Forensics and Autopsies: Exploiting Popular Culture to Teach Design for Commercial Manufacture?

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Abstract

Forensic science is the discipline that students and parents consider as most interesting, providing a well paid and satisfying career (Manufacturing Foundation 2003). The influence of popular culture and the high level of media exposure may be a reason for this positive perception. Contrary to this, there seems to be a negative image of manufacturing, often perpetuated by the media. This anti-manufacturing attitude has prevailed for some time and is acknowledged by many (e.g. Scottish Executive, Make It Scotland, RSA, Foresight, MORI/EMTA, Unipart, The Manufacturing Institute). Industry and universities alike are finding it increasingly difficult to find enthusiastic recruits.

This paper reviews current approaches to teaching the relatively new curriculum content (SQA, 1999) of commercial manufacture in the Scottish secondary school system and describes development work with in-service teachers and school students. The development work described aims to challenge the anti-manufacturing stereotype through a pedagogy designed on motivational principles and explicit use of the language and tools of popular media culture. The approach taken exploits the interest in all things 'forensic' and uses 'product autopsy'. It aims to link the author's previous work in exploring values and expressing opinions in Technology Education (McLaren, 1997) with recent curriculum developments and related teaching strategies. The integrated approach attempts to encourage greater engagement in aspects of technological sensitivity and technological perspective (SCCC, 1996) when learning about designing for commercial manufacture.

Key words: forensics; autopsy; commercial manufacture; motivation; popular culture; curriculum development.

Demands of curriculum arrangements

In contrast to the Scottish Qualifications Authority Standard Grade Craft and Design course (SQA, 1989), where school workshop processes are used to create a 'one off', custom made, prototype, the curriculum arrangements for Intermediate 2 and Higher Craft and Design (SQA,1999) require knowledge and understanding of commercial manufacturing. It is an integral component. Students have to identify manufacturing processes and materials, detail products for manufacture in terms of materials, processes, performance, aesthetics, cost, technical and environmental issues and the interplay between such technical issues and design factors. The shift from one off, job-shop production to commercial manufacture (i.e. manufacture in quantity) has made demands on the knowledge of the traditional technology teacher.

Challenging current perceptions

Through some bad press, manufacturing has developed a negative image. It is 'seen by many as being dirty work, boring work, dangerous work, low paid and hard work' (Manufacturing Foundation 2003, p11). However, the report notes that pupils had more positive perceptions of manufacturing when the jobs involved the production of what are perceived as the more glamorous products (e.g. high performance motor bike rather than jeans) The results of the survey indicated that, generally, the pupils (and parents) rated working as a 'forensic scientist' as the most interesting, the best paid, requiring the longest training, offering the best prospects and being the most difficult. (p22). One can only presume that this image is gleaned from television programmes such as 'CSI' and novels by Deaver and Cornwell.

Common current approach

To support the introduction of the new curriculum, the 'Higher Still' Development Unit (1997-2000) distributed a small number of support resources e.g. a course guide, sample homework and class tasks, and instruments of assessments with answers. Although the Technology Enhancement Programme, Institute of Materials, Focus in Education and others have produced classroom resources (e.g.CDROM) these are often adopted within current practices of introducing manufacturing processes through note taking and handouts, videos and animations, with little hands on activity. Teachers and pupils alike are not enthralled with this passive strategy and this has created a reluctance to spend much time on the topic. There was a clear need for staff development with specific reference to teaching approaches.

SQA advice and feedback to centres: issues arising
The reluctance to shift to detailing for commercial manufacture was evident in the first years of presentation. Presenting centres had to be reminded by the SQA that the 'planning for one-off production is not acceptable and will not attract marks'. (Design Assignment Guidance Craft and Design, SQA Sept. 2002).

