Experiences with a Synchronous Virtual Classroom in Distance Education

Herman Koppelman
Open University of the Netherlands
PO Box 2960
6401 DL Heerlen, The Netherlands
+31534322894
University of Twente
Enschede, The Netherlands
H.Koppelman@utwente.nl

Harald Vranken
Open University of the Netherlands
PO Box 2960
6401 DL Heerlen, The Netherlands
+31455762373
Harald.Vranken@ou.nl

ABSTRACT
Modern technology offers the tools for having synchronous virtual classes. This paper reports about experiences of such a class in the context of distance education. The paper focuses on the tool as well as on the pedagogy. It outlines the pedagogical approach of the virtual class, which is an adaptation of good practices of face-to-face classes. The results of an experiment are discussed. Strong and weak aspects of synchronous virtual classes are identified.

Categories and Subject Descriptors
K.3.2 [**Computers in Education**]: Computer and Information Science Education – *computer science education, information systems education.*

K.3.1 [**Computers in Education**]: Computer Uses in Education – *collaborative learning, distance learning.*

General Terms
Design, Human Factors.

Keywords
Distance education, virtual classroom, pedagogy, educational technology, active learning.

1. INTRODUCTION
The Open University of the Netherlands offers distance education. Although the courses are designed for self-study, many students need some support. Therefore, optional face-to-face classes are offered for several courses, in a small number of cities scattered over the country. For many years the number of students attending those classes has been small. On the one hand this low attendance number is a positive sign, since the course materials for self-study are rated highly by students and cause little need for students to participate in classes. On the other hand, some students do not attend due to restrictions on travel distance or time schedule. Also, we observe that students who attend the classes usually perform better. Although higher attendance numbers would improve the performance of students, the current low attendance numbers cause a strong urge to economize on those classes.

We wonder whether virtual classes can solve these issues. For economic reasons, we may need to replace multiple small classes in different cities by a single virtual class. More students may be able to attend since there will be no need to travel. Furthermore, the virtual classes may be recorded and students – also those who did not attend the classes - may replay the recordings later.

In this paper we report on our first experiences with a virtual class. Our main questions are: How should we organize the virtual classroom? Is there an adequate pedagogical approach? Which tool or which features of a tool should we use? Are virtual classes effective in student participation and achievement?

It can be expected that at least for part of the students in the near future the choice will not be between virtual classes and face-to-face classes, but between virtual classes and no class at all. Therefore our main question is *not* whether virtual classes can be as effective as face-to-face classes. The main question is whether they can be effective at all.

For the organization of the virtual classroom two things are essential:

- to have a suitable pedagogical approach
- to have a tool that supports that approach.

Many authors stress the importance of the pedagogical approach in a virtual context. In an overview study [1] on the effectiveness of distance education it is concluded:

"Characteristics of pedagogy tended to take precedence over media. Does this mean that media are not important? No, it cannot mean that, because media are a requirement for DE (distance education) to exist in the first place. It does mean, however, that instructional practices, independent of the medium, are critical to all forms of educational practice, including and perhaps especially DE. This seems almost too axiomatic to state, and yet in the DE literature there is an exaggerated emphasis on the medium du jour."; and:

"A medium should be selected in the service of instructional practice, not the other way around." [1]

Our paper presents a pilot study with a virtual class we conducted in the computer science department of our university. In the pilot we

ITiCSE'08, June 30–July 2, 2008, Madrid, Spain.

focused on the tool as well as on the pedagogy. We based the pedagogical approach in the virtual classroom upon our experiences with face-to-face classes that we have been giving for many years. By and large the students and the instructors are positive about this pedagogical approach. Therefore we consider them as 'good practices'. We transferred those good practices to the virtual classroom, taking care for the need of adjusted implementation.

Communication in the virtual classroom can take place in two ways: synchronously and asynchronously. In this pilot we focus on synchronous communication. The main reason is that communication in a face-to-face class is mainly synchronously. Therefore it is comparatively easy to translate good practices to synchronous classes.

In the next sections we will discuss the course, the pedagogical approach and references to prior work, the tool we used and our experiences.

