INTEREST IN THE COMMERCIAL? USING COMMERCIAL DESIGN PROJECTS IN PEDAGOGY

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ABSTRACT
This paper considers the issues surrounding the use of live commercial design research projects as teaching material for Product Design students. The premise for the paper is based around the Design Unit, a design and research group at De Montfort University in Leicester, staffed by academics who are also involved in lecturing product design students. It highlights an observation that students may not become highly engaged when presented with assignments based on 'real life' design projects that have previously been completed by Design Unit staff.
It could be argued that such projects are simply too big, the detail can seem esoteric and feel irrelevant to the fledgling designer. In addition, the commercial constraints of the real world project could, at times, impose inappropriate restrictions on student designers.
As a lecturer used to dealing with industry experts and then being expected to present to design students on a project within a new industry sector, it could be quite easy to become complacent with regards to the student's prior knowledge. The aims of this paper are to explore what key areas can be extracted from commercial projects to make the best use of them as educational material. It will aim to suggest tools that could be used to present the material in an effective way and how this could better engage the student to help them understand the validity of the proposed design project or teaching aid.

Keywords: Case studies, live projects, commercial design projects.

1 INTRODUCTION – THE DESIGN UNIT

The Design Unit is a multi disciplinary research group at De Montfort University staffed by a number of academics carrying out live product design projects with commercial clients.
As a result of their work, the group generates research outcomes for the university. Their activities also provide a strong link to industry with SMEs /large blue chip companies as clients but also with a raft of commercial suppliers and specialists.
The academics within the group are also involved in lecturing to Product Design students. To this end, there is a wealth of useful knowledge within the group and a broad range of potential teaching material to choose from. As the scope of projects undertaken by the group has become more diverse, it has become more difficult to tailor projects/ aspects of projects to be used in pedagogy.
The issue explored by this paper is how does the research generated by the Design Unit and similar design research groups at other universities filter down to become useful teaching material? This paper aims to examine, what should be extracted from a typical live design project, how it should be presented and by whom to give students a relevant view of empirical product design.

2 THE DESIRED LEARNING OUTCOMES FROM PRESENTING 'LIVE PROJECTS'

Design is a skill based profession, Dym and Little 2008 state: *'like riding a bicycle or throwing a ball, like drawing, painting and dancing, it often seems easier to say to a student "watch what I'm doing and then try to do the same thing yourself!" there is a studio aspect to try and teach any of these activities, an element of learning by doing' [1].* The learning through doing approach, demands that, the design lecturer must refrain from simply presenting pertinent facts from a live project which could promote the student to engage in the 'skim' learning of facts or 'surface learning'. Instead the teacher must encourage and inspire the student to undertake further proactive study/design practice, thus encouraging 'deep learning'[2]

2.1 Creating the ‘need’ for knowledge

The journeyman design lecturer must also aim to develop an intrinsic motivation within the student to learn about the subject area in question. When presented with something new, it could be observed that unless students are aware of the value of the subject matter, they are apathetic towards it. Once students understand that what they are being presented with has validity, they are more likely to be engaged and to undertake deep learning. This could be seen as self perpetuating in that once the ‘need’ to learn about a subject is understood, the hunger for knowledge increases. This is illustrated in the diagram below (Faulconbridge 2008) [3].

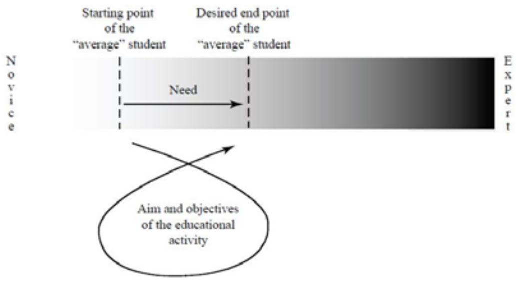

Figure 1. An illustration showing how the need for knowledge increases as knowledge is learnt Faulconbridge 2008 [3]

3 DESIGN UNIT - A PROJECT CASE STUDY

The following case study outlines a project undertaken by the Design Unit. Whilst a straight forward project in terms of technologies used, it has been chosen to demonstrate a sample of areas that ‘could’ be extracted to be used as teaching material:

Company SP produce a range of pneumatic pressure redistribution mattresses for the prevention of pressure ulcers in hospital patients who are confined to a bed. The inflation/deflation of the mattress is controlled from a central electronic control unit. As well as housing all of the pneumatic pumps/valves, this control unit also acts as the user interface for the product.

