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Subject Area: Marine Engineering

This case study has been developed from data gathered through observations of the teaching component; interviews with the tutor and a student focus group.

Background
The BEng (Hons) Marine Engineering Technology run by Rod Beams at the University of Greenwich at Medway’s School of Engineering is a degree that concentrates on system operation, maintenance, problem analysis and solution. The University classifies it as a ‘specific career based degree’ so that graduates would be able to work as marine engineers onboard ships. To do so, the course has to meet the Standards of the International Maritime Organisation (IMO). In the UK, these are implemented through the Maritime and Coastguard Agency (MCA) of the Department for Transport. The MCA issues the Certificate of Competency (CoC), which is the government licence to practice, required by international regulation. Marine Engineering Technology graduates achieving an overall pass mark of 50% receive exemption from CoC written examinations and only need to pass the oral component to obtain their certification. The degree programme also had to be approved by the Merchant Navy Training Board (MNTB). All UK student sponsorship comes via the MNTB and consequently the programme has to meet their training requirements, such as the National Occupational Standards (NOS). The degree programme is also obtaining accreditation from the Institute of Marine Engineering, Science and Technology (IMarEST).

In order to cover the breadth and depth of material to satisfy all of the regulatory and professional bodies the course utilises a computer based teaching/training (CBT) programme: Cobalt. This programme has been developed by Rod Beams over the past 12 years and reflects his experience from a lengthy career as a marine engineer, ships’ systems simulator designer and programmer, as well as a trainer of both marine engineers and simulator instructors around the world. Currently the programme contains around 300 learning objects, described as modules by the tutor. These are of varying length and complexity and divide into three basic types:

1. ‘Underpinning knowledge’. These modules are used to give presentations in the classroom and may include simulations as well (see item 3 below).

2. Interactive or experimental type modules. E.g. students could use the program to build a virtual engine. They can then make various changes to the setup parameters and see what happens when these changes are made. The students will do this work in their own time after having been shown how to use the systems available by the tutor.

3. The simulations. These are all on real ships’ systems. The students have to apply what they’ve learnt and use it in the simulated activity. Rod gives them a demonstration that they can follow through on their laptops. They will get time, monitored by the tutor, for them to learn themselves. Normally, the students will then have to make presentations to members of staff, to prove that they understand and can do the various processes.

The observed teaching was of a simulation demonstration of ‘switchboard operation’ with the second
year cohort of nine students. The student group were slightly more mature than typical university second year classes. There was a range of nationalities: five British, two Angolan, one Nigerian and an Italian. The cohort size was fairly typical of recent years and reflects the lack of recruitment in the British shipping industry. The students arrived promptly and all enthusiastically set up their laptops running a copy of the Cobalt program. They all followed the simulation on the main screen as well as simultaneously working through the simulation on their computers. Rod had a very good rapport with the students. He engaged them well and while systematically working through the simulation he ensured they were following every stage of the process and frequently threw out questions to confirm their understanding. The students were all keen to engage in this process and occasionally asked questions of their own. Rod would always answer these fully, after first posing the question in a slightly altered format to see if the student was able to answer their own question.

**Reasons for introducing this teaching method**

Prior to Rod being appointed at Greenwich there had not been a Marine Engineering degree and over the past four years, together with Alec Coutroubisis, they have worked to develop an appropriate accredited degree programme. So the approach started from scratch and, as Rod had previously developed the Cobalt CBT package, he introduced it straightaway into his teaching.

A main driver for using the Cobalt system as a pivotal aspect of the teaching and learning approach is the volume of material that has to be covered. The technology on ships has advanced rapidly and is now far more complex than just “nuts and bolts systems”. At the same time, the ship owners have eroded the amount of time available for their sponsored students to achieve qualification. It used to be five years, while now it is basically three years, including six months actual time at sea. On top of that are all the statutory rules, regulations and maritime law that students have to be aware of, yet with no additional time allowance. So it had been necessary for Rod to see how more information could be transferred effectively to students in a shorter space of time. Cobalt has been very successful in achieving this.