2. THE COURSE

The pilot with the virtual class was conducted in the course *Introduction to Computer Science*. This course is the first course of the bachelor curriculum in Computer Science and it gives a broad introduction to several subjects, as object-orientation, UML, Java-programming, relational databases, binary numbers, operating systems, computer networks, and so on. Many students enroll for this course to get acquainted with computer science and to explore whether to embark on a full curriculum in computer science or not. In fact, this is one of the main objectives of this course. For that reason, many students never participate in the examination.

In our distance education university, students are free to study courses whenever they like, but we advice and promote the use of a schedule. This schedule resembles schedules in face-to-face education: a year has 4 blocks of 10 weeks and in every block a number of courses are 'offered'. Most students study according to this given schedule.

When *Introduction to Computer Science* is offered, enrolled students can join face-to-face classes in a number of places all over the country. Attending those classes is optional and students are not marked. In many cases the number of students joining these classes is below 10.

3. PEDAGOGICAL APPROACH

We have been teaching face-to-face classes for the course Introduction to Computer Science for several years. At the heart of the pedagogical approach are activities performed by students. During the sessions students are not passively listening to lectures, but the instructors invite the students to get involved in activities. This approach is in agreement with the well known ideas of active learning. Silberman [8] characterizes active learning as follows: "To learn something well, it helps to hear it, see it, ask questions about it, and discuss it with others. Above all, students need to 'do it'—figure things out by themselves, come up with examples, try out skills, and do assignments that depend on the knowledge they already have or must acquire." Several reports have been published about the application of those ideas to computer science education. For example [3, 6, 7] discuss several possible activities in the CS classroom.

In our face-to-face classes the activities of the students are focused upon solving problems. In every session we offer problems that are typical for the scheduled subjects. The students discuss these problems in interaction with each other and with the instructor.

In the virtual classes we adopted the same approach. In every session some relevant problems are offered, related to the new topics. The problems are offered just in time, they are typical for the scheduled subjects and can be solved with the knowledge as offered in the course material. The problems are tuned to provoke discussion, e.g. problems are formulated such that they can be solved or interpreted in different ways.

A key question is: how can we offer the students in the virtual class an environment that invites them and supports them to be active? An essential condition of this environment is that it should facilitate interaction. The importance of interaction for educational activities, especially in an online context, is stressed in [9]. During the sessions we strive for as much interaction as possible, interaction between the students and the instructor, but also interaction among the students themselves. In a face-to-face class interaction happens in several natural ways. In the virtual class this interaction has to be designed carefully.

We used a number of features of the tool (to be discussed in more detail in the next section) to do so. First we used *electronic hand raising*. The functionality is the same as the physical hand raising. Students can raise hands individually and on their own initiative, indicating that they want to say or ask something. They can also raise hands in reaction to a question of the instructor, indicating that they want to give an answer. All participants can see on their screen which students raise hands electronically.

We also used the *feedback* feature of the tool for eliciting interaction. The instructor can use this feature to get feedback from all members of the group at the same time. For example, the instructor can ask whether a statement about a topic is true, whether a given answer of one of the students is correct, and so on. All students can give feedback by polling yes or no. Everybody sees the distribution of the yes/no polls. After the poll the instructor can ask a student to give an explanation to his or her vote. In the same way a multiple choice question with 3 or 4 options can be posed and the answers can be discussed. The instructor can use feedback also to ask about the progress of the learning process, for example whether any questions are left with respect to a subject.

During each session a number of topics are covered. The instructor gives a brief introduction on each topic by presenting some slides. Next a number of problems are discussed. This can be done in several ways, according to the type of problem. We give a typical example of how this happens. The instructor asks the students to raise their hands if they want to give a solution to a problem. He gives the turn to one of them. This student gives a solution, for example by typing and/or drawing it on the shared whiteboard. Then the instructor asks the students if they think the answer is correct by giving them the opportunity to poll right or wrong. Everybody can see the result of the polling. The instructor selects one of the students to explain why he/she thinks the answer is right or wrong. For example, if the original answer was wrong, the turn is given to somebody who thought so. Using the microphone, this student may state his of her motivation. Next other students can be asked to give their view. In this way several students can contribute to the discussion. Of course, on any time students can raise hands on their own initiative if they have a question or want to say something.