Another factor of the product is the quick release ‘CPR valve’. This allows for the air within the mattress to be quickly expelled in the event of the patient requiring CPR.

Company SP approached the Design Unit at De Montfort University to redesign their current range of mattress control units and CPR valves.

Figure 2(a) Existing Control unit 1

Figure 2(b) Existing CPR valve in machined aluminium

Figure 2(c) Existing Control unit 2

A ‘conventional’ design process was followed for this project. The results are shown below:

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Figure 3(a)

Figure 3(b)

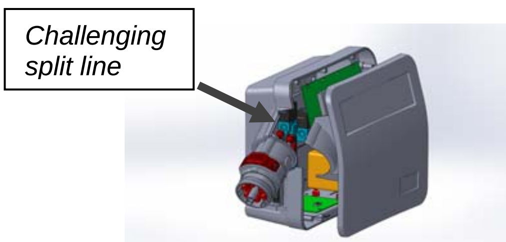

Figure 3(c)

Figure 3(a) & (b) Two iterations of the finished product *(the new CPR Valve shown with the red button on the left of each product)* 3.2c shows a split line that presented the designers with a challenge

The project presented the Designers with several unforeseen challenges during the design process:

Figure 3(c) shows a split line around the CPR valve exit port that was particularly taxing to ensure simple 'open-shut' tooling, negating the need for sliding cores.
Other challenges included designing a quick release air valve that could be used repeatedly without air leakage, creating a means of dampening vibrations from the air compressor that was to be used in the product, devising a cost effective way of mounting the control units to almost any hospital bed, creating an enclosure that was modular and could be used in for a wide range of model configurations, complying with relevant standards, styling plus many more.
A close working relationship with the MD of the company was critical; relationships were also developed with the company's electronics contractor and their internal specialists/ engineers.
To summarise, this project has many of the factors that the fledgling engineering/product designer can expect to encounter when embarking on their career (particularly if working with SMEs).

4 IDENTIFYING PROJECT AREAS FOR TEACHING FROM THE CASE STUDY

The following project areas have been selected to discuss their suitability as teaching material

Table 1. Knowledge factors identified from 'Commercial project' for potential teaching material

Identified area of project knowledge	Suggested Use as teaching material
Difficult split line between case halves	This could be used as an aid to teach students about injection moulded component design and the avoidance of undercuts (CAD exercise?)
Designing a strong mounting system in plastic for mounting to hospital beds	This could be used to demonstrate how to design structurally sound profiles in plastic
Dampening the vibrations of the air compressor	This could be used as a practical example to introduce the student to NVH analysis
Working with other specialists and working to a project plan	This could be used as a teaching aid in design management
Designing a modular/common enclosure and chassis to be used by a range of models	Modular design is a key feature of many products; this project could be used as an example.

It could be argued that any of the above factors could be elaborated upon to create teaching material. Each factor was experienced by the practising designers working at the Design Unit. This should give credence to these factors being empirical and suitable for use in teaching. However it would be all too easy for the design practitioner who spends more time engaged in design with specialists and their peers than lecturing, to overlook the inexperience of students.
Any of these factors presented in isolation, be it in lecture form or as a case study for example would most probably be seen as esoteric by a student. At best the student would be encouraged to surface learn and perhaps retain some facts for future reference as opposed to 'deep learn'. One of the elements Gibbs (1992) discusses when talking about fostering a deep approach is a well structured knowledge base. He states 'without existing concepts it is impossible to make sense of new concepts. 'It is vital that students existing knowledge and experience are brought to bear in learning'[2].
Is the knowledge discussed above therefore of little use unless it, by chance happens to coincide with a particular design project being undertaken by the students being taught?
The knowledge outlined in table 4.1 could be described as 'professional knowledge'. Leinhart et al (1995) [4] actually form a distinction between 'Professional knowledge' and 'University Knowledge' Biggs 1998 explores this further summarising these concepts as ***'professional knowledge****: procedural, specific and pragmatic dealing with executing, applying and making priorities and* ***University knowledge****: declarative, abstract and conceptual it deals with labelling, differentiating, elaborating and justifying'*. He goes on to discuss that university teaching for the professions is often declarative with a skills component taught separately as procedural knowledge. It is then left to the student to integrate the two domains [5]
In theory, a simplified version of Company SP's case study could be an ideal tool in demonstrating how the gap between university knowledge and professional knowledge is bridged and how the skills/knowledge the students are learning are applied in industry. It seems the challenge is aligning such a case study with the existing curriculum and making it a tool to aid deep learning.

