Using E-tools in Computer Science Education: a Proposal

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Abstract

We present some thoughts about devising educational designs for experiments with the use of e-tools in computer science education. We stress that the focus should not be on technological issues but on educational design issues. Our intention is twofold. First of all it is proposed to gather information about the use of such tools, in order to compose guidelines and hints for computer science lecturers. Next, we propose to design and conduct new promising experiments about using e-tools within the context of computer science education.

Keywords: web-based learning, IT-education, distance education.

Introduction

Web-based learning has developed very rapidly during the last decade. As a result a number of simple e-tools for educational purposes has been available for some years. Some examples are:

- e-mail
- discussion groups
- shared workspaces
- real time audio conferencing
- other tools for real time communication, like NetMeeting
- browsers

Typical for these tools is that everybody with a computer and a connection to internet, simple as it may be, can use them.

Tools like these can be used to support asynchronous communication, real-time communication, and also resource-based education.

A fair number of practitioners' reports (see for example (Clear & Daniels, 2001), (Hara & Kling, 2001), (Koppelman, van Dijk, van de Mast, van der Veer, 2000), (Lavonen, Meisalo, Lattu, Leinonen, & Wilusz, 2000), (Mason, 1998), (Mason, 1999), (Mason & Weller, 2000), (Rotbottom, 2001) and (Wegerif, 1998)) can be found about applications of these tools in education. Reading these reports one gets the impression that we are still living in pioneering days. There are no standards and hardly any guidelines or hints for using these tools in education. Moreover, there seems to be an emphasis on the

technology of web-based learning, and not on educational designs. In many of the reports these points are stated explicitly. We give some examples.

About using discussion groups in an educational context, in (Mason & Weller, 2000), it is remarked that: '… the conditions which are needed to produce good educational discussions are far more complex, more people-dependent and more educationally determined than mere technology will ever influence very significantly.'

In a paper significantly entitled 'Students' Distress with a Web-based Distance Education Course' (Hara & Kling, 2001) one of the observations is: 'There is a huge discrepancy in the quality, quantity and accessibility of the materials that can help lecturers improve face-to-face courses versus that which is available for lecturers of on-line courses.' One of the conclusions is: 'We have not found any widely publicized articles that encourage faculty who are starting to teach on-line courses to prepare in special ways.'

In (Rotbottom, 2001) it is stated that 'The technology provides the educator with a very powerful toolkit, but this is no substitute for learning design.'

About the use of computers in education in (Lavonen, Meisalo, Lattu, Leinonen, & Wilusz, 2000) it is observed that: 'The real opportunities are recently limited not by the technology itself, but by the imagination of people trying to make use out of it'.

About resource-based learning programs in (Mason, 1998) it is observed that: '… what is needed is educational design expertise. Technology is rarely the problem - and equally rarely the solution.'

One of the observations in (Clear & Daniels, 2001) is: 'In the complex areas of international collaborative learning and Web based GroupWare, the questions related to forging effective virtual groups are still being asked let alone answered.'

In this paper we present some thoughts about devising educational designs for experiments with the use of e-tools in computer science education. We stress that the focus should not be on technological issues but on educational design issues. Our intention is twofold. First of all it is proposed to gather information about the use of such tools, in order to compose guidelines and hints for computer science lecturers. Next, new promising experiments should be designed and conducted about using e-tools within the context of computer science education.

Investigating E-tools

Our first task is to investigate educational and practitioners' resources for experiences with (preferably simple) e-tools and to consider what could be learnt from them with respect to computer science education. Nowadays there seem to be a lot of practitioners' reports about experiments and experiences. These reports can be investigated for general questions like: Which experiments did succeed, which failed? What are the students' frustrations with web-based learning and why?

A few of the specific questions to answer when investigating those resources could be:

- How can we, with our students and our subjects, make a success of discussion groups? Under which circumstances should the discussion group be open, maybe for possibly huge numbers, and when is it better to create a more safe environment for small groups? Is it useful to set timelines in discussions? How should the moderator in group discussions behave? To what extent and in which way should he or she structure the discussions? Which input should the lecturers provide? Which are suitable incentives for students to participate actively in discussions?
- How can you support collaborative work? Can virtual groupwork substitute for face-to-face communication? What is the role of the lecturer? If you work with virtual teams (i.e. teams without face-to-face

meetings) how large could they be? Which real-time and which asynchronous tools could be used under which circumstances? Which measures do lecturers and moderators have to take if the teams are composed of students from different countries and different cultural background, with probably different native languages? Do students need a helpdesk for technical problems?

- How can we foster the creation of learning communities? How does the lecturer have to engage in such a community?
- How can you make a success of using internet as resource in a course (‘resource-based education’)? How can you stimulate students to use internet as a resource?

Devising Pedagogical Designs

Designs Related to Activities

Our second task is to devise new pedagogical designs, based upon the e-tools as mentioned. These new designs could as a consequence lead to experiments within the field of computer science education.