We stimulate the students to be active prior to the class meeting, as well. Therefore we send the problems to them in advance, urging

the students to prepare themselves. The instructors expect the students at least to have *read* the problems prior to the class. In this way the students come to the class with some common experiences they can discuss. During the class no time is spent on reading and understanding the problems, therefore the available time can be used efficiently.

A relevant issue is the frequency of the sessions. In the face-to-face classes we limit the frequency to one session in two weeks, because of the traveling effort of the students as well as the instructors. Therefore there are five sessions of about 2.5 hours. In virtual classes there is no need for this limitation. A class meeting is considered to be an incentive to prepare the topics. A higher frequency of meetings gives more structure to the students and will help them to study regularly. Therefore we offered weekly meetings of about 1.5 hours during 9 weeks. The first session is an introductory session. All participants introduce themselves and the instructor explains the way of working in the virtual classroom and the use of the tool, like how to electronically raise your hand and how to poll.

The sessions are recorded and are available for the students after the sessions. The recordings and problems are stored and can be accessed and played back by all students who are registered for the course, including students who did not attend the class.

4. THE TOOL

We needed a tool that could support our pedagogical approach. Therefore this tool should first of all:

- stimulate students to participate actively and synchronically in the sessions
- facilitate different kinds of synchronic interaction between the participants
- be easy to use; technology should be no obstacle for participating in the virtual class.

Based on a successful pilot in another department of our university we decided to use LearnLinc, a product of iLinc Inc [4]. LearnLinc offers a lot of functionality for synchronous virtual classes. We used only part of its features. Most important for our pilot were:

- two-way audio conferencing, by way of Voice over IP (VoIP). In the LearnLinc classroom the instructor has control and can give one student access to audio conferencing. That student will then be heard by the class and a picture of that student is shown on the screen
- shared whiteboard; the whiteboard is a shared workspace to which instructors and students can easily add content, like notes and simple graphics
- feedback from students; instructors can poll students about any subject, and students can give feedback
- electronic hand raising
- delivery of presentations; LearnLinc has a viewer for PowerPoint slides
- chat
- record and playback; virtual classes can be recorded and replayed at a later date.

We asked the students to use chat only for procedural and technical issues, for example to report issues as failing audio or not being able to view the PowerPoint slides.

In section 3 we outlined how we used the other features within our pedagogical approach.

Prior to the introductory session a short individual session with each student was held, allowing us to check whether the technology worked properly, especially the audio.

LearnLinc offers video conferencing but we decided not to use it., because we expected technical problems. Students often participate from home and many of them lack a fast internet connection and/or a well equipped pc with a webcam.

Instructors received a one day training with the tool.

5. EXPERIENCES

5.1 Student participation and interaction

During the spring of 2007 we offered a block with virtual classes as well as face-to-face classes. We decided to limit the number of students of the virtual class to 15. We enrolled among the students that were registered for the course.

Three students of the original 15 resigned during the course: two could not keep up with the pace and one gave up for medical reasons. During each session a few of the remaining students were absent for personal reasons. During the final session 10 students participated and two apologized for not being able to join.

The students participated actively from the start. Usually they prepared the sessions reasonably well by working on the exercises.

Of our initial group of 15 students starting in spring 2007, 9 passed and 1 failed the examination while the remaining 5 did not sit for an exam by the end of 2007. It follows that 67% of the students (10 out of 15) signed in for the examination and that 90% of the students (9 out of 10) that signed in for the examination, passed.

