From Active Learning to Interactive Teaching Individual Activity and Interpersonal Interaction

Draper, Stephen W

Department of Psychology,
University of Glasgow
Glasgow, G12 8QQ U.K.
http://www.psy.gla.ac.uk/~steve/

INTRODUCTION

In this talk I am going to describe briefly three teaching and learning techniques I have been involved in developing, and a theoretical story that may be used to reflect on them.

The three techniques are:

- CSCLN (Computer-Supported Cooperative Lecture Notes). A class is divided into groups, each of which must produce lecture notes for one of the lectures and publish them on the web for the whole class.
- PAL (Peer Assisted Learning) (also known as 'SI': supplemental instruction), where students may attend voluntary weekly sessions run not by staff but by students who recently completed their course.
- The use of the PRS classroom voting system. We have seen this put to a variety of different pedagogic uses, including self-assessment questions, to stimulate classroom discussion, and in contingent teaching where the lecturer does not have a fixed linear 'script' but rather a diagnostic branching tree where audience responses to early questions determine what is done next.

The theoretical story begins with the idea of active learning, which emphasizes the importance of getting a learner to do something rather than only listening or reading passively, and that the mental processing involved in deciding how to act plays an important role in promoting learning. However, is it just a coincidence that all three of these techniques involve interaction with 'peers', with other learners? Is there something in interaction, rather than only in personal action, that is important to learning?

CSCLN

The first time CSCLN (Computer Supported Cooperative Lecture Notes) was implemented, it was accompanied by an evaluation study looking at its value for students. It was carried out in a class of 59 students as an assessed exercise on a 20-lecture module on Human Computer Interaction, as part of a taught M.Sc. in Information Technology. Learners were divided into teams, and each team was required to produce public lecture notes for their assigned lecture on the web, thus jointly building a complete set of public lecture notes.

The exercise had these features:

- It is an experience of cooperative work mediated by computer (by WWW and email).
- A practical exercise on using the WWW on a real task.
- Exploring a question-and-answer format for learning materials. Students were encouraged to structure their notes as a list of the key questions around which the lecture revolved, and suggested answers to those questions.

There were several educational ideas justifying this design.

- Learner reprocessing: re-expressing material in a new format.
- Self-monitoring: by looking at each other's notes, learners gain information about how well they understood each lecture.
- Similarly, the teacher is likely to discover problems in good time either because the notes are inaccurate or because of students' questions when writing up the notes.
- Peer interaction is good for learning content, good for giving opportunities for self-monitoring, and good for building a community spirit in the class.
- In the context of an HCI course, this is also seen as positive as a practical experience of CSCW (Computer Supported Cooperative Work).
- In the context of an information technology course in 1998, it was seen as positive just by being an occasion for practising web authoring.
- The Q&A format as another perspective on material. It could be interesting to take this further, and construct more course materials as if they formed a reference manual (i.e., indexed by questions).

The effectiveness of this exercise was evaluated using the method of Integrative Evaluation (Draper et al. 1996), including some observation, sample interviews at various times, and questionnaires. The main evidence came from a short questionnaire which, since lecture notes find their main use when revision for exams is being done, was administered directly after the exam. Of 59 students, 98% responded; and of these 84% said they had referred to the communal lecture notes, 76% said they found them useful and, most important of all, 69% said they found them worth the effort of creating their share of them. They also, as a group, rated these web notes as the third most useful resource (after past exam questions and solutions, and the course handouts). This shows that, while not the most important resource for students, nor universally approved by them, this exercise had a beneficial cost-benefit trade-off in the view of more than two thirds of the learners.

The exercise, associated teacher materials, and the set of web notes produced by the students may be seen at http://www.psy.gla.ac.uk/~steve/HCI/cscln/overview.html

PAL

PAL (Peer Assisted Learning) consists of organizing weekly group meetings for students on a given course, attended voluntarily but officially recommended by the department, and led not by a staff member but by a 'facilitator' who is a student who did the course previously. The content discussed may be anything that seems relevant and important to the groups, but may include administrative details on the one hand, or deeper implications of the course material on the other. The longer-term aim is to encourage students to help each other, and to seek help both from others on the course and from those who have done the course earlier.

There are a variety of possible benefits from PAL.

- Information supply. It could be that simply the basic information provision is important: it is impossible to ask many questions in big lectures, and this is a chance to get them answered.
- Extra study time. Some of the weaker first-year students at this university appear (from other studies) to do almost no work outside contact hours. Simply spending an extra hour a week thinking about and discussing their work would significantly boost learning since learning depends on the amount of mental processing done. (In contrast, students with superior personal study skills would already have adopted the habit of going over and re-processing their lecture notes every day, and so would not need this aspect of PAL.)
- Generating explanations. Explaining a topic to someone else is powerfully conducive to learning in the explainer (apart from possibly helping the questioner). This is the essential cognitive boost from peer interaction, as studied for instance by Howe et al. (1995, 1998).
- Adopting peer interaction outside the sessions. The process may convince them that peer interaction is a powerful learning resource, and so introduce them to the practice of doing this outside these particular scheduled group occasions. This amounts to a general study skill being acquired.
- Tinto integration. Spending time interacting in a group of fellow students helps to bolster academic and social integration (thought by Tinto (1975, 1982) to be the most important predictors of student retention or dropout). That is, even if the content is not important to learning outcomes, the process may make the students feel much more at home in their role and in their subject, with general positive effects.
- Benefits to the facilitators. A separate set of benefits accrues to the facilitators.