5 INCLUDING A LIVE PROJECT IN THE CURRICULUM

When thinking about how to present this 'live' project material to undergraduate students we must consider the knowledge and skills we are trying to equip them with and the way in which they may learn. Kolb (1984) puts forward his now well known cycle of experimental learning shown in Figure 4[6].

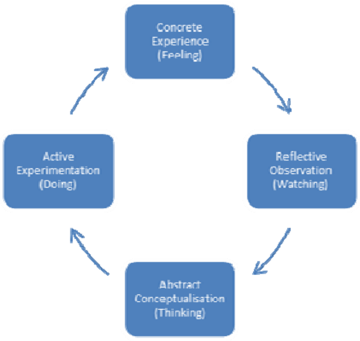

Figure 4. Kolb Cycle of Experimental Learning [6]

This is a model particularly suited to the product designer/design engineering student as it combines both the hands on and theoretical aspects of study. It is also conducive to the pursuit of deep learning.

Ideally, the live project should immerse the student in one of the four areas Kolb identifies, to begin the cycle. Even if this could be achieved we are still left with the question of where the live project fits in to the curriculum.

Biggs (1999) discusses his principle of 'constructive alignment' [5], in regards to consistency in the curriculum. He alludes to the course/module learning objectives, the teaching activities and the assessment criteria, all being aligned.

In presenting live projects to students, it could be argued that the material used and how it is taught should really be a pre planned exercise that is signed off by other teaching staff/module leaders and course leader involved in planning the curriculum. As appealing as it may seem to have a design practitioner to carry out an 'ad hoc' lecture on some recent work they have done, unless this is fully aligned to the course, then deep learning is unlikely to be encouraged.

At DMU where both BA and BSc product Design Courses are run, the main design project modules are aligned and supported by academic modules that 'feed in' to the main design projects throughout the course of the semester. For example, a main design project for a particular semester could be supported by modules in CAD, Materials and Manufacturing, Design process and hand drawing. The skills/knowledge learnt in these modules should come together to be used in the main design project itself. It has been observed that students can be slow to see the relevance of the supporting modules when undertaking their design projects. This integrates with the student combining declarative and procedural knowledge.

It could be stated that there is a clear benefit of using the experiences of a commercial project as teaching material in bringing together these modules and showing the student the 'real world' relevance of what they are learning in their studies.

6 REVERSE ENGINEERING PROJECTS AS A WAY IN TO THE CURRICULUM

Many product design/engineering design courses now carry out a project in which a product is procured, dismantled and its design/manufacture retrospectively analysed to try and assess why the artefact was designed/manufactured in a certain way. Sheppard (1992) refers to the practice as 'mechanical dissection' [7]

If we use the product(s) from the case study of company SP in section 3, maybe this could be the ideal route in to the curriculum? The product certainly has enough depth for this type of project and it could be that many of the areas of knowledge identified in table 4.1 would proactively be struck upon by the student. For example when talking about the 'dampening of the vibrations from the air compressor', the student would see upon opening up the product that the air compressor is sat upon special dampening mountings. They would then perhaps start to enquire why?

Also, the tutor could ask the question *'Can you see any parts of the injection moulded case that would have been difficult to design'?* This would hopefully lead to the student applying their base knowledge and perhaps identifying the area of the difficult split line (identified in table 4.1) themselves. If not, the tutor would be on hand to give the answer and the student would have a good grasp of the context of the problem after already trying to identify it for themselves.

In both cases, the student's 'need' for knowledge should be self-generated (as discussed in section 2) whilst they carry out the disassembly. The student will also have hopefully started their journey on Kolb's experimental cycle of knowledge. [6] Historically, it could be observed that the drawback of this kind of project is that it relies on the tutor having a deep enough understanding of the product being dissected to guide the student. If a piece of technology is purchased and upon dissection it appears the teacher is technically out of their depth, then the exercise quickly loses some credibility.

One of the major benefits of a product being dissected that was designed by the tutor is that the tutor will know the product intimately. They will be able to discuss some of the problems they overcame in context and be able to answer in depth questions about the nature of the materials used, the technologies employed, the physical structure, colour, texture and so on.

Another benefit is that the designer may well have a close relationship with the manufacturer(s) of the product (this is certainly true of the case study in section 3). In which case they may be able to arrange student visits to an injection moulder a tool maker or an assembly line for example.

