

# “Bring Your Own Laptop Unless You Want to Follow the Lecture”: Alternative Communication in the Classroom

Louise Barkhuus  
Department of Computing Science  
University of Glasgow  
17 Lilybanks Gardens, Glasgow G12 8QQ, UK  
barkhuus@dcs.gla.ac.uk

## ABSTRACT

The introduction of laptops and wireless networks in classrooms has increased the possibilities for student-teacher interaction. Here we explore the premises for this interaction by studying the use of ActiveClass, a system that enables students to ask questions electronically and anonymously in-class. The study emphasizes how the diverse prerequisites for teaching interaction separates students even more in the classroom. We then suggest a differentiated approach to the introduction of interactive technologies in the class room.

## Categories and Subject Descriptors

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

## General Terms

Classroom technologies, user studies.

## Keywords

Learning, ubiquitous computing, classroom interaction.

## 1. INTRODUCTION

Recently, collaborative computing technologies have entered areas of education, supporting, for example, university lectures. Universities are increasingly offering students new premises for learning such as electronic course discussion boards and in-class on-line interaction between teachers and students by way of WiFi-enabled laptops and PDAs. Previous research highlights disadvantages with free use of laptops in the classrooms [4, 6] and advantages of deploying networked systems specifically for classroom use [9, 10]. But while the implications are most often looked at in experimental settings such as supplying everyone in the classroom with a laptop, less attention has been given to the actual environment of university classrooms where students have different goals, ambitions and different access to the technology. This conflict is likely to affect the lectures; where most interaction facilitating systems are developed for use by all students, in reality students are not a homogeneous mass that will adopt the new technologies in a uniform fashion [3]. The aim of the research

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presented here is to explore premises for technology enhanced classroom interaction in situ. By examining behavior in a university classroom equipped with a wireless network and ActiveClass, a tool that promotes interaction between teacher and students, we aim to inform the design of interactive classroom technologies. Our method is ethnographic and observational rather than experimental, since we found that the everyday-world of the students most valuable to explore this way. The study aims to investigate the mundane behavior within the classroom and provide information into certain aspects of technology-facilitated interaction through the use of ActiveClass. We find that the existing values and practices of a heterogeneous collection of students affect the students' attitude and thus also their use of classroom facilitating technologies. We stress that this diversity amongst students should be considered when designing and implementing classroom technologies. Before introducing the study further, we first review previous approaches to networked classroom systems and other classroom technologies.

## 2. NETWORKED CLASSROOM TECHNOLOGIES

With the deployment of wireless networks at many universities, the possibilities for network-facilitated teaching have increased. Not all classroom-oriented systems depend on wireless networks but in-class remote interaction does, and we therefore limit the scope of related research to this area. Several systems have been developed to provide teachers and students with an easy way to make and take quizzes in-class through either laptops or PDAs [2, 9]. This function, however, requires that all students have access to the technology and that each piece is actually fully functional at the time of the quiz. Franklin and Hammond point out that in practice this can be quite complicated; the chances of students forgetting their devices or of one of the devices not working are often greater than the chance of everything working smoothly [5].

In most traditional lecturing, the teacher is solely responsible for interaction with the students. The teacher chooses to ask questions of the class and decides when students are allowed to comment on the lecture. Most teachers prefer a fairly high level of interaction and encourage students to ask any questions they may have. However, especially in large classes, this interaction is not always easy to promote [2]. Students themselves differ in learning approach; studies of student behavior show, for example, that students have different strategies for help-seeking, particular in large classes [7]. Many researchers have therefore suggested facilitating the student-lecture interaction through technical means. One approach is to focus on students' ability to give

feedback by means other than face-to-face. A tablet PC based Classroom Feedback System (CFS) at the University of Washington enables students to give real time feedback to the teacher. Students with laptops can here give feedback attached directly to the slides shown by the teacher [2]. The feedback can be given by attaching one of three categories to a specific place in a slide: ‘got it’, ‘more explanation’ and ‘example’. The WILD services, presented by Steele et al, similarly support quiz-taking, online questioning and simple real-time feedback to the lecturer, in regards to the quality of the lecture [9].

