# Learning to Design for Both the End-User and Client Companies: A Pilot Survey of Practice in UK Schools

## Abstract

Professional designers have long had to grapple with designing products for both the end-users and the company which commissions the work. This paper reports on a survey, which aimed to examine how students are introduced to these concepts in schools via a questionnaire to new undergraduates of industrial design.

The indications are that students are first introduced to the concept of designing for others at an average age of 13. Design for a company tends to be later, averaging age 15. The survey showed that teachers use a number of techniques to introduce these concepts. A comparative analysis is not possible within this research design. Those techniques that students felt were most effective at developing their understanding of design work in a commercial context are reported.

## Introduction

A constant paradox for any designer is the need to respond to the needs of both the intended users of a product and the company that commissions the work, pays the designer's fees and produces the product. A good designer also needs to understand something of the commercial context in which the company operates.

Teaching students to design simple products for users other than themselves in terms of gender, culture, ability and so on is potentially a very valuable learning tool. It may help children overcome an egocentric view of the world. Similarly children need to be helped to see that companies make products for users and yet operate in a commercial context. In both these respects design education is a valuable tool in general education.

It is important for staff at a university level to be aware of the prior learning of students. The author has two foci for exploring this prior learning: the teaching and learning of undergraduate designers and supporting trainee teachers in exploring the pedagogy of this area at a school level.

These issues are complex. A long-term aim is to identify and promulgate good practice. This paper reports one step: a pilot survey of undergraduate students on their prior experience of how teachers introduced these concepts in schools. This approach is, of course, partial, relying on students' memories and seeing the process only from their perspective. In addition, the survey is of students who have done well in their design studies, gaining either A or B grades at Advanced (A') Level examinations. This means that the survey will be biased towards better practice in schools. A second survey will gain data directly from teachers to complement this survey.

The paper looks at some of the literature in this area. The educational context in UK schools is explored, including statutory requirements and pedagogical issues. The methodology used is explained and its limitations drawn and acknowledged. Results are presented and discussed and conclusions are drawn.

## Background

Design teachers have long understood the need to teach students to design for other users. One aspect was the study of ergonomics (human factors). A common approach in schools is to firstly look at basic anthropometry and the physical sizes of people. Students then learn to apply this data to design products in the broader context of applied ergonomics. In many respects this is a logical approach to teaching and learning: start with basic concepts and build to the more complex in the context of 'hands-on' design work.

Industry, however, is now extending the understanding of the needs of the user far more broadly than, for example, the appropriate height of a work surface for users such as primary school children. Many 'needs' are less tangible. Sweet (1999) stated:

> No matter how elegant and functional a design is it will not win a place in our lives unless it can appeal at a deeper level, to our emotions.

The message is clear: if products are to succeed in a market place, designers have to look at user needs far more broadly. Companies normally commission market research, carried out by specialists, to gather data on the potential users of products prior to design work. There has, therefore, been a degree of separation between user and designer. Many authors now encourage a more direct contact between designer and user. This is termed user centred design (UCD):

> An approach to designing that places the potential user as a central design resource. It aims to elicit understanding and awareness beyond the functional needs
> (McDonagh-Philp and Denton 2000: p 111)

This brings the designer into the design research process (as is normally the case in schools) and in direct contact with the

*Howard Denton*

*Loughborough University*

potential users over the design process and not just at the start of the process. The additional effort in researching user needs over early product design phases usually pays off in minimising errors before financial commitments are made, such as building working prototypes or production planning (Baxter 1995, Backhouse and Brookes 1997). Clay and Clayburn-Cross (1995) point out that the active involvement of designers in research helps to ensure that design opportunities are not missed. A typical technique used to bring users into the design process is the focus group: a collection of individuals brought together to discuss issues relating to the design task. It may meet a number of times over the process, depending on the needs of the designer or design team. The method relies upon the interaction between the individuals during the discussion, also referred to as the *synergy* of the group (Kitzinger 1994). Such techniques can be used in schools.

Designers also need to be sensitive to issues involved in working with the client company. Company managers and senior staff may have a background in accounting or similar areas: they may not have knowledge and experience of interpreting conceptual designs. Put simply, they may not 'see' the potential in concept drawings. The designer needs to be very aware of this issue and be prepared to use various channels of communication in order to 'sell' concept work. This is a good argument for universal design education at a school level, in that it can help all children to appreciate design work and be able to 'read' concept drawings. In addition, designers need to be sensitive to the effects on production costs etc. of design decisions, balancing these against what they see as desirable features that will attract purchasers.

The National Curriculum for England for design and technology has a number of requirements relating to the issues in this paper, for example, pupils must consider issues that influence design planning. The examples given are:

> *the needs and values of intended users, function, hygiene, safety, reliability, cost*
> (p20, 1e, Key Stage 3 – ages 11-14)

This states clearly that pupils should design for others, rather than simply themselves. The attainment target within the National Curriculum for England refers to *users* as early as level 4; that expected for the majority of pupils at age 11. It is far less explicit on design for production by companies. Nevertheless, looking at a typical examination syllabus for the General Certificate of Secondary Education (GCSE), to be taken at age 16, there are specific requirements for pupils to:

> *design for manufacture in quantity to ensure that the quality of the solution will be suitable for intended clients and consumers*
> (Assessment and Qualifications Alliance syllabus, Section 9.1)

Here, design for manufacture is explicit and the syllabus differentiates the client (which could be a company) from the consumer (user). At A' Level, taken at age 18, a typical syllabus, outlining the nature of design and technology, states:

> *The distinguishing feature of any design and technology course is its practical nature. Knowledge and Understanding is not therefore to be acquired purely for its own sake, but in order to apply it to the solution of practical problems which arise in everyday life and in industrial and commercial contexts. ... Designers develop an awareness of the opportunities and constraints placed upon them by taking account of the demands of users and producers and of market forces.*
> (Assessment and Qualifications Alliance Advanced syllabus, Section 9.5)

Teaching students to understand something of the way design operates in a commercial environment or when working with companies can be difficult and must be considered as a part of a long-term plan for development. One possible technique is simulation that can be defined in this context as:

> *ongoing dynamic representations of real or imaginary situations designed for learning purposes. They are characterised by:*
> * *Being based on a context, usually in real life.*
> * *Operating at various levels of simplicity/complexity.*
> * *Being experientially based.*
> (Denton 1992)

There is a considerable literature in this field, for example, Denton (1992 and 1994), Percival (1987), Jones (1990). At a simple level, teachers may set 'briefs' for projects which simulate a company briefing a designer. Such briefs can be useful in helping students appreciate that they are working for a company. At more sophisticated levels teachers may bring company staff into school to set a project, brief students and assist in assessment and feedback. Feedback loops are an important feature of simulations.

Whilst simulation techniques can be very valuable, some authors warn that there is no evidence that they are any better at assisting the learning of facts than more conventional teaching (Jones, 1990, Percival, 1978). Nevertheless there are indications that student motivation improves when working with industry in simulated product design exercises (Percival 1978, Adams 1977, Denton 1992). Motivating students is an important step in enabling and promoting learning.

**Method**

A sample of 110 students was surveyed by questionnaire early in their first year at university, that is while their experiences in schools were relatively fresh. The sample represented 105 different UK schools. The questionnaire was developed, piloted and then administered in a lecture hall to ensure a full return rate. The usual briefing was given including assurances on anonymity. Two research questions guided the design of the questions:

- How and when did teachers first introduce the concept of designing for other users?
- How and when did teachers first introduce the concept of designing for a company and mass production?

11 questions were framed. Each had a box for respondents to enter the age range at which they remember the teacher first introducing the concept. The questions explored:

- designing for others
- designing for production by a company
- the use of 'briefs' which simulate a company request
- whether 'live' clients/users were used
- any staff inputs on designing for others and production by companies
- if teaching aids were used
- if production simulations were used
- any use of team-based design (as this was often linked to simulating commercial work)
- what the student felt was the most effective exercise done at school in relation to learning about design for production in a commercial context.

Data generated was both qualitative and quantitative: qualitative when descriptive answers were gained and quantitative in terms of the age range at which these were introduced (if at all). The qualitative data was analysed by direct comparison and the identification of emerging factors, whilst the quantitative data was entered into a spreadsheet. It was important to remove any zeros from the quantitative data (indicating the topic was not covered), as this

would have skewed the mean age ranges shown for each result.

It is important to realise that the sample surveyed were all undergraduate industrial designers. 97% had A' Level design subjects with a grade of A or B, together with at least two other A' Levels. The sample, therefore, reflects the more successful output of design work in schools.

**Results**

Each question is reported followed by:

- percentage of students answering positively
- average age in which the factor had been introduced by teachers
- summary of qualitative feedback.

*1. How were you first introduced to the idea of designing for other people rather than yourself?*

- Percentage where activity had been experienced: 100%
- Average age when activity was introduced: 13.4 years

All students reported experience of designing for others. The range over which teachers first introduced the concept varied from Year 7 (age 12) to Year 11 (age 16): a significant difference. The most common 'other users' were friends, family and younger children; all relatively easily accessible. Some pupils were asked to design for the disabled. The most frequently used method for teaching students to design for others was to conduct simple questionnaire surveys amongst family and friends. Group brainstorming (mind-mapping) and basic ergonomics teaching also introduced the issues of design for other user groups.

*2. How were you first introduced to the concept of designing for production by a company?*

- Percentage where activity had been experienced: 95%
- Average age when activity was introduced: 14.5 years

95% had been introduced to the idea of designing for production by a company and the mean year group for introduction rises to 10.5 (age 15 years). The range of methods used varied from videos showing design work produced for companies, to simulations such as designing vacuum formed model boat hulls for batch production, board games, novelty badges, biscuit making kits and using 'lego' (a construction kit) to simulate production lines. Teachers also used formal class talks to introduce the concept of designing for companies, visits to companies, CAD/CAM

exercises such as designing flat pack chairs for children, board games and acrylic photograph frames. A few teachers introduced the concept whilst teaching students about injection moulding as that related to mass production. A number of students reported being introduced to designing for companies by entering a competition: the design of a production item for a company making a type of manufactured board.

*3. Did your teacher use design 'briefs', which simulated you designing for a company? If so, please give an idea of what the brief said.*

- Percentage where activity had been experienced: 82%
- Average age when activity was introduced: 14.1 years

The feedback indicates that this was a common technique employed, particularly by teachers in graphical design projects. The format was usually a sheet of A4 paper with instructions of the type: *a company manufacturing cakes needs a new design for cake boxes which will flat-pack and carry a new logo*. This technique was used less in design work focussing on resistant materials and technology, though projects were reported in which students were given briefs to design for a company producing lamps for the teenage market, biscuit cutters, executive toys and alarms for specific ranges of users.

*4. Did your teacher ever bring a 'live' user as a client into school for you to design for? Or you may have gone out to meet such a client (for example, a disabled person). Please describe how this was done.*

- Percentage where activity had been experienced: 38%
- Average age when activity was introduced: 15.5 years

A far lower proportion of teachers employed this technique and the average age when it was experienced jumps to 15.5 years. The two most common live clients were disabled pupils and younger children in local primary schools. In the post-compulsory period of age 16-18 it was more common for students to be required to find their own external client for major project work. In some cases teachers used staff from other areas of the school as a 'client' (for example, the design of a teaching aid for science teachers). Some students had entered a young engineers competition in which they had worked in a team of students to a brief set by a 'live' company.

*5. Did your teacher ever bring in a person from a company who introd\uced a brief task*

*for the company? If so, please describe the situation.*

- Percentage where activity had been experienced: 3%
- Average age when activity was introduced: 15.4 years

This technique was used infrequently. Some companies such as Dyson will send a designer to a school to run exercises and set a brief for students to work to. Of course, there would be a limit to the number of schools any company could do this for. Generally those teachers who did use this technique took the initiative and approached a local company for a brief and a member of staff to introduce it to students.

*6. Did your teacher ever give talks on designing for other people? How was it done?*

- Percentage where activity had been experienced: 71%
- Average age when activity was introduced: 14.7 years

This question identified whether teachers prepared specific talks on designing for others: 71% did. The majority of this was in the form of short talks integrated with project work rather than a more formal whole class 'lecture'. Again, designing for the disabled was a common focus for such discussions, though introductions to ergonomics were also frequently used to talk about designing for others. A small number of teachers introduced this area by having students analyse a range of products and identify aspects of designing for a range of people. Two teachers reported in the qualitative feedback had worked as designers and used their prior professional experience.

*7. Did your teacher ever give talks on designing for companies?*

- Percentage where activity had been experienced: 66%
- Average age when activity was introduced: 14.9 years

This question is similar to question 6, but aimed to differentiate talking about designing for companies (that is consideration of design for mass or batch production) rather than simply other people. The proportion of teachers who did this dropped to 66% and the average age at which it was done rises to 14.9. This is logical as the concept is slightly more advanced than that in the previous question. Again, such talks tended to be integrated in on-going project work rather than separate lessons.

*8. Did your teacher use any aids to get these points over, for example, videos, software,*

*visiting speakers, visits etc.? Please provide detail.*

- Percentage where activity had been experienced: 77%

- Average age when activity was introduced: 15.0 years

A range of techniques was described. Visits to companies and to industrial exhibitions were the most frequently referred to. Videos were used including several off-air recordings of the work of designers, Seymour Powell '*Better by Design'* (BBC 2 series), Dyson schools information packs (including web-based materials) and some car manufacturers.

*9. Did your teacher ever run production simulations, such as assembling 'lego' on a 'production line' or using small scale card models to design, for example, chairs.*

- Percentage where activity had been experienced: 22%

- Average age when activity was introduced: 14.6 years

Production line simulations were used relatively infrequently (22% of sample). Some teachers used flow diagrams to illustrate production lines. A small number of teachers got classes to run production line simulations using lego 'cars', toy wooden train or card models of flat pack chair production. One teacher used 'cell' production techniques (that is small teams of workers who assemble a whole product, as opposed to production line techniques where each worker repeats the same sub-task) and had teams of students producing and assembling components for a fuse tester.

*10. Did you ever do any team-based design work?*

- Percentage where activity had been experienced: 56%

- Average age when activity was introduced: 14.4 years

Team-based design work in schools is often linked to commercial simulation and so has relevance to this survey. The report of only 56% with experience of team-based design work was surprising. The National Curricula for England, over the period when the students sampled were at school, specifically required students to experience team-based design work. This finding would require more exploration before any firm conclusion could be drawn. One possibility is that student respondents did not remember specific team-based design work when they were at school. If this were the case, it would indicate that the experience had been ineffective.

*11.What do you feel was the most effective exercise you did at school in relation to learning about designing for production or designing in a commercial context?*

- Percentage where activity had been experienced: N/A

- Average age when activity was introduced: 14.4

This question generated a range of observations. The highest number of responses (28) was to the major project usually undertaken at age 17 as a part of 'Advanced Level' studies in design and technology. Also mentioned as effective were case studies of commercial design as a part of these studies. As the average age given above worked out to 14.4 years it indicates that there were other effective exercises done at earlier age ranges. These included CAD/CAM work, which is often taught with commercial production as a central aspect of the work. Some respondents reported teachers using product analysis exercises in ages 13-16 effectively. Some students came directly into contact with companies by working on company sponsored projects or competitions, including 'Young Engineer'. Videos were mentioned by a small number of students as being effective in learning about design for commercial production. Some schools run 'enterprise week' activities, which these students considered effective. These usually involve students forming small teams to design and market a simple product, often in competition against other teams. Students design in their teams, cost materials and, in some cases, processes, run production lines, package products and sell them. Some students reported visits to companies and visits by company staff to schools as effective. Some teachers ran production line simulations effectively, such as the design and production of board games. Finally, some students reported work experience at age 14 as an effective exercise in relation to learning about design in companies.

**Discussion**

The memory of respondents is a significant limitation on any such survey of this type and will lower reliability. The perspective of a sample of teachers would be valuable, but ultimately it is what students remember and learn which is most important.

The survey indicates that teachers are generally applying the principles of progression logically; simple concepts are introduced earlier than the more complex. However, the survey showed that each concept had a fairly broad age range for its introduction. For example, while an average

age for the introduction of students to the idea of designing for others of 13.4 seems reasonable, this masks those who were not introduced to this concept until much later. Teachers introduce the concept of 'other users' logically by choosing those closer and more accessible to the student initially; for example, friends and family. This experience is then expanded, moving on to people more distant from students' own experience such as the elderly or disabled. Teachers appear to primarily use design projects as vehicles for teaching about designing for others, normally giving short inputs at appropriate stages within the project.

Question 3 showed that the use of design 'briefs', simulating a company was briefing the student as a designer, is used more in graphical design than other design work. The author's experience of schools in the UK indicates that when these briefs are used it is rare for staff to extend the simulation further. For example, the brief could mention a maximum cost for manufacture, specify preferred materials and processes which the company already uses, set down interim report points and so on.

Question 4 explored the use of 'live clients' for design work. The proportion was lower at 38% and an average age range of 15-16 years. The qualitative responses show that teachers use both users of products, particularly the disabled and, occasionally, staff from companies. This raises the issue of whether teachers are differentiating the nature of 'client' between users of products and the companies who commission design work and manufacture products. Certainly the issue can form the basis of useful discussion on the responsibilities of the designer and the moral questions they are faced with.

Only 3% of the sample experienced staff from companies being brought into schools to introduce a design project. This may reflect the workload of teachers and the need for time to set up such visits. Not all company staff would be effective in briefing students. This is a very different task to their own professional experience. The teacher has an important role in ensuring such visits are well planned and supported. If done well, such visits can be valuable. The author's experience indicates students tend to react extremely positively to visiting company staff. They appear to be given credibility by students, perhaps because they are perceived as relevant to future careers in industry (Denton 1992). Such visits, therefore, can be powerful motivators. At only a 3% recall it appears that this is not as well recognised by teachers as it deserves.

The survey asked which exercise which was most effective in helping students to understand the commercial dimensions of design. The majority referred to their most recent experiences with major projects and case studies in the period of A' Level studies (age 16-18). This is to be expected, these projects were the most recent for students and also more personal and intense. It should be noted that three other types of exercise were reported as being effective: the analysis of existing products, the (increasing) use of CAD/CAM and 'enterprise weeks'.

The majority of teachers in the UK do not have experience of designing in industry. They need support in developing this aspect of their teaching. In the UK the scheme to extend CAD/CAM to all schools (DATA Pro/DESKTOP) recognised this issue and has invested in training existing staff rather than simply the new hardware/software needed. This initiative appears to be succeeding and points the way for developing materials and training teachers to be able to teach the commercial dimensions of design effectively.

Whilst the CAD/CAM initiative has had some success in supporting design for industry there is a danger of the focus being too specific. Teachers might miss broader issues such as ergonomics and the emotional dimensions of design in an industrial context. An over-simplistic approach is, to some extent, evident from this pilot survey in that teachers primarily use the disabled as a focus for designing for others. Pedagogically this is a valid approach for introducing the concept to students. It also has many relevant moral dimensions. However, designers need to develop a sensitivity to design for finer differentiation in a normal population rather than the more obvious ones of the disabled. This can be done, but only if appropriate materials and supporting training are available to teachers.

**Conclusion**
All students reported they had been introduced to the concept of designing for others. The methods used and points at which it was done varied as one would expect in a sample of 105 schools of many different types. However, not all students remembered being introduced to the concept of designers working for companies. It may be that these students simply did not remember this work, however, even then the professional responsibility lies with the teacher.