The technical education assessment panel

Principal Assessor's reports (2003) on the Intermediate 2 and Higher courses indicate that students were able to answer exam questions requiring facts and direct knowledge of materials and manufacturing processes. However, a significantly large number of candidates were under performing when understanding was to be applied to design situations. Encouraging as it is to note that the students are now proving their ability to learn about materials and processes of manufacture, the concern is that they remain less able to relate these to the overall production for assembly in a design context. The difficulties lie in making connections between, and recognising the influence of, design decisions regarding processes and materials, with other design factors such as aesthetics, semantics, function, cost, etc. This is what demands greater understanding and appreciation of the issues and higher order thinking skills.

Support for teachers

A 'Design for Commercial Manufacture' short course or continuing professional development (CPD) course was designed to support teachers. This aimed to challenge the existing practices and exemplify a range of 'hands-on' learning approaches and activities to illustrate pedagogy suited to classroom teaching which in turn encourages thinking skills and more interaction. It had been noted that, in school, Unit3, 'Design for Commercial Manufacture' had been treated in isolation from reiterative designerly thinking and appeared to be a last stage addendum. The impact and influence of materials and manufacturing processes on design was all too often overlooked. The CPD sessions were primarily devised to raise awareness of the interplay between commercial manufacturing processes, material selection and design decisions required to meet design specifications. In order to help the teachers recognise the connections, explicit links were made to product evaluation (Unit 1). The CPD course designers were mindful of the negative image of manufacturing. They had a desire to challenge this prejudice and were aware of the public's fascination with forensics. This led to the analogy of looking for clues, collecting evidence and preparing an argument for presentation, as if to a court of law, to be used as motivation to engage learners. The main purpose was to develop a pedagogy that did not merely transmit facts but to develop higher order thinking skills to be applied through responding and exploring to value judgments, observing, evaluating options, connecting cause and effect, sorting and analysing information, logical surmising, drawing conclusions and providing justification, i.e. inductive reasoning.

Development of strategy through field-trial

Midlothian Council 'Design Day'

The CPD work was adapted on request of Midlothian Council. A 'Design Day' event was devised to bring together approximately 100 students of Craft and Design, aged 16-17 years old, from the six high schools of the local authority. Over the last three years (2001,2002,2003) the event has been staged when the students are approximately ten weeks into their SQA higher and Intermediate 2 Craft & Design course. Prior learning includes Product Evaluation (Unit 1) and Design for People (Unit 2) and often Standard grade Craft and Design.

Design Day 'Commercial Manufacture' Workshop Agenda

Introduction:	Context setting and familiarisation with PRS hand sets
Input:	Impact of technology- process and design trends on product development
PRS activity :	Exploring emotional response
Group Task 1:	Initial responses and evaluation of product provided
Break	
Input:	Manufacturing processes and material identification
Group Task 2:	Forensics and autopsies: looking for clues, preparing case.
Plenary:	Verbal presentations by groups
Evaluation:	PRS handset

Figure 1

The short workshop (1hour 45 minutes) aimed to present 'Design for Commercial Manufacture' as an enjoyable and interesting topic rather than 'the dry and boring bit'. This required an approach which would sustain concentration. The presenters needed to capture the attention of the student group, share objectives and stimulate them quickly. (Dweck, 1986). Motivation was required; more than could be created by the novel surroundings (a Mining Museum), the mix of attendees from various high schools and general curiosity towards the event itself. Therefore the workshop session was designed to ensure there was a range of required learning styles which changed with purpose and focus of content. Each of these demanded learner reaction of a different type and physical interaction and involvement which, following the Keller (1987) model of motivational design (Figure 1), is an essential part of the learning process,

