Exploiting popular culture: Exploring pedagogical and motivational approaches for Design and Technology Education

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Abstract

This paper describes a case study of pedagogical developments carried out with teachers and secondary school students in response to new curriculum content in Product Design courses presented in Scottish secondary schools. The pedagogy attempts to challenge the anti-commercial manufacturing attitude that prevails among teachers and students and is based on motivational principles. It makes explicit use of the language and tools of popular media culture, specifically ‘ask the audience’ interaction and investigative forensic science. An electronic voting system is incorporated as an introduction to detailed product evaluation and technical analysis collaborative activities. It examines the educational potential of such ICT systems to help students explore emotional response, product semantics and value judgements and make connections to commercial manufacturing detail design.

121 wordsKeywords: curriculum development; design pedagogy; emotional response; forensic science;motivation; product evaluation; popular culture; electronic response systems; value judgments.

Introduction

This paper describes a case study of ongoing pedagogical developments which attempt to address the challenges of the relatively new curriculum content of product design, specifically design for commercial manufacture, in Scottish secondary schools. These developments exploit concepts of subconscious personal responses and values of the 'consumer' and motivational principles. They make explicit use of the language and tools of popular media culture, specifically the current interest in 'ask the audience' interaction and investigative forensic science. The case study discussed includes professional development for teachers. This introduced a range of interactive group activities and approaches which were tested with secondary school students. In conclusion, the paper reflects on the underpinning theoretical basis of the development work and reviews the potential contribution to design and technology education.

Demands of curriculum change on teachers and learners

The focus of this paper is directly connected to the development of a new Technology Education secondary certificate course offered by the Scottish Qualification Authority (SQA), entitled Craft and Design (1999,a&b), revised to Product Design (2004,a&b). The new course requires a shift from the teaching and learning of traditional woodwork and metalwork which culminated in students producing individual, crafted projects in the workshops to students becoming more involved with the knowledge, processes and systems related to manufacturing production and commercial industrial design. This demands appropriate classroom approaches to cover the strategies, knowledge and understanding embedded in the unit topics of 'Product

Analysis' and 'Commercial Manufacture'.

Generally, curriculum guidance for Technology Education in Scotland promotes product evaluation, appraisal and critiquing of the outcomes and impacts of design activity. This guidance [e.g. 5-14 Environmental Studies Society, Science and Technology (LTS, 2000); Craft and Design (SQA,1999,a&b), Higher Product Design (SQA,2004,a&b)] suggests that students should look at what currently exists, what has existed in the past, and learn from the work of others and ones own design activity. Product evaluation as a learning activity can challenge students to debate tastes and preferences. Many have argued the importance of exploring values and value judgments in design and technology education (e.g. Allison, 1999; Keirl, 2000; Layton, 1994; Martin, 2002; McLaren, 1997, 1999, 2003; Riggs and Conway, 1992; SCCC,1996; Quin, 2003). Evaluation can stimulate further examination of influences and impacts of values and subjective decisions on other individuals, societies, economies, and the environment. Product evaluation also provides a platform for further analysis of functional and technical detail. Pedagogy is developing. The challenge is to create a learning environment where the potential of critiquing is fully realised. Through practice and experience, students should be able to develop the disposition and skills, in discourse and dialogue with others, to help clarify personal and collective thinking. Keirl (2004) acknowledges that there may be discomfort in such learning and he suggests that 'like risk-taking in creativity and designing, risk-taking in critiquing requires safety nets.'

Value judgements are implicit in the decisions we make as consumers and designers. Encouraging youngsters to make their thoughts explicit by articulating their opinions may initially seem straightforward. Youngsters know what they like and what they don't. Indeed, most will have engaged in some sort of shopping experience and have made some personal

choices. In an environment of relative comfort, they may be willing to express their thoughts and personal emotional responses to their closest peers. Even then, justifications and reasons for such judgements may be less forthcoming, due to various factors such as unwillingness to be thought of as having different opinