TOWARDS INTERACTIVE LECTURES IN DISTANCE EDUCATION

Herman Koppelman
School of Computer Science, Open University of the Netherlands, PO Box 2960, 6401 DL, Heerlen, The Netherlands

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Abstract: In the last decades many studies in computer science education have emphasized the role of interaction promoting techniques. The context is usually face-to-face education. In this paper we focus upon a well-known example of such techniques, the interactive lecture, and discuss how to adapt it to be useful in distance education. We discuss two key factors. The first is the role modern technology can play to support the interactive lecture in distance education, podcasting in the first place. The second is the use of well-designed problems. We discuss the characteristics of well-designed problems, and their importance in distance education.

1 INTRODUCTION

During the decades that the discipline of computer science has been taught, a lot of pedagogical knowledge has been built up. In contemporary computer science education interaction promoting techniques play a dominant role. These techniques stimulate students to perform activities in interaction with each other and with the instructor. Several examples can be found within the context of active learning, such as interactive lecture, minute papers, and role playing (McConnell, 1996). Many benefits have been reported in the context of face-to-face education, among them that students enjoy the learning process more and are more likely to continue (Sowell, Chen, Buhler, Goldman, Grimm and Goldman, 2010).

Almost always the context of research or experience reports about interaction promoting techniques is face-to-face education. An interesting question therefore is: is it possible to adapt interaction promoting techniques that are known to work well in-class, to be useful in the context of asynchronous distance education?

This question is of importance, because lack of interaction is a key problem for distance students. As many times has been observed (Lee and Chan, 2007; Lonn and Teasly, 2009) distance education is often experienced as a lonely activity, and as a result many students are confronted with motivational problems. It is well known that distance education students feel more isolated and less member of a group, compared to students in face-to-face classes. They have fewer possibilities to interact with fellow students, which can decrease their motivation and enthusiasm. Another problem is the perceived lack of contact with and timely feedback from the instructor (Lee and Chan, 2007).

In this paper we select the technique of interactive lecture, as a case study, and elaborate how it can be adapted to be useful in (asynchronous) distance education.

The interactive lecture is a well-known active learning technique in face-to-face education (Davis, 2009; Lau, 2007; McConnell, 1996). The bottom line is that students interact with the instructor and with classmates. A characteristic approach for computer science instructors is to give a mini-lecture in which a new concept is introduced and to offer students immediately thereafter a problem to force them to think about the concept.

In section 2 we describe the interactive lecture in the context of face-to-face education in more detail. Section 3 focuses upon two key elements in adapting this technique to asynchronous distance education: the role modern technology can play, podcasting in the first place, and the use of well-designed problems.

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2 INTERACTIVE LECTURE IN FACE-TO-FACE EDUCATION

In the computing science community several reports exist in which experiences with interactive lectures are described. For example, Lau (2007) uses active learning sheets in a course on Reasoning about Imperative Programs. The instructor hands out a sheet of questions at the beginning of the lecture. The students complete these sheets while listening to the lecture. The questions cover the key points of the lecture, but do not take too long to read, understand and answer. An example is: given are a loop and a loop invariant, and the question is: is the post-condition of the loop invariant correct. For formative feedback, the instructor gives the answers to the questions at the end of the lecture.

Students can give feedback with paper and pencil, but the use of more advanced tools can be appropriate. For example, Carter (2009) describes the use of in-class assignments in the context of an introductory computing course. Examples of assignments are multiple choice questions on simple code comprehension and code completion tasks. He used an electronic device to allow students to respond to multiple choice questions. The student reactions were assembled and assessed. Aggregate responses were shown to the class in real time, followed by discussion and immediate intervention if necessary, for example by working through the solution to the assignment or giving a mini-lecture.

This technique tends to increase the level of engagement, because it also might involve students who may be reluctant to respond to questions verbally.

The approach can be extended to stimulate students to be active before the class. Davis (2009) for example gives her students before the class starts ‘warm up’ exercises in two design courses. These exercises ask students to apply new concepts to real-world problems, to explain concepts in own words, to compare methods, to produce small design artefacts such as a scenario or use case, and so on. Answers to these exercises have to be submitted before the class, so that the instructor can integrate them into the lesson plan, to make lessons ‘just-in-time’.

Carter (2009) presents a slightly different approach. In his classes students were offered a number of screen casts (PowerPoint presentations with voice-over) that presented some relevant programming concepts. Students were asked to study them prior to attending the classes. The classes started with multiple choice questions that aimed to assess students' understanding of the concepts presented in the screen casts. Answers were discussed ‘just-in-time’ in-class. The assessments allow the instructor to focus subsequent class time on concepts that students find particularly difficult.

As a result of applying this technique students understood the material more thoroughly (Carter, 2009; Davis, 2009).

3 INTERACTIVE LECTURE IN DISTANCE EDUCATION

Distance education with asynchronous communication can be implemented in several ways. In this paper we distinguish two opposite educational settings.

In the first setting students follow courses purely individually, according to their own schedule. They have access to an Electronic Learning Environment, with facilities as a bulletin board and forums, they can contact an instructor by e-mail, but they have no direct interaction with fellow students.

In the second setting students can participate in an asynchronous virtual class. They study according to a schedule designed by the educational board. They are stimulated to interact with each other and with the instructors in several ways, for example to discuss relevant topics in discussion groups. For each course a strict schedule is used, describing which learning units in which week should be studied. A standard approach might be to have a block of 10 weeks for each course.

We will discuss a few key elements in transforming the technique of interactive lecture to both educational settings.

