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# Peer Tutoring in Conceptual Design

by Dr G. S. Langdon

In design, students are often uncomfortable with defining the problem they are to solve, and then using their basic knowledge of engineering principles to create a solution. A peer-tutoring scheme was piloted in a second year engineering design module to facilitate the design process. Formal lectures were given during the first 4 weeks of the semester, introducing students to basic components, mechanisms and fastening methods. Other lectures on schematic drawing, problem solving and communication were also included.  The first design problem was given out – the students were given various constraints and geometry considerations, and were instructed to fill the 'black-box' with a mechanism design that met the design criteria.

Peer tutor sessions were used to define the problem, generate ideas, discuss possible solutions and evaluate their designs. Solutions, in the form of schematic drawings, were submitted and a formal design critique lecture was held. The critique lecture was used to provide feedback to students on the strengths and weaknesses of their design approach, drawing technique or problem definition.  The next exercise was given out and the process continued until the students had completed three designs.

The research was focused on whether the peer tutor support would improve the ability of the students to tackle a design project which involved the student defining the problem and solving it without the intervention of lecturing staff. Previously, students have been uncomfortable with problem definition, independent thinking and problem solving skills. A second question raised within the department was whether peer tutoring could enable a reduction in staff involvement in design teaching, historically a labour intensive subject for the lecturing staff – this was proving problematic as student numbers were increasing. The main aim was to assess the potential of the peer tutoring concept.

The peer tutors were trained to help them understand the need to facilitate the learning process rather than to teach the subjects. Training included sessions on learning approaches, group dynamics, session strategies, helping students think creatively, listening skills and re-directing questions. An experiential learning approach was adopted, where tutors all took a turn to role-play the tutor and students in a scenario with 'problem students' (such as dealing with silence and dissent). To engage the tutors' attention and develop their confidence in tutoring, 'real' design problems were used in context.

In order to evaluate the scheme, the following information was collated and analysed:

- Coursework marks
- Attendance at lectures
- Attendance at tutorials

- Student feedback on the new module through the standard questionnaire (anonymous)
- Student perceptions of the peer-tutoring scheme through a dedicated questionnaire (anonymous)
- Subject lecturers perceptions through individual discussions
- Tutor perceptions by a focus group session with the tutors

Student feedback of the peer-tutoring scheme was obtained through an anonymous questionnaire that consisted of six open ended questions. Students were asked what they felt they had gained from participating, what could be improved and what aspect of the tutors teaching methods they found particularly effective. Their comments were grouped to similar themes (a response could fall into more than one theme) and plotted as bar charts. One question asked 'what do you feel you have gained from the peer tutoring scheme?' The comments showed that a small number of students failed to gain anything from the experience, but it is most likely that these did not attend the tutorials as the same percentage of students said they did not attend. Not all of the students chose to attend the peer-groups, but most of those that did go felt more able to take responsibility for their own learning, promote creative problem solving and improve group-working skills. When students were asked about the frequency of the group meetings, the majority felt that the number of meetings was about right. In the future, more rigorous data collection should be performed and evaluated but this pilot scheme was limited to assess its potential (whether it should continue).

Pre-defined questions were used to facilitate the focus group meeting with the peer tutors. Minutes were taken during the discussion and the tutor responses grouped under question headings. For example, one question asked 'What happened in the tutorials?' and the responses were:

- The students discussed different ways of solving the problems.
- Students worked on the white boards.
- Students worked in small groups and came back together for fuller discussions.
- They explained their designs to each other and to the tutor.
- They thought more about their designs.
- They asked questions about what the course was like in later years.
- Groups met informally outside of the timetabled slot, at the students' request.

The data was used to demonstrate the wider benefits of the scheme and identify any problems encountered (there were some minor administrative issues surrounding peer tutoring schedules and room availability). The tutors felt they had improved team-working ability, leadership skills, and confidence and developed a more responsible attitude towards learning. The lecturers commented that the scheme encouraged self-learning and maturing of the students and took some of the pressure off academic staff. They also felt that weaker students in the groups would learn from stronger, more mature students, equipping them with improved design skills. This process was not detrimental to the stronger students, who gained from explaining their designs and ideas to their peers.

Peer tutoring is a particularly cost-effective and beneficial way of achieving positive interaction between students. The marks improved from exercise 1 to exercise 2, indicated that the

students were becoming more capable of defining and solving engineering design problems, although with the course being a new one it is not clear whether the peer tutoring sessions or the critique lectures were responsible for this. It is suggested that both elements played an important role in improving the student performance, and that this could be built upon in the future and expanded to other subjects taught.

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