One disadvantage of wireless networks in the classroom and students’ increasing access to and use of laptops is the distraction that the laptop can create. Hembrooke and Gay found that students who were allowed to use their laptops during a lecture did significantly worse on a subsequent quiz than the students who were not [6]. This highlights one of the problems with interaction-facilitating technologies: they provide additional focus for attention. Unless the teacher specifically prohibits the use of laptops in the classroom, the wireless networks will inevitably provide a source of distraction for students who bring their devices to class. In our study we therefore address the compromises that have to be made in an increasingly technology saturated classroom setting.

### 3. ACTIVECLASS

The system we investigated for the purpose of this paper, ActiveClass, was not significantly different from many of the previous systems described here. The system was not even particularly new, having been in place for about a year and a half when our study took place. ActiveClass is part of a larger, campus-wide system at UC San Diego called Active Campus, and has been evaluated on several occasions – but mainly with focus on usability issues [8]. We found this tool to be a good candidate for studying student-teacher interaction in a realistic situation where students use the technology on a voluntary basis.

The application is built around three primary functions – questions, polls, and ratings. The questions section allows students to ask questions anonymously over the internet and to vote on which questions they think most require an answer. Anyone in the class can answer the questions as well – and do this anonymously, but most of the time, questions are meant to be raised in class and answered by the teacher. The polls section enables the administrator to post a question, for example about the students’ preference for the next lecture and the students can then vote in real-time; however, this section was not used in the class we followed. Finally, the ratings section lets students rate the speed of the lecture as ‘too slow’, ‘just about right’ or ‘too fast’. The students can also rate the quality of the lecture on a scale from one to six. The students have access to the system through a website hosted by the university or can download it to their PDA. The system interface is illustrated in figure 1.

### 4. METHOD

We chose to study a large undergraduate class in computer science (enrolment 141), where ActiveClass was used. We hoped that since large classes typically have more limited interaction between students and teachers [2], this class would benefit from ActiveClass. The class was an advanced class on compiler systems where part of the students’ work had to be carried out in groups

outside the bi-weekly lectures. Early in each lecture, the lecturer would ask the students to log into ActiveClass and use it – they had all been instructed during the first lecture how to log in. We observed the class for the last two thirds of the quarter in each lecture, inquired to students’ use of ActiveClass and general classroom behavior through a questionnaire and interviews with eight of the students. Although only 31 of the students returned the questionnaire, we believe that these can be used to infer certain trends in technology consumption as well as the students’ motivation whether to use ActiveClass or not. The interviewed students were recruited after each lecture; by asking students directly, we hoped to decrease the self-selection bias that occurs when participants have to volunteer. Naturally several students declined – but most of the ones we asked were happy to participate. The interviewed students had an average age of 23.5 and two of the eight were female.

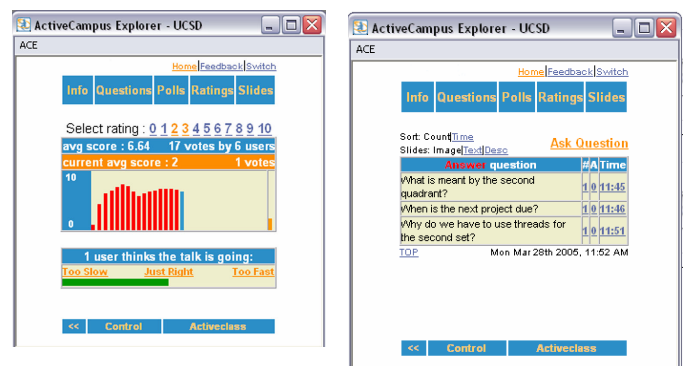
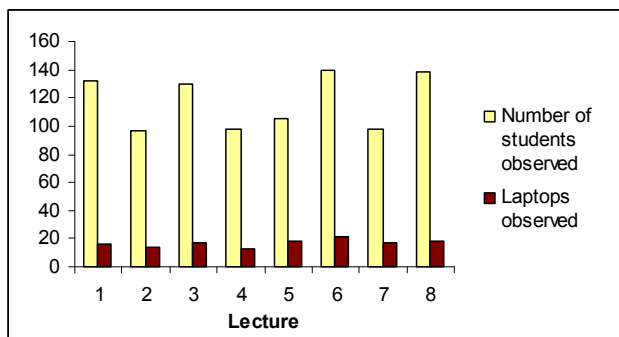