3.1 Use of e-Learning Tools

In a face-to-face setting the interactive lecture consists of two kinds of alternating activities: activities performed by the instructor and activities performed by the students. This idea can be applied to distance education. The activities of the instructor, usually a series of face-to-face mini-lectures, can be replaced by podcasts covering the same subjects. An essential element of these podcasts is that each of them results in relevant questions about the presented subject, which invite students explicitly to start discussions.

In a virtual class setting the students are stimulated to discuss the questions within their class, for example by using a blog or a forum. Of course, this discussion should be subjected to a strict and clear schedule, to support the discipline of the

participating students. Discussions about specific questions should not drag on for days and days, but for example should be restrained to the same week in which the subject has been scheduled. This discussion should be moderated by the instructor. For formative feedback, the instructor can go over the answers at the end of the discussion and give feedback, for example again in the form of a podcast.

If students follow courses purely individually, the questions as posed by the instructor can be multiple choice questions, which can be answered by using a suitable interactive tool (for example Blackboard offers this functionality). In this way the students can get feedback immediately, based upon the chosen alternative. Because students are not in a position to pose additional questions immediately, instructors can give links to relevant parts of the printed or electronic course materials. It is also possible to have asynchronous discussions, but without any time schedule, in the same spirit as for example interesting discussions are held about TED-talks (www.ted.com/talks).

In all cases the questions the instructor poses should be well-designed, for various reasons which we discuss in the next section.

3.2 Well-designed Problems

Educational research confirms that well-designed problems are important for asynchronous communication in a virtual class, maybe even more than in a face-to-face class. In a study among a large number of instructors experienced in asynchronous discussions, Beaudin (1999) identifies carefully designing questions as the most important technique to keep discussions on topic.

> The technique of designing good questions is key to good teaching and learning. (..) Good questions promote active participation of the learner by stimulating various levels of thinking and/or by creating cognitive dissonance. (…) Keeping the learner focused through the use of well-designed questions will assist learners in reaching the learning objective. (p. 51)

But when is a problem well-designed? We discuss relevant qualities of well-designed problems in the context of computer science education.

First we want the students to be active and interact with each other. For that reason the problem should provoke discussions. If the answer to the problem is simply yes or no, or in another way unambiguous, no interesting discussion is likely to happen. One way of provoking discussions is to give open-ended problems, i.e. problems that have multiple solutions. Such problems lend themselves well to active learning, as the presentation of alternate solutions makes students think critically about which solution they feel is preferable.

Another way of provoking discussions is to use a problem-partial solution approach. A problem is offered to a group of students, and also a solution. In computer science this solution is in many cases a model, a program or a diagram. The solution is in one way or another incomplete or incorrect. It might for example have different kinds of flaws, some of them serious, others less serious. Or it might have parts for which alternatives exist. This approach usually produces many relevant discussions. This is especially the case if the solution is in several ways incomplete and incorrect. Students supplement each other's comments. Many times students complete the solution in an incorrect way or even see non-existing errors. This usually results in animated discussions.

Another relevant quality of a well-designed problem is that it should have the appropriate complexity. In a face-to-face class, the instructor might give a hard problem, unintentionally or to challenge the students. If it is too complex for the students, this usually does not cause frustrations. An experienced instructor perceives this immediately and can give hints or ask supporting questions. But in an asynchronous context instructors are much less flexible. It is less easy for the instructor to perceive that a problem is too difficult, and it definitely takes much more time. Meanwhile many students might already have had frustrating experiences, trying to solve a problem that exceeds their knowledge. Therefore the complexity of the problem should be carefully monitored. By the way, this is not a plea for not offering challenging problems in an asynchronous setting. All kinds of problems can be offered, but the students should know in advance the level of complexity.

A third relevant quality of a well-designed problem is that it should provoke well-known misconceptions of the students. Misconceptions happen, whether the instructor likes it or not. It is better to be explicit about them, than to keep silent. Therefore it should be considered as positive if those misconceptions arise in the discussions. This gives the instructor the opportunity to combat them effectively. Hopefully fellow students discover and combat them, but if this is not the case it is up to the instructor to react.

Computer science is a discipline that makes heavy use of mathematical notations, diagrams and

graphics to describe all kinds of artefacts. If appropriate tools are not available for students, or take too much time to use, because of lack of experience, this needs not to be a problem. Nowadays other response media are available. Students can just make a paper-and-pencil version of the artefact, make a picture of it, and upload the result as a contribution to the discussion. Or they might produce a short podcast, if they feel that is an appropriate way to give an explanation or express doubts about their solution.

4 DISCUSSION

In this paper we discussed how to apply the technique of interactive lecture to distance education. We focused upon two key elements: how to design problems that are appropriate for distance education, and the use of e-learning tools, podcasting in the first place.

Podcasting in education is relatively new, but its use is rapidly increasing and becoming popular. Instructors are only just beginning to discover the power of it. Podcasting is mainly used in face-to-face education, to record and upload lectures. It is a simple way to allow students to view lectures whenever and where ever convenient. But podcasts might also be highly beneficial in distance education.

There is much debate about the effects of podcasting in face-to-face education, and the question of possible educational benefits remains to be answered (Lonn and Teasley, 2009; McKinney, et al., 2009). About possible benefits of podcasting in the context of distance education even less is known. There are claims that podcasting can be effective in reducing feelings of isolation and in promoting a sense of belonging to a community, and therefore is able to increase distance students' motivation (Lee and Chan, 2007). But the evidence seems rather anecdotic.

Instructors are just now beginning to realize the power of new technologies in (distance) education. In many cases it is not clear how to use them within pedagogical frameworks, and in which ways they can lead to new student learning opportunities. What we need, therefore, are experiences and more research, which might result in a description of best practices of integrating new technology in pedagogical approaches within distance education.

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