To overcome the acknowledged difficulties of eliciting answers, polling students by show of hands, and engaging student in discussion in large group situations (e.g. Atherton, 2003; Bligh,1998; Draper, 2002), the use of a personal response system (PRS) was incorporated. PRS offered the potential to motivate through novelty, fun, curiosity, and connection with popular media of TV e.g. *Who Wants to be a Millionaire?* However, caution was taken in order to maintain the integrity of the pedagogy. The ICT available was not to seduce by novelty, but to allow greater interaction in discussion and exploration of product design through value judgements. Discomfort in discussions involving articulation of value judgements is common (McLaren, 1997). The benefit of using the PRS 'ask the audience' approach, is that it allows every student to enter an anonymous response and results are displayed immediately and graphically. Using the individual handsets, students transmit their personal response to a variety of questions. These were designed to involve polling of student opinion, students offering 'best fit', selecting personal preferences, making guesses, gauging visceral reaction, etc. Through this process, products presented on a power-point presentation, were explored from a subjective and emotional stance, and the students were introduced to the 'reading' of the products (albeit images only, at this stage) and externalising these responses.

The intention was that the students would be encouraged to be more reflective and view their own response in the context of others, and the context of any observations, comments and further provocative questions posed by the presenters. The approach allowed students to explore the product through projected impressions and perceived intention,

through use of style, form, material and detail in relation to function and target group (perceived or otherwise). Thus the PRS allowed a more comfortable way in to enable the students explore initial 'emotional engagement' or 'emotional ergonomics' which is embedded in products to create innate desirability. (Norman, 2002, Quin, 2003, Seymour, various)

The suitability of the PRS to the environment the presenters were anxious to create was evident. It encouraged the youngsters to respond and be willing to deposit an answer. It appeared to have positive effects on the attentiveness of the students and certainly achieved a more relaxed atmosphere as they were introduced to the next section of the agenda for design for commercial manufacture. The students were given 'real world' illustrations from industry and design consultancies to emphasise the importance of analysing existing products. Brief descriptions were given of the methods they employed, e.g. user trips, ethnography, technical analysis to gain an insight into manufacturing methods, costs, assembly performance, etc. in order to identify shortcomings, successes and advantages.

The PRS icebreaker served to develop interest and start the students thinking about products, the materials and processes used to manufacture them, fashions, preferences and tastes, target groups, added value, and influences on the evolution of products over time. This approach contributed directly towards two of the four aspects of technological capability, which is at the core of Scottish technology education, described as 'technological perspective' and 'technological sensitivity' (SCCC, 1996). The context for learning about the materials, manufacturing processes had been made explicit to the students and emphasised as integral and necessary components of designerly thinking.

Progressing from values and emotions to technicalities
The forensic autopsy strategy was then introduced to the students. In keeping with a role play, an investigative method was to be adopted. i.e. looking for clues, using painstaking inquiry, questioning, thinking out loud and progressing through collaborative question and answer. Co-operation and responsibility was required to solve the problems. A variety of products were distributed. One product type was given to each of the fourteen groups of four students.

Part 1. 'Product picture/scene setting'.
Students explored their initial emotional response to the product provided and familiarised themselves with it through evaluation to set up the general

impressions and understanding of the product. This created the story line of the big picture: the overview of 'the scene of the crime', the people, the place, the context.

Part 2. 'Product autopsy'.

Students were provided with the 'tools' of the post mortem: rubber gloves, screw driver, files and magnets. For reference and ease, several of the products had been pre-disassembled. Students were encouraged to quiz each other, to explain why a particular assumption was being offered. As a result sometimes students revised their own understanding of how they thought it may have been manufactured and from what. Groups were provided with support resources in form of activity guides part 1 and part 2, a 'flow chart' of prompt questions to structure initial examination, a legend of polymer codes and annotated terminology to describe sheet metal cuts/ forming. Facilitators were on hand. It was considered acceptable to say, 'I don't really know but I think...'

All conclusions were recorded and justified by physical, sensory evidence, and/ or assumptions supported by informed theory and/or evidence. A verbal 'pitch' was encouraged so that each group could take responsibility for stating their findings and theories.