The method was chosen mainly because of the availability and power of modern computing technology. When Rod started in HE it was “chalk and talk”. Rod has experience in computer programming and worked on one of the first CBT systems that was developed by Texaco. A lot of the information that the students need to understand is dynamic and three dimensional and this is difficult to explain on paper but can be achieved using computing power. Since those early days with Texaco, Rod set up his own company and spent three years working full time to develop the Cobalt system. As a chief engineer, Rod knows what the students need to know and in the Cobalt system he believes he has developed an effective way for them to learn that material.

**Lecturer perspective**

Rod believes in going right back to basics before building up complexity. He works on the philosophy of: “Tell me - I’ll soon forget; show me - I might remember; make me do it - and it sticks”. He maintains that in other situations, if you ask students at the end of the day if they had understood what they had been taught that day, the answer would probably be: ‘No’. He feels that with this CBT approach the students get a much better immediate understanding of what is going on. Also by giving students a copy of the complete programme from the first day of the course, the students can rerun any exercise. Rod considers that the course is more applicable to the more mature student and that these have a greater incentive to learn. He maintains that the students don’t seem to be overwhelmed with the amount of material in the Cobalt system and explains that there is even a lot of material included in the package that won’t be covered in their course.
Rod has also introduced a collegiate approach between the various year groups to encourage altruistic behaviour. On the first day of each year he gets the three year groups together so that they all get to know each other and they are all encouraged to work for the common good. This can work effectively because of the small year group cohort size.

On an annual basis, Rod gives the students feedback forms where they are given the opportunity to suggest changes to the teaching approach and the Cobalt programme. If the students suggest a valid change then Rod will make it. The Cobalt system is growing all the time and constantly being updated. The time taken to make specific changes to the modules in Cobalt is variable, e.g. to make a learning object about a specific type of valve would take a few hours, whereas developing the simulations is a much more complex process and some of the mathematical models required have taken two or three years to develop. Rod has now developed all the base core models and so can quickly build a new version that would allow transferability of the approach to other disciplines. The Cobalt system is marine engineering because that is the background of its development, but by teaching the principles the system could readily be adaptable for mechanical, electrical, electronic, control engineers etc.

An unexpected benefit of using the approach has been in developing an understanding of technical English in overseas students for whom English is not their first language. These students are tested on spoken English when they come to the University but they can struggle with technical terminology. Using Cobalt helps enormously with this. A further benefit of the system is in succession management. Traditionally, when a new lecturer joins the staff, they have to write all their own lectures but with this approach a new lecturer could just take over using the programme. There is a danger that instructors might see the system as potentially replacing them, although Rod is insistent that you cannot lose the input of human experience.

If starting again, Rod says that he would not do anything differently as he knows that the programme that he has developed and the teaching approach in which it is embedded works.

Students’ perspective
The CBT approach is viewed as being very beneficial, especially for practically-minded students. “Seeing how things work makes it so much easier.” The pictorial representations and simulations are considered relatively straightforward to use and, because the programme is on disc, the material can be worked through repeatedly, away from the classroom or laboratory. All the students said that they use Cobalt outside of formal classes. There is a lot of additional material that can be accessed and they can work through material again that was not understood sufficiently in class without slowing down the rest of the group. Additionally, the huge gallery of actual photographs on the system helps the students to realise what things look like in real life. The students appreciated that the Cobalt programme, as well as the whole degree programme, incorporated the wealth of experience that the tutor possessed. They also appreciated the tutor’s willingness and enthusiasm to ensure a complete understanding of the systems and processes involved. They explained that Rod’s attitude to students was very much ‘open door’ and that he positively welcomed questions: “Rod is worried if you don’t ask questions”.

It was readily apparent that using Cobalt was intensifying the learning, as students were clearly confident that they were understanding the underlying processes. “One example that really highlights it: we had turbochargers last year and Rod went through the theory and then he put on the screen, using Cobalt, a simulation of how air flow actually worked through a turbocharger and it just made it so much easier to understand.” The interactivity built into the programme was considered to be extremely helpful. One student explained that Cobalt was like a toy that you could play with without breaking it and that it wasn’t
an extremely expensive ship, so you were free to make mistakes and learn from them.