5.2 Student's view

We held two evaluations among the students, a formative evaluation about halfway through the course and a summative evaluation at the end. In general students are positive about the virtual classes. Most important findings are:

- Main reasons to choose virtual classes (instead of face-to-face classes) are interest in the use of IT-tools (64%) and avoiding travel time (43%).
- Students report better understanding of subject matter and providing structure to study regularly as the main benefits of attending virtual classes. This finding is in agreement with the findings of a similar pilot, as reported in [5].
- Students think it is important that exercises to be discussed in a class are sent to them in advance. They prepared those exercises reasonably well. At the end of the sessions a growing number of students had problems to keep up with the pace.
- About half of the students replayed recorded sessions at a later date; many of them replayed several classes.
- Also many students (260) who did not attend any of the classes, downloaded some of the recorded sessions or the accompanying exercises.
- Students like short, frequent classes; they had no problems to maintain attention during the class.
- Students had no problems worth mentioning using LearnLinc; LearnLinc is considered user friendly; including the log in procedure, participating in the sessions and replaying them.
- The quality of the audio is evaluated as reasonably well, though some students don't like the delay in the audio.

- The LearnLinc features that supported interaction (feedback with polling, hand raising and giving students a turn) are evaluated very well.
- Many students said they missed video and proposed to use video in future classes.
- Some students missed the opportunity for nonverbal communication and for social communication (jokes, getting to know each other better, expressing emotions).

5.3 Pedagogical approach and instructor's views

Students actively prepared the sessions by trying to solve the problems we sent them in advance. At the end of the cycle some students had problems to keep up with the pace and to prepare the sessions. During sessions all students participated in the discussions. The instructors continually tried to keep the students active, by asking questions that could be answered by electronic hand raising or by polling. When the instructor asked for 'volunteers' to answer a question, usually many hands were raised. Especially the feedback facility proved to be an effective and natural way to keep interaction going and to elicit a reaction from the group as well as to keep the students alert. When the instructor gave an opportunity for feedback, usually all or almost all of the students actually voted. The threshold to react by electronic voting seems to be lower than to react in a face-to-face class.

In many cases the students had no problems using the whiteboard to give a solution, by entering a text or drawing a simple figure. Sometimes they preferred the instructor to type or draw their answers.

The instructors had no problem handling a group of 10-15 students. It can be doubted whether the group can be much larger with the same pedagogical approach. Instructors have to divide their attention to several modes of communication at the same time. They have to concentrate on the content they are teaching, in the first place. At the same time they should notice if students raise hands. They have to operate the tool, using and controlling the facilities of hand raising, feedback, drawing figures and entering texts, and controlling which student is allowed to talk to all others. They also have to check the chat and sometimes have to act accordingly, for example to synchronize students who 'got lost' or had a technical failure. They should notice if a student comes late. If the number of students increases it becomes harder for the instructor to stay in command of the class.

The instructor has to understand that it is important to constantly explain what is happening next, because physical cues available in the face-to-face environment are not available online.

The tool should be no obstacle for the students to participate in the discussions. This means that the type of problems designed by the instructors need to match the feedback facilities of the tool. For example, the students can not be expected to draw complex diagrams or use mathematical notation. Therefore we had to rely on problems where the feedback consisted of audio, short written texts or simple figures. We had to adapt several problems to this requirement.

We found out that the feedback feature of LearnLinc provides the possibility to diagnose the progress of the group as a whole. From the feedback to a multiple choice question, the instructor gets easily and quickly a survey of the level of understanding of a specific topic.

5.4 Technology

A number of problems with technology arose. For example, some students sometimes could not log in, other students experienced problems with the audio. On the whole these problems had no heavy impact upon the course of the sessions and most of them could be solved easily. Two-way audio is an essential feature for virtual classes to succeed. The quality of the audio proved to be reasonably well. A drawback of the audio is the delay. This delay hampered to some extent spontaneous conversations and discussions. In the LearnLinc classroom the instructor has control and can give students access to audio conferencing, but only one at a time. This has the drawback that students can not discuss directly and spontaneously with each other. A student can only react to another student after having been giving explicitly access to the audio by the instructor. An advantage is that the instructor can easily control the quality of the audio. Students cannot speak together and disturbing background noises can be suppressed.

Students had only minor problems with the access to LearnLinc and with the usability of the (in this pilot selected) features of LearnLinc. LearnLinc was by and large considered easy to use.

6. CONCLUSION

We offered a virtual classroom with a pedagogical approach based upon active learning. The students participated actively from the beginning. They performed well: only 3 students (out of 15) resigned during the course, and 9 of the remaining 12 students passed the examination by the end of the year. The students also held positive opinions about the classes. The tool LearnLinc was felt to be intuitive both for the instructors and for the students.