The designer should also have examples of how the product developed through the design process, i.e. sketches, models, technical drawings, first off mouldings with imperfections etc. This evidence could all be used in subsequent lectures to tie together the design process and give students an empirical example of the skills that they themselves are learning but perhaps don't realise when to apply them.

Asa Harvard [8] talks about the importance of the artefact itself being used as an educational tool in a *'knowledge culture centred on producing artefacts'* This approach is certainly true of the reverse engineering project, as the artefact being dismantled contains or has undergone many of the processes being taught on the course.

These projects should also give credence to the guest lecturers/academics who have designed the artefacts being dissected. It could be argued that in the era of higher fee paying where students are 'calling the tune' [9], the confirmation of quality in lecturing staff (practising what they preach) is more important than ever.

7 LIVE PROJECTS: GUEST LECTURER OR A FAMILIAR FACE?

Biggs (1999) discusses the academic as being primarily concerned with keeping up with their chosen area of research first followed by their teaching practice second [5]. It could be observed that many students wouldn't be aware of this and simply see their tutors as just that, i.e. tutors simply delivering a syllabus dictated by the university. It could be assumed therefore that when faced with the prospect of a guest lecture on the subject of a 'live project' delivered by somebody in industry, students would find this more motivational than the content delivered by their normal university lecturer. Rather surprisingly, when this question was posed to the final year BSc Product Design course students at DMU, the results were to the contrary:

Question: Would you hold the 'live project' lecture content delivered by a practising designer in industry in higher regard than the lecture content delivered by your usual DMU academic? The possible answers were as follows:

1. Yes, I hold the practising designer content in higher regard
2. No, I hold the content delivered by my normal DMU academic in higher regard,
3. No difference, the content of both is held in equal regard

90% of the students answered with option 3, the remaining 10% option 2. However when asked a similar question about the appeal of the lecture, the results were very different

Question: Would you make a special effort to ensure that you attended a lecture given by a visiting practising designer to discuss a 'Commercial project' over and above the effort you would make to attend a normal lecture given by DMU staff? The possible answers were as follows:

1. Yes, I would make a special effort for the visiting lecturer,
2. No, I wouldn't make any special effort
3. No difference

In this instance, the students answered unanimously 100% for option 1. These results are interesting and warrant further research. If nothing else it affirms the saying 'Familiarity breeds contempt!' The reason for asking this question was to ascertain if the commercial project material held any more weight if presented by a guest lecturer from industry/ a research group member who was involved with the project/product in question rather than the normal lecturer.

The Design Unit staff (and staff of similar research groups affiliated to design courses) could be seen as guest lecturers but they have the benefit of being close to full time teaching staff and course leaders. This means they are in a position to have their commercial work scrutinised by colleagues involved with the course and are thus better suited to align it with the curriculum.

8 DISCUSSION AND CONCLUSIONS

Whilst live commercial projects from industry may seem like an attractive proposition to aid teaching, there are many factors to consider when aligning them with the curriculum, such as obtaining 'buy in' from others involved with the course to ensure the material being taught fits in with the established curriculum, learning outcomes and assessment criteria. Also, the material must be presented at a suitable time when the students have enough base knowledge to take on board what is being discussed and to be inspired by it.

The reverse engineering projects are only one mechanism for presenting live commercial work to students. If up to date commercial project factors could be injected in to the curriculum at the front end (i.e. planning stage), then the material could be delivered in a very controlled way that is beneficial to constructive alignment. For example if there was a constant feedback loop between the research group and the heads of course who plan the curriculum, then they would know what content is available from the commercial projects currently being undertaken. The academics of the research group could then perhaps tailor their work to suit teaching material (without compromising the project) based on requests from the course heads who could be looking for a particular 'real world' angle on a given design assignment. In the first instance, the course material presented by the Design Unit could simply be in the form of a simple case study saved in PDF format, and stored in a library that is available for all parties to see (including the students). This would allow the live project material to be woven in to the curriculum at the front end as the course head deems fit, encouraging conceptual alignment as discussed in section 5.

This paper has explored how the 'Commercial project' can be interjected in to a design course. It could be said that any sporadic contact with professional designers and their live projects is a good thing if these extra circular meetings are not subject to academic study or assessment (i.e. do not have the effect of 'rocking the design course boat'). Such meetings can be invaluable to help students in knowing where to turn upon graduating and to aid confidence when embarking on their careers. They should also help in letting students experience the realistic tight deadlines and the level of detail that is expected of the designer working on a Live Commercial Project.

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