They were all of the view that the material and, in particular, the simulations gave them an immense amount of confidence to know what they were doing when they went onto ships during their summer placements and ultimately for when they embark on their careers. They felt they knew that they could go onto a ‘dead ship’, with no engines or lights and could implement the correct procedures to get all the systems functioning properly to bring it to life. “You gain the confidence to control the systems and that gives confidence when going on board.”

The module had obviously captured the students’ interest. They felt that other lecturers should be encouraged to use the approach, as it would make learning so much easier in these subjects. If other lecturers wanted to adopt this approach one student suggested that they should: “maintain the balance of information and interactivity because a lot of lecturers, in my experience, try and kill me with PowerPoint and just slide after slide, it just gets boring but if, after a couple of slides, they went, ‘Here is a simulation for you to try’, it’s a lot more interesting. It keeps your brain active, rather than just looking at something for an hour.” Other students stated that the Cobalt system already helped them in other areas, for example in fluid mechanics.

The students felt that the material was really comprehensive and that there was a lot of information that was additional to the requirements of passing their degree or obtaining their MCA licence. The students appreciated that the programme and the teaching method would be very beneficial in the process to becoming licensed. They also appreciated that they would be able to continue using Cobalt when they had embarked on their careers. “When we have finished our degree, we’ve still got Cobalt. So if we find something on a ship, we can go and look on Cobalt and, more than likely, there will be something there that will explain it to you.” Without Cobalt the students maintain they would not have achieved their level of understanding. The simulations could only be done in Cobalt, so they felt they would have missed out hugely if they had not had it. One student, who came from a shipping family stated: “My dad’s been in the business for over 30 years. I showed him a copy of it and he thinks it’s fantastic.”

Issues
The programme is distributed via disc. These are updated on a regular basis of around every three months. There is the potential for students to be working from different iterations of the programme and this could cause problems when groups of students are working through a simulation on their personal computers in concert with the tutor. This situation actually arose in the teaching observation of the switchboard simulation. The tutor’s teaching style, in making sure that all students were following the demonstration, allowed the difficulty to be spotted quickly. The issue could be avoided if the programme was maintained on the University’s network, but apparently there has been an issue with the University’s IT management that has prevented this from happening for the present. There would be other advantages to having the programme networked, particularly for communication and assessment purposes.

The students stated that the Cobalt programme focuses on practice but does not concentrate so heavily on the underlying theory when compared with other subjects, although they did maintain that there was sufficient theory.

There is so much information lodged within the Cobalt programme and, even though it is set out in a logical format, there is the possibility that navigation could become an issue. Rod has indicated that he will add an interactive contents page/index to a forthcoming upgrade.
Benefits
The Cobalt CBT system develops a generically broad yet deep understanding of the engineering processes and systems that are operational on modern ships. This engenders supreme confidence to be able to board any ship and be able to operate and manage the onboard systems.

The programme can be used in several ways:
- as a teaching aid
- for simulating engineering systems
- as a means for self study and revision
- for students to make presentations to demonstrate knowledge and understanding
- for familiarisation with technical English
- as a research tool.

The approach would facilitate ‘succession management’. A new lecturer coming in to take over the course would not need to write their own lecture course from scratch but would just need a few days to familiarise themselves with the Cobalt programme.

Reflections
It is clear that the tutor has developed a CBT system that is extremely effective. The students really appreciate it and also the way that the material is delivered by the tutor. The importance of engineering confidence in students cannot be underestimated. For marine engineers, having the confidence in their ability to board an unfamiliar ship and operate it effectively is crucial. This teaching approach can achieve this level of capability. The approach can also be adaptable to other engineering and wider scientific disciplines. Those subjects could benefit from such an experiential process, particularly where there is a demand for generating graduates that are geared for their respective industries.