As the starting point for devising relevant designs we take the activities lecturers expect from computer science students. A number of important and frequent activities within the discipline of computer science are:

- Design activities, like programming and modeling. These activities are very important within computer science. Some typical examples are: designing programs, designing entity-relationship diagrams, designing dataflow diagrams, designing state-transition diagrams, designing relation databases, designing human computer interfaces. In face-to-face education it is assumed that one learns these skills by exercising them. Usually practice sessions are offered to the students, where they can exercise these skills, coached by instructors. An additional function of these sessions is that they support the discipline of the students, by offering them a plan.
- Activities within team projects. Projects are assigned to teams of students, and the students have to cooperate to carry out the projects. For these activities communication is crucial, primarily communication within the teams, but also communication with the lecturer.
  In face-to-face education the teams are offered facilities to collaborate and to communicate. Also the teams can meet their lecturer.
- Activities where the emphasis is on reading texts, about which the students should be able to answer questions. In face-to-face education usually a book has been described, there are lectures to support the study of the book, and in the end there is an examination.

In a face-to-face context these activities are supported in several ways. It is a challenge to design pedagogical frameworks to support these activities in a virtual context, using eTools. In the next section some ideas are presented for supporting the design activities, by using eTools.

An Example: Supporting Design Activities

Typical for design activities in face-to-face education is that experienced lecturers have a lot of pedagogic knowledge. They carefully select exercises, from which the students can learn as much as possible. They know the mistakes the students are apt to make, and they know how to react as a lecturer to these mistakes. They know which additional questions to ask and which answers to provide.

It is a challenge to devise pedagogical designs that make this kind of knowledge available in an efficient way within the context of an electronic environment. So the question is: is it possible to exploit this knowledge also in another context than face-to-face meetings?

We describe a possible experiment which addresses the first class of investigatory questions as posed in section 2, about the use of asynchronous communication tools, for example a discussion group. There are a lot of experiences with the use of these tools ((Hara & Kling, 2001), (Mason, 1998), (Mason, 1999), (Mason & Weller, 2000)). It is well known that it is not enough just to provide a discussion group. Usually students will not engage spontaneously in discussions. They need incentives and a structure to contribute to discussions. How can lecturers provide such a structure within the context of design activities? The following basic idea is very simple. The lecturer starts the discussion by giving an assignment. The lecturer knows the assignment thoroughly. He knows which correct and wrong solutions the students might conceive. For example, he gives a problem statement and an entity-relationship diagram, a dataflow diagram or a state-transition diagram. Maybe the diagram has some well known errors, maybe it does not have errors, but it is incomplete. Or it might even be correct. If the problem and the solution are carefully selected, the students are induced to make well known errors. What the lecturer aims for is a discussion between the students. So, next the students have the possibility to comment on the diagram, but also to comment on the comments of other students. In the ideal case, in the end the students will agree on one or more correct solutions. Whether this will be reached or not, after some days the lecturer gives his final comment, and tells the correct answer, and comments on erroneous reactions of the students.

Although this framework is a very simple one a number of decisions have to be made. Will the discussions be open to all students who are interested, or is it better to conduct discussions within small groups of students who know each other? Should the lecturer correct very bad ideas immediately, or leave it up to the students? Will there be a fixed deadline? Or will the lecturer only react after enough students' reactions? Will the lecturer give the correct answer, or only ask questions?

These decisions concern the role and involvement of the lecturer, and also the amount of structure that is offered to the students. For this reason it can be expected that these decisions are crucial for the design to succeed.

With respect to this framework a technical but important issue has to be resolved: how should diagrams and other graphical solutions be rendered? It can be expected that students will not like to perform complicated operations in order to construct diagrams. So the way the assignment is given should imply the minimum of operations such as these from the students.

It might be interesting to compare this asynchronous communication approach to a synchronous approach. A number of students get the same input, i.e. the same problem and solution, and react in real-time to each other, under supervision of a lecturer. Such an experiment can be conducted using a tool like NetMeeting (http://www.microsoft.com/windows/netmeeting/) which is a tool for synchronous communication and cooperation with anyone on the Internet. Some features are: video and audio conferencing, a whiteboard for collaborating via graphic information, program sharing during conferencing, real time conversations using text ('chat').

It should not be expected that this way of learning will be received positively by all of the students (nor by all of the lecturers). For some of them only face-to-face contact is satisfactory. But for other students these kinds of interaction might be interesting and appealing. However, it should be kept in mind that activities such as these are beyond what usually happens in the classroom. As it is posed in (Mason, 1999): 'Computer conferencing is hard work for students, much more so than listening to a lecture. There are not many precedents for interactive discussion in education - discussions in which one is expected to formulate a point of view, express it and modify or defend in the face of comment or criticism.'

Conclusion

It is argued in this paper that the community of computer science lecturers should perform experiments within their teachings with the use of relatively simple ICT-tools. There are a lot of reports with findings and ideas of educational scientists and practitioners, in all kinds of disciplines, which can be considered as a starting point to get ideas about educational designs for using such tools.

It is proposed that these ideas, guidelines and findings should be applied to and be associated with the different activities that are typical for education within the field of computer science.

The paper describes a first, simple experiment, for supporting design activities with the use of an asynchronous and synchronous communication tool. The objective to perform experiments like these is that they should result in insights, guidelines and hints about the use of ICT-tools within the field of computer science education.

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Biography

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