[translated]"

> "We just decided to avoid the video assignment, we took some film and did a bit of editing, but just to get something to hand in.[translated]"

Students, like the coaches, were not keen on the online forum as a medium for communication. They commented that they preferred electronic mail and ICQ, a type of internet chat tool. Students who had been involved in video conference sessions between Sweden and USA were happy with them, but felt that it was hard to tell what people really thought sometimes.

The web resources were used by some, but there were also people who felt that some aspects of the web based material had not worked out well. Some quotes that give a good feel for the student perception of online course aids of various types follow.

> "it is always better and you get more from sitting down and really listening to a person. Films on a computer is not the same thing, and one never gets around to reviewing stuff one downloads to look at at home.[translated]"

> "... coaches are important for every team, and the other information was very useful also on the web. People are not easily replaced by IT devices, though support via IT can help to give a new experience.[translated]"

It also seemed that students had difficulty finding relevant updated material on the web site. In one interview a student also mentioned that the material on the web specifying what was required when preparing deliverables was distributed over several locations on the site, and seemed not to be consistent in what it asked the groups to do.

Coaching was seen by students to be vital to quality, though not all students were happy with the coaches actions with respect to their teams. Some felt that the coaches lacked leadership experience and ability to handle the team dynamics. Another aspect that was criticised was the level of relevant technical knowledge of some coaches. While this has some impact on quality, the major impact could be in the scalability, since students clearly want to have expert and experienced coaching staff.

4.3 Course scalability

Staff Perceptions Senior staff acknowledged that there had been pressure on their time during the course, but also seemed to feel that much of this time was a once off investment. It was observed by a coach that there were some potential bottlenecks in terms of expertise that was held by senior staff, and was not easy to replicate.

Anecdotal evidence from interviews suggests that staff time demands for the course have not been reduced significantly if one counts in the time spent by coaches. In fact the coaches remarked on the time demands in supervision. This was most apparent when talking to the staff who had more than one team to supervise, or had been in hardware support roles.

The number of staff (in particular the number of coaches) needs to scale with the class size to support the teaching model. This is only possible when both funds, and suitably

qualified staff are available. This observation, combined with the fact that retaining good graduates as research students is increasingly difficult due to high industry salaries, is one of the greatest threats to creating scalable courses following this model.

The technology cost overheads associated with a technical course such as this one are high. Specialist equipment was used by many groups. It appears that the majority of these costs are borne by the sponsors, or by general infra-structure development projects at KTH. Student travel between countries and funds to fly lecturing staff between locations seem also to be largely drawn from sponsorships.

Student Perceptions Students perceptions of scalability in the course while retaining quality tended to focus on providing enough coaches and equipment. The issue of coach experience and technical knowledge in the project area was seen to be important by some, others felt that the coaches ability to motivate the group to work together and focus on the project topic was the most important skill.

Some typical quotes that illustrate breadth of views on scalability and the use of online resources are included here. Some other relevant quotations have already been presented when discussing quality issues in the previous section.

> "I would say that scalabililty and quality are sustainable if the level of equipment (portable computer and wireless card, plus web support and online material are maintained), as well as a coach per team. The provision of videos of lectures is a good idea, but hard to review at home, when it would be most convenient, without having broadband access."

> "Web data resources were really good, and the online web lectures were useful and interesting."

It was pretty clear from the response to questions on scalability that most students had not really considered the issue. When they were asked to comment they focused on the more easily identified factors such as availability of coaches and equipment. In terms of the relationship between scaling up the course and quality there were no strong opinions in the interview data.

5 Conclusions

It is clear from the data collected in this study that the number of teaching hours per student remained high for this course, despite the introduction of web based learning resources and enhanced opportunities for peer learning. This is mainly as a result of time spent by the coaches interacting with the student project groups. This time can be considered scalable however, since one of the fundamental assumptions of the course is that sponsorship funds are available to employ a coach responsible for each group.

Funding is another factor that has traditionally been regarded as non-scalable. In this study the significant funding generated from industry sponsorship has enabled most of the travel of staff and students between Stanford and KTH, as well as providing most of the technical equipment required to realise the projects.