It cannot be denied that in our virtual class interaction is much poorer than in face-to-face classes. There is hardly any nonverbal communication and even the possibilities for verbal communication are limited. From that point of view a virtual class is a poor variant of a face-to-face class. On the other hand virtual classes provide opportunities that are hard to implement in a face-to-face context.

- They offer flexibility in frequency and duration of the sessions. Especially in a distance education context this is a substantial benefit. In our case we offered a session every week, which cannot be achieved with face-to-face classes. More sessions provide more structure, which might support the students.
- Sessions are recorded and can be replayed, also by students who could not join the class. This facility provides for a need of many students.
- The features for hand raising and feedback ('polling') result in a lot of interaction and keep the students alert. These are natural and explicit features of the tool that invite students to communicate. We have the experience that the threshold for students to actually use these features is very low.
- The feedback feature offers a nice possibility to diagnose if the group as a whole has problems with specific subjects.

All of this could also be realized in face-to-face classes, but they are a standard feature of the used tool. LearnLinc provides affordances for these specific forms of communication [10].

The interaction during the pilot was limited. The students' input was limited to audio, text, simple drawings and polling and there was hardly any nonverbal communication. In the future we would like to use features for drawing diagrams, for using more complex

notations and above all for using video, which is also a pressing wish of many students.

Our pilot was limited to a group of 15 students, one course and one tool. The results are encouraging but we need more experiences with the same and different courses and other tools to assess the possibilities of virtual classes. Ultimately we would like to contribute to the development of a pedagogical approach for the virtual CS classroom, where for example also Bower ([2]) is aiming at.

7. ACKNOWLEDGMENTS

We thank Gerrit C. van der Veer for his comments on an earlier version of this paper.

8. REFERENCES

[1] Bernard, R. M., Abrami, P.C., Lou, Y., Borokhovski, E., Wade, A., Wozney, L., Wallet, P.A., Fiset, M., and Huang, B. 2004. How Does Distance Education Compare With Classroom Instruction? A Meta-Analysis of the Empirical Literature. Review of Educational Research, 74, 3 (Fall 2004), 379-439.

[2] Bower, M. 2006. Virtual Classroom Pedagogy. Proceedings of the 37th SIGCSE technical symposium on Computer science education (Houston, Texas, USA, March 03 - 05, 2006), 148-152. DOI= http://doi.acm.org/10.1145/1121341.1121390

[3] Briggs, T. 2005. Techniques for active learning in CS courses. Journal of Computing Sciences in Colleges, 21, 2 (December 2005), 156-165.

[4] iLinc, http://www.ilinc.com/

[5] Mathews, C. 2005. Synchronous Distance Delivery of an Electrical and Computer Engineering Program. 35th ASEE/IEEE Frontiers in Education Conference, October 2005, Indianapolis.

[6] McConnell, J. J. 1996. Active learning and its use in computer science. Proceedings of the 1st conference on Integrating technology into computer science education (Barcelona, Spain, June 02-06, 1996), 52-54. DOI= http://doi.acm.org/10.1145/237466.237526

[7] McConnell, J. J. 2005. Active and cooperative learning: tips and tricks (part I). ACM SIGCSE Bulletin, 37, 2 (June 2005). DOI = http://doi.acm.org/10.1145/1083431.1083457

[8] Silberman, M. 1996. Active Learning 101: Strategies to Teach Any Subject. Allyn & Bacon.

[9] Su, B., Bonk, C.J., Magjuka, R.J., Liu, X., and Lee, S. 2005. The Importance of Interaction in Web-Based Education: A Program-level Case Study of Online MBA Courses. Journal of Interactive Online Learning, 4, 1 (Summer 2005).

[10] Weller, M., Pegler, M., and Mason, R. 2005. Use of innovative technologies on an e-learning course. The Internet and Higher Education, 8, 1 (1st Quarter 2005), 61-71. DOI= doi:10.1016/j.iheduc.2004.10.001