Figure 1: Interface of ActiveClass: Questions and polls

### 5. FRAGMENTED USE OF TECHNOLOGY IN THE CLASSROOM

In order to explore the premises for interactivity in the classroom, we first traced the trends of actual use of mobile technologies in our class. The students were not provided with any devices by the university, so despite having wireless access to both internet and ActiveClass, the condition for using this was that they supplied their own laptop or PDA with a wireless connection. Sixty eight percent of the respondents to the questionnaires owned a laptop with wireless access; however, classroom observation showed that only between thirteen and seventeen percent of the students had a laptop out and running during each lecture. Indeed many students chose not always to bring their laptops to class, which limited the use of ActiveClass. The interviews provided information in this respect: students thought their laptops were too heavy to carry around all day and they worried that they would run out of battery at inconvenient times. This was also true for PDA use; forty two percent of the respondents had PDAs, but only one was observed in use in class. An additional obstacle to this, which we observed, was the coordination that students would have to deal with in relation to their device. Because the classroom only had fold-up desks, space for laptops and notepads was very limited. Students therefore had to choose between their laptop and their notepad. The interviews confirmed this unavoidable choice and two claimed that they would acquire a digital tablet, which affords better note-taking, when they could afford to buy one. But presently, they preferred their notepad to a laptop in-class. Finally, an observed obstacle to laptop use was in relation to the

lecturing structure: approximately every second lecture, the lecturer would pose a quiz, the result of which would affect the final grade. This had to be done in class on paper, with every notepad, device and other potential aid removed from the desk. Although some students would start the lecture with their laptop out, the fact that they had to put them away during the quiz meant that they were reluctant to bring it out again. The observed number of devices at the end of quiz classes was therefore generally lower than in non-quiz classes.



**Figure 2:** The maximum number of laptops observed compared to the maximum number of students observed in each class

Despite between fourteen and twenty two mobile networked devices being present in each class, very few students actually logged into ActiveClass. Although they were encouraged to log in at the beginning of each lecture, only between one and twelve students were observed online in ActiveClass each time, making the activity there fairly limited. The participation decreased through the quarter, although the observed number of laptops remained fairly constant, see figure 2. In contrast to the Classroom Feedback System from University of Washington, mentioned above, the teacher did not respond to questions posted immediately – because he could not see the questions himself. He would instead pause once in a while and ask the teaching assistant if any questions had been posted. This meant that the questions were sometimes related to material discussed ten minutes previously. This could point to one reason for limited satisfaction with ActiveClass among the students.

## 6. STUDENT HETEROGENEITY IN THE CLASSROOM

Students are, despite often addressed as a homogenous group, a diverse set of people with different behavioral patterns. One of the challenges for the teacher is to ensure that all students have equal opportunity for learning despite their differences. Although research highlights how some students are intimidated in larger classes and reluctant to ask questions [1], not all students behave like this. Our observation showed that several students asked questions or commented on the lecture material each class; however, it was typically the same students who interacted, class after class. This diversity makes it difficult for the teacher to know if everyone follows the lecture and understands the material, because on the surface these eager students seem to understand or get their uncertainties clarified. Clearly, the more shy students would benefit from anonymity of a system such as ActiveClass, however, we found a complex situation where the shy students

were shy online as well. One student describes her strategies when not understanding the lecture material:

“... when I am in there, I kind of don’t understand a lot of the stuff that [the teacher] is talking about. Like, I just kind of wait ‘til the end when he [...] stops... [...] [A]fterwards [then I can] just, like talk about it with my friends.”

This student was too intimidated even to use ActiveClass as a medium through which to ask questions; her help-seeking strategies were different from those of the more eager students who claimed that if they had a question they would just raise their hand. Some of the students mentioned that because of the few laptops in class they worried that when asking a question, the other students would be able to ‘guesstimate’ who it was. There was also a gulf between the eager students who said they would rather follow the lecture than monitor a system on their laptop and the more shy students who were found to be shy online as well. This finding was similar to what the researchers using the CFS system at University of Washington found; sometimes, the students who indicated that they wanted more explanation were not willing to speak up in class when asked to elaborate on the uncertainties they had indicated electronically. Other students were more enthusiastic about ActiveClass and liked the fact that it provided them with the option to ask the questions they were not comfortable asking in-class. As a student described a situation where he wanted to ask a question but did not have a laptop:

“I [was] sitting on the middle row trying to see if anyone had a computer so I could have used it. Nobody did where I was sitting”.