The ability to generate scalable funds by tailoring projects that are attractive to industry seems to be a prerequisite for the type of scalability model for learning pioneered by this course. Even in the presence of scalable funding the ability to hire appropriately qualified staff may limit the scalability of future course instances.

The generation of funding via sponsorship also generates other questions. What is the role of the sponsors in defining projects that are suitable to the academic requirements

of the course? How much influence should the sponsor be able to exert, and how directly should they be involved in the progress management and definition of intermediate goals within a project? The issue of allowing sponsors to allocate a significant part of the group grade should also be seriously investigated as this can create fears about the academic integrity of the grading process.

It is clear that the course was greatly enjoyed by the students that took part, though some parts of the course were very work intensive. The video deliverable was a major factor in the workload perception of students. It was appreciated, but its relevance was questioned by a number of students.

Reducing workload density can be achieved by removing one of the "lessons learned deliverables" and the "rough cut video deliverable". However, the video itself appears to be a powerful tool encouraging students to identify the key elements of their work and convey them to a non-technical audience. This element of the course needs to be motivated better, in the sense that the value of the task and its relevance to a technical degree program needs to clearly explained to students.

Given the constraints of the study it appears that a type of course scalability is possible given the underlying funding model used here. However, concerns remain. It is difficult to appoint a sufficient number of skilled teaching assistants, and the time demands on teaching assistants were perceived by many to be higher than in a normal course context. Time investment by the coaches may be offset by the fact that many projects were in their own research area. An additional question that emerges is the question of preserving academic integrity in industry funded project based education where the sponsors have an active role in grading students.

6 Further Work

This report is a detailed draft, and lacks a full comparative data analysis using qualitative methods. Much of the data presentation is anecdotal and many conclusions have been reached by manual scanning of interview recordings and typed notes. This lack of formalism in data presentation and analysis is due to the short time lag (3 weeks) between when the final data was collected and the due date for this report. A more theoretically rigorous analysis of that data should be performed.

Accesses to online course materials should be logged to get an impression of the cost effectiveness and usability of those resources. Statistics of this sort should log a user identifier with each access so that the percentage of individuals in the class that have reviewed a given resource can be computed.

The impact of active sponsor roles in defining projects and managing and grading student work should be investigated. There is the potential for loss of academic integrity in both curriculum content and grading, since industry managers do not necessarily have similar objectives and criteria against which to measure group success.

References

1. Alant, Busisiwe, Cedric Linder, and Delia Marshall. Metacognitive-linked developments arising from the design and teaching of conceptual physics. August 1999.
2. P. Bazeley and L. Richards. *The NVivo Qualitative Project Book.* London: Sage Publications, 2000.
3. Shirley Booth. *Learning to Program. A phenomenographic perspective.* Number 89 in Göteborg Studies in Educational Science. Acta Universitatis Gothoburgensis, Box 5096, S-402 22 Göteborg, Sweden, 1992.
4. Norman K. Denzin and Yvonna S. Lincoln. *Handbook of Qualitative Research.* Sage Publications, 1994.
5. Celia Gahan and Mike Hannibal. *Doing Qualitative Analysis with QSR NUD.IST 4.* London: Sage Publications, 1998.
6. F. Marton and S. Booth. *Learning and Awareness.* Mahwah NJ: Lawrence Erlbaum Ass, 1997.

AUTHOR

Dr Arnold Pears (arnoldp@docs.uu.se) took his BSc(Hons) in 1986 and PhD in 1994, both at La Trobe University in Australia. He has held posts as a Senior Lecturer at La Trobe University (Australia) and is currently a Tenured Senior Lecturer at Uppsala University in Sweden. He is a member of the IEEE, ACM and SCS, where he also serves on program committees for conferences in his areas. He has published widely in the areas of Parallel Computer Architecture and Network design, Parallel Algorithms, Simulation, and Computer Science Education. He can be contacted at the Department for Computer Systems, Box 325, Uppsala University, 751 05 Uppsala, Sweden.

