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Developing an understanding of the design process to promote creative problem identification and problem-solving

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Developing an understanding of the design process to promote creative problem identification and problem-solving

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Tutor in study: Anna Hiley, School of Mechanical, Aerospace and Civil Engineering, the University of Manchester Subject area: Professional Practice
Study completed: March 2006

This case study has been developed from data gathered through a demonstration of the teaching and learning materials available, interviews with the tutor and a student focus group.

Background

'The Design Process' is part of the first year undergraduate Professional Practice module for all civil engineering and construction students within the School of Mechanical, Aerospace and Civil Engineering at the University of Manchester. Seven workshops are delivered during Semester 2 aimed at giving students an understanding of the design process. "The aim of the module is to promote the evolution of investigative, analytical and creative problem-identification and problem-solving skills."

Each workshop focuses on a core characteristic of the design process and guides the students to investigate a related need or problem. The framework for the sessions has been devised so that a view of the whole process is progressively revealed through the exploration of a sequence of concepts. At the start of each workshop the background to a core concept and related examples of scenarios is given by a visiting professor whose presentation includes numerous real world examples. The tutor then offers a reflection on the presentation, putting it into context for the students and highlighting what they should take away from the briefing. For each workshop there is an assessed assignment based on the problem or scenario which is the vehicle for learning about the specific design process phase or stage. The students investigate the scenario or problem in small teams and after each workshop produce a team submission. Depending on the task, they are given between five and ten days to complete the work. At the start of each new workshop the students are provided with a debriefing by the tutor on the assignment they have just submitted. This describes the process that should have been followed and is supported by a handout for reference. Detailed feedback on each submission is returned during the following session. Through the use of an enquiry-based learning approach it is hoped that students will see how the design process can increase the quality of problem solving in general.

At the end of the programme of workshops students also complete an assessed reflective report. They are asked to reflect on a number of key issues such as 'how did your abilities develop and which parts of the process did you find difficult?' This reflective report has two aims, the first to make students think about what they had done and how they could utilise the skills acquired and the second to give the tutor the opportunity to look at how the sessions could be improved.

Reasons for introducing this teaching method

This approach was first introduced in September 2002 to develop the design abilities of students undertaking civil and structural engineering degree programmes. The tutor's experience in both industry and higher education had shown that many students and

graduates found the design process very difficult and that many did not develop the appropriate skills to solve design problems. Often their experience of secondary education had instilled an approach which focussed on tasks and not processes and on the repetition of explicit information. Therefore, for example, they found alien the notion of appropriate options emerging through the process of problem definition. The tutor started to develop some basic curriculum innovations on core skills, including the design process, critical thinking and team working. “It was found that there was a need to promote a learning environment which raised awareness of the importance of the design process as a multi-faceted decision-making process.”

Students’ perspective

The students welcomed being “made to think” as well as being given the opportunity to be “creative”, and “use your own mind”. As the assessment required a lot of team work students felt they had been able to learn “a lot about how to organise a team and communication”. Having to submit coursework every week was commented on as being “tough”. However, students whose teams were working well had found completing the work less of a challenge than those where not all members were participating. In advance of the workshops a teamwork induction session had been run to promote self-directed teamwork. However, some students would have welcomed the tutor providing direct supervision by, for example, recording who attended briefings and meetings.

Issues

The early sessions could be difficult because of the different approach taken which required a different way of thinking from the students. Students initially found it difficult to work on how they would arrive at a solution rather than working on the actual solution. “There were problems in trying to prepare the students for not giving me an answer but giving me a process.” One student commented: “Thinking from concept level was totally new to me, as I am one of these people who used to dive in and start coming up with elaborate ideas to solve the problem, instead of first trying to determine what the task and indeed the problem actually was.”

Ideally a flat room is needed to run the session so the students can sit and work in their teams. Because the class size this year rose from 90 to 170 students this has been more difficult to accommodate and although a relatively large room was found, the class had been divided into two and each input session repeated for both halves. Also the methodology was adapted by including more team rather than individual assignments. This also helped with the increased marking and feedback load created through increased student numbers.

Benefits

The sessions were structured in such a way that the students felt they “had to engage” with the materials. It was seen as “more time consuming” than some other modules because of the continuous assessment strategy used, however, many welcomed the opportunity to be assessed through coursework rather than exam. The students valued the input from the visiting professor, which provided more real world examples, and expressed an interest in more visitors being invited from industry. The debriefing sessions and regular assignment feedback were also seen as valuable. “It’s good seeing what you were supposed to have done. We got it completely wrong for the first few times but now we think we’ve got the idea.” During second year modules the visiting professor had seen much improved “design literacy” in students who had studied the design process in this way and saw this as a major benefit. The tutor found evidence that these sessions equipped students “with tools they could use in any other area”.

Reflections

For first year students the methodology is considered by the tutor to be appropriate because "it doesn't throw them in at the deep end, it's a step by step approach, you need that to change their approach in thinking methods." The sessions are structured to allow the tutor the opportunity to offer feedback at every stage. Questions are also encouraged during or outside sessions.

Restructuring the module and writing the new sessions took the tutor about six months. The tutor received curriculum innovation funding to develop the supporting teamwork induction course. Also, with other colleagues, she received a UK Research Councils Basic Technology Fund grant to look at design related issues amongst different disciplines. Further curriculum innovation funding has now been awarded to support further development of a generic core unit using this enquiry-based learning approach to teaching the design process. In 2005 the tutor commenced running similar sessions for material scientists.

"[The tutor] puts a lot of thought into it and as students we just take that for granted".

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