More information on this can be found at http://pal.psy.gla.ac.uk/

PRS AND CLASSROOM VOTING SYSTEMS

One of the weakest points in the teaching at many universities is the use of lecturing, especially to large classes. The common diagnosis of what is weak in this method is the lack of interactivity. Teachers experience this as a feeling that they cannot get any discussion going and so lose much sense of how well the material is going over. A more theoretical view is that because no overt response is required of students, little mental processing in fact takes place, and hence little learning, at least during the lecture. A technology aimed directly at this gap is that of interactive handsets such as PRS, where every student can key in a response to a displayed MCQ (multiple-choice question), and the aggregated results are immediately displayed to everyone.

We have explored the introduction of this technology for the last two-and-a-half years at our university, with uses right across the university in biology, medicine, the Vet school, computing science, psychology, and philosophy. Evaluation showed that from both the teachers' and the students' viewpoints, it was judged to be of definite value in almost all cases (Draper & Brown, 2004).

The handsets immediately and reliably create greater interactivity in lectures. The simplest use by a lecturer is to provide a few self-test questions for students, who can check how well they understood the material and decide from that how much more work they need to do out of class. Another important use is to launch discussion: a question is displayed, each student registers their initial view, the 'correct' answer if any is NOT announced, and then the class is instructed to discuss with their neighbours (say, in groups of four) how they would justify their view. A third use is 'contingent teaching'. Here the teacher comes, not with a fixed linear script for the session, but with a branching script (like a diagnostic tree) including many more questions than can be used, and decides after each audience response which topic or question to use next. The purpose is to zero in on what this particular audience needs.

Still other possible methods of use are discussed in Draper et al. (2002). Further information on the developing use of this equipment, including evaluation studies, can be found at: http://www.psy.gla.ac.uk/ilig/

The question is: What is the crucial aspect of such equipment and uses for improving learning? Is it simple student activity (pressing buttons rather than sitting still)? Is it student mental activity (having to choose an answer, having to produce explanations when discussing possible answers with other students)? Or is it real interactivity between teacher and learners?

A THEORETICAL COMMENTARY

A simple view of the idea of active (or interactive) learning is that activity promotes learning. Sometimes people seem to think this means physical activity: the number of button pushes, moving around the room. It is true that unless the learner is awake and alert, learning is unlikely; and some lecturers take seriously the idea that most students' attention span is 20 minutes at most, and have a break half way through a session in which they require students to move about physically. However physical movement itself surely does not 'cause' learning. Simply going through a procedure in a science lab, unless you understand and are thinking about the science behind the actions, does not in fact lead to any learning. What really matters, I would argue, is mentally processing and re-processing the ideas, preferably into a different form than the one you were given. Choosing an answer to a question, like writing an essay or a computer program, does do that. This is activity that does promote learning. However it is individual activity. Practising maths by doing exercises in a textbook is like that. Yet the three techniques above all involve students interacting with other students: with peers. Is that an accident?

There are several ways in which peer interaction could promote learning. The first is that peers simply act as a prompt to the action that is the actually important thing, which is perhaps the main point of physical exercise classes: no-one can exercise your body for you, but other people's presence somehow is a great encouragement to persuade you to actually do it. Really it could just as well be a textbook or anything else rather than peers, but perhaps they help your motivation.

A second way peer interaction may be important is that it exposes you to views that contradict your own. Like getting data you did not expect from an experiment, thisprompts you into thinking much harder rather than being able to assume it was ‘obvious’.

A third way peers may be important is that in even the simplest discussion, peers tend to make you produce not just an answer but an explanation for the answer. This is something more than textbook exercises alone usually do, and producing explanations is more powerful in promoting learning than just producing an answer. The biggest successes in CSCLN, in PAL, and in using classroom voting may be when those techniques include peer discussion rather than simple information giving or sharing.

However the greatest gains may be when not only is each learner active, and not only when they are truly interacting with peers in the sense of having to produce answers and explanations that depend on what the other learner does, but where the interaction includes the teacher. Although many uses of classroom voting are first motivated by a desire to make the students more active, many teachers after some experience say that they now feel the biggest benefit is in the better feedback from the learners to the teachers, who now discover much more clearly what this particular class knows and needs. This is valuable because the teacher can then change what they do in response to that new information. When this happens, this is truly interactive teaching (not only interactive learning). In much conventional teaching, teachers only really get good feedback once a year from exams and course feedback surveys, so the rate of change is once per year. With the techniques above it is more nearly once a week that the teacher sees or hears student responses and may respond by making some adjustments to the next lecture. The most advanced use however is true contingent teaching, where a teacher comes prepared to adapt and react on the spot by planning a tree of diagnostic questions and responses, and the branch they go down depends on the audience responses to the early questions. This has been introduced in a statistics course at Glasgow University in some large ‘tutorial’ sessions with a class of up to 200 students.

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