A brief evaluation at the conclusion of the 1 hour and 45 minute workshop experience indicated that students had enjoyed themselves. On a scale of 1-5 (where 5 = very much) over 32% selected the rating of 4 and 5 thus implying they perceived the session had increased their knowledge. Over 31% selected 4 and 5 indicating that they felt the session had increased their confidence in tackling such issues in the course work of the curriculum. Subsequent teacher feedback, based on related project work, suggested that the students had gained important knowledge, including the techniques of material/process investigation, more so than the students themselves had realised at the time.

Conclusion

New curriculum content demands reflection on, and selection of, appropriate teaching methods. Changes to curriculum content often undermine teacher confidence in the short term. Teachers may feel insecure in their own knowledge base and rely heavily on published resources or revert to limited teaching and learning strategies which inhibit connection with wider learning. Commonly a 'one way transmission' teaching model is adopted to create a feeling of control. Designing does not accommodate this model well. Teachers, and students too, devise 'avoidance' strategies. The result is that a superficial understanding is

developed. This is evidenced by the greater success at written response exam type questions than in the application in design context.

Motivation is key to capturing interest and creating a willingness to participate in the learning. Many teachers are well aware of the motivational, and related confidence, difficulties in teaching the syllabus of 'design for commercial manufacture' which is competing with student's memories of the smells, noises and physicality of making a one–off, prototype model in the school workshop as was the dominating aspect of by their previous experience (SQA Craft and Design, Standard Grade 1989).

When genuine enthusiasm is not present in the teacher, students may pick up a negative attitude towards the curriculum content or specific aspects of the syllabus.   As professionals, teachers are encouraged to take responsibility for their own personal and professional development. Attitudinal issues and knowledge shortfall can be overcome by industrial experience in manufacturing placements (Stevenson, 2004), participation in initiatives which challenge the anti-manufacturing perception (Make it Scotland, SEED) or attending short courses (e.g. the Polymer Study Tour, Institute of Materials lectures). The evaluations received from teachers on completion of the Strathclyde University short course (total 88 to date) indicate an increased confidence and willingness to engage in an enquiry method of learning about manufacturing.

Brochocka, Baynes and Smith (2001) argue that 'teachers and curriculum planners would benefit from paying more attention to the lives, ideas and preferences of students who, after all, are at the fulcrum of the educational process.'   The curriculum and pedagogical development described in this paper draws directly on popular culture and media 'gimmicks' (i.e. forensic science and 'Who Wants to be an Millionaire?') in an attempt to counteract stereotypical prejudices that are all to common towards commercial manufacturing, 'traditionally the area that causes most problems' (PA Higher Craft and Design 2003 p.3.).

The role the students were asked to adopt, that of a team of forensic 'scientists', to seek for clues and validate any deductions in direct relationship to this evidence, engendered fun, cooperation and enthusiasm for the authentic learning activity to be undertaken. (Gagne,1985)

Language of media and popular culture can be borrowed too. In this development, the terms 'emotional ergonomics' and 'forensic autopsy' are words that were used blatantly to conjure up

associations beyond the classroom. They were used explicitly as titles for strategies for learning that, together, developed a model of approach which demands complex and multi faceted understanding. The approach adopted granted students 'permission' to have a private, personal, 'peer–free' emotional response to a product. It illustrated how many different tastes and preferences, values, opinions and ideas a product can generate on visual impact alone. Relating this phenomenon to issues of consumer appeal, choices and manufacturing detailing helps the students to appreciate the relevance of such discussion. In turn it is seen as worthwhile within the context of designing for commercial manufacture. The relationship between value laden exploration and inductive reasoning in the context of manufacturing becomes more of a core consideration, rather than the bolt-on.

The extent of the success or failure of such pedagogical development is not fully assessable using standard post activity evaluations of CPD nor special events such as the 'Design Day'.

The influence and impact will only be apparent through the adoption and implementation of such teaching and learning models within school programmes on a long-term basis. The trials to date indicate that there is an increased appreciation, by teachers and pupils, of the value of teaching technical commercial manufacture knowledge through a more integrated approach that requires exploration of the relationship between technical, emotional, aesthetic, economic and environmental values.

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