The survey indicates that the majority of teachers are using logical, but fairly simple, techniques to introduce these concepts to students. However, whilst such techniques are

a valuable tool in the early stages of secondary education, few teachers are developing more sophisticated techniques as students gain experience later in the school. The most obvious example is the minimal use made of direct links with local companies to generate design simulations. The motivational and learning potential with such links is considerable. However, it must be recognised that to work well such links need careful planning and a considerable amount of time and energy by teachers. Teachers in the UK are frequently reporting work-load difficulties and this may be one of the reasons why so few are taking the opportunities to develop such links.

This survey has a limited sample and draws data only from the memory of students; one must be careful as to what conclusions can be drawn. It would appear that teachers of design and technology in the UK are developing students ability to see that designers must be able to design for others. This has potential benefits in terms of helping students empathise with others, but it is obvious that the levels of sophistication with which teachers manage this element of the subject are variable, meaning many students get a very limited opportunity.

Looking specifically at the aspect of helping students appreciate that designers need to work within a commercial context and with a company as client we see the situation in the schools surveyed to be weaker. Significant educational benefits are being missed. There may be a number of reasons for this: workload, lack of suitably researched teaching materials or it may be that relatively few UK teachers have a background in any other profession than teaching and this lowers their confidence in building links. In terms of both the general educational and pre-vocational value of design and technology as a school subject, this aspect requires further investigation.

**References**
Adams, R. J. (1977) *The Development of a Simulation Game for Library User Education*, MLS thesis, Loughborough.

Assessment and Qualifications Alliance (2001) *Design and Technology (Resistant Materials) syllabus*
http://www.aqa.org.uk/qual/pdf/AQA3545WSP.pdf

Assessment and Qualifications Alliance (2001) *Design and Technology (Product Design) Advanced 6551 syllabus*
https://learn.lboro.ac.uk/cd/01dtp302/indexnonav.html

Backhouse, C. J. and Brookes, N. J. (eds). (1997) *Concurrent Engineering: What's Working Where*, New York: Wiley.

Baxter, M. (1995) *Product design: A practical guide to systematic methods of new product development*, London: Chapman and Hall.

Buzan, T. (1985) *Use your Head*, London: The British Broadcasting Corporation.

Cross, N. and Clayburn-Cross, A. (1995) *Observation of Teamwork and Social Processes in Design*, Design Studies, 16, 143-170.

DATA website. Pro/DESKTOP
http://www.data.org.uk/develop/cadinschools.htm accessed 18 12 2002.

Denton, H. G. (1994) *Simulating Design in the World of Industry and Commerce: Observations from a Series of Case Studies in the United Kingdom,* Journal of Technology Education. Fall. http://scholar.lib.vt.edu/ejournals/JTE/jte-v6n1/contents.html.

Denton, H. G. (1992) *Towards maximising pupil endeavour: An enquiry into a learning approach centred on teamwork and simulation in the context of Technology education*, Ph.D thesis, Loughborough University.

Jones, K. (1990) *General Activity for Management Education – a Deliberate Ambivalent*, Simulation/Games for Learning. 20, 2, 142-151.

Kitzinger, J. (1994) *The methodology of focus groups: The importance of interaction between research participants,* Sociology of Health and Illness, 16, 103-21.

McDonagh-Philp, D. and Denton, H. G. (2000) *User-Centred Design and the focus group: Developing the Student Designer's Empathic Horizons*, in R. Kimbell (Ed.) Proceedings of The Design and Technology International Millennium Conference. DATA

Percival, F. (1978) *Evaluation Procedures for Simulation/Gaming Exercises*, Perspectives on Academic Gaming/Simulation 3, 163-169.

Sweet, F. (1999) *Frog: Form Follows Emotion* (Cutting Edge), London: Thames and Hudson.

*The National Curriculum for England: Design and Technology* (1999), London: Department for Education and Employment.