Appendix A

Letter to Staff

Dear Colleague,

this cover letter introduces the form that accompanies this electronic mail. The form, and an interview with you are requested as a part of the data collection phase of a collaborative project evaluating "course scalability" between Uppsala University (Sweden), KTH University Stockholm (Sweden) and Stanford University (USA).

The data collection is intended to record time and staff and student experiences that are relevant to evaluating the research hypothesis presented in Appendix A.

An outline of the principles underlying the data collection exercise may also be of interest to you. These can be reviewed in Appendix B below. If you have any questions on the study or the manner in which the data will be used please contact Dr Arnold Pears (Uppsala University) either by surface mail or electronic mail at the addresses below.

Dr Arnold Pears.
Department of Computer Systems
Box 325,
751 05 Uppsala, SWEDEN.
arnoldp@docs.uu.se

I should like to assure you that all information collected in the study will be rendered anonymous during analysis and any reports generated will not identify individuals.

When filling in the entries in the form, not all areas will be relevant to you. So fill in areas that are not relevant with a '-' to indicate to us that you were not involved in those acitvities. For activities that you are involved in please estimate to the nearest 15 minutes or half hour the amount of time that you engage in such activities in a given week, and enter this on the form at the end of the week.

You might find it useful to take some time usage notes during the week to help you fill out the numbers pretty accurately. The idea of doing this is find out how people are really spending their time, in contrast to how they "believe" they are spending their time. These can be rather different!
We are also interested to see how time usage differs over the duration of the course, depending on the types of roles that you are engaged in.

Where there are categories that indicate two possible activity types face to face (F) and virtual (V) we would like you to enter two numbers in the format 30V 75F, meaning 30 minutes virtual interaction and 75 minutes face to face interaction in that week.

I hope that this is of assistance to you in filling out the form.

Again, many thanks,

Arnold Pears.

Time Spreadsheet

Course Scalability Study

Name:

Role in Course:

Course Time Outlay

Write in the total in minutes spent on each activity per week in the areas provided (rounded to nearest 5 minutes). If there is no activity in a class please place a '-' in the box. Estimated time to complete this data collection per week is 15 to 20 minutes.

Activity	Lectures (mark as face to face [F] or virtual[V])	Course Materials	Marking	Tutorials	Project Supervision	Individual Consultation (Virtual [V] or face to face [F])	Group Consultations (Virtual[V] or face to face [F])	Web	Course Related Research Activity	Other
PreCourse										
Week 1										
Week 2										
Week 3										
Week 4										
Week 5										
Week 6										
Week 7										
Week 8										
Week 9										
Week 10										
Week 11										
Week 12										
PostCourse										

NOTES:

- use the other column to specify special activities that are not listed in the table.
- form can be either printed out, or filled in electronically and returned at the end of the course period.
- data supplied is confidential and will not be associated with names or other personal information.
- questions on the form, or related to the research should be addressed to either Arnold Pears (arnoldp@docs.uu.se) or Helge Strömdahl (helge@lib.kth.se).
- this form is to be returned to Arnold Pears, arnoldp@docs.uu.se Arnold Pears, Department of Computer Systems, Box 325, 751 05 Uppsala, SWEDEN.

Appendix B

Staff interview structure

Is it possible to scale up the whole course?
To what size?

Of those
What aspects are most scalable?

What aspects are least scalable?

Is it possible that student questions could have been
satisfied by interactions between the students themselves
of technological teaching support. Relieving teaching staff
of some time costs?

Comment on the possibility for students to re-use and
build upon the previous, and current experiences of
their coursemates.

What opportunities would this have for reducing time
spent asking questions and instead reallocate time in
other categories?

Which other categories would you consider most important
to use such (gained time) in?

Is there something else that you would like to talk
about in relation to the course?

Student interview structure

Can we replace teacher interaction with electronic supported
access to information and learning tools, while still
supporting high quality student learning?

What impacts do you feel increasing the number of participants
might have on your learning experience?

How might your allocation of time to different study/learning activities
have changed over the duration of the course?

Is this change due to the types of support technologies and
teaching methods used?

Is there something else that you would like to talk
about in relation to the course?