He continued explaining that he would only say something in-class if he was “one hundred and fifty percent sure it was correct”, supporting our preconceptions about students being intimidated in large classes. Although ActiveClass requires the student to have a laptop (or one nearby as in this example), the group of students with the premises for interaction does not always overlap with the group of students who need to use the technology.

### 6.1 Student Attention

We observed that students tended to use laptops in class for web-surfing, writing projects and communication with peers. The questionnaires did confirm this as well; students with laptops in class did on average 1.6 different activities, such as surfing the internet, emailing or writing assignments, during a lecture. When comparing their laptop use to their self-reported level of attention, a difference emerges between attentive and less attentive students. Where 66 percent of the students with laptops out on their desks reported that they pay close attention, only 50 percent of the students without laptops reported paying close attention. It was observed that more people with laptops had placed themselves in one of the ten back rows, an indication that they wanted to pay less attention in the lecture. Also, students who reported in the questionnaire that they were not paying much attention in the lecture had often placed themselves in the back of the class. One student, for example, who was interviewed close to a project’s submission deadline, explained that he had to work on the project (for the class) and had therefore placed himself in one of the back rows with his laptop out throughout the lecture. He did not want to miss the class but admitted that he had paid little attention to the lecture. He was indifferent to ActiveClass, saying that he never used it – but thought it might be good for other students.

The students, who reported paying attention to the lecture, were also positive towards ActiveClass (indicating that it was good for the class and that ActiveClass should be implemented in other classes). The students who used laptops in class but did not pay attention, on the other hand, were all less positive (responding that Active Class did not do much for the class). This indicates that laptops in-class are used for very polarized tasks: either to assist the student to follow the class, or to engage in a task unrelated to the class.

The diverse behavior of students makes it difficult to implement a lecture supporting system such as Active Class and make it evenly beneficial for all students. Besides the fairly low level of students who currently have laptops and who regularly bring them to class, the students' already inherent habits and classroom behavior, challenge the implementation of classroom technologies in unpredictable ways – ways which need to be addressed. As we have seen, some students are negative towards new ways of interaction and others are simply not interested, or sufficiently confident to participate actively in class. The challenge is not just to make students use a new interactivity-facilitating system but also to question if it is desirable to change current classroom behavior. In the case of ActiveClass it was clear that the teacher encouraging students to bring laptops led, to a certain degree, to inattentive students, few attempts to actually use ActiveClass and the 'shy' students, the anticipated beneficiaries, were sometimes so shy that they could not benefit from it. Finally many students chose not to spend the physical effort required to bring their laptop to class and use ActiveClass.

## 7. DISCUSSION

When students enter the classroom, they each have their own notion of how to behave there. Although they have a common understanding of which classroom activities are appropriate, their background and social roles influence their behavior. They are 'tuned in' to certain conduct, which they have learned throughout their previous education and their social roles affect their level of interaction. 'Shy' students are less likely to ask questions in class than outgoing students are but their learning patterns are also different because they tend to seek help by other means than those offered in class. When introducing technology designed primarily to assist one particular group of students (in this case shy, introverted students), a polarization can occur between those who feel they benefit from the technology and those who do not. Even though they are in no way obliged to use the system, those students who do not find it useful typically react negatively. The eager students' perception of the technology is different from the others in that their presumptions of classroom learning are tied to high attention level and active student-teacher interaction.

While the heterogeneity of people is often seen as a disadvantage when implementing new technologies, we suggest that the technology focus on facilitating interaction for *subgroups* rather than aiming at complete demographic coverage. Inevitably, some will receive the new technology with a negative attitude or give up on it quickly; however, other groups will likely be more positive and use it to their advantage. It is important to be aware of this heterogeneity as designer as well as a user and not force anyone into using an undesired new approach, such as those that the technologies we have examined provide. We suggest that

classroom networks are used in parallel with traditional lecturing techniques in order to embrace the heterogeneity of students.

Finally, the importance of the adoption rate of technologies should be considered; in a classroom environment where only few students have laptops, they become very visible to the other students and the teacher. Although as many as twenty-one laptops were observed in one class, the visibility of the laptops can inhibit the use of a system which depends on anonymity. Currently, computing technologies in classrooms are common but not saturated. As the use of technology increases and provides attractive possibilities for classroom teaching, it becomes more appropriate to examine the process of implementation and diffusion that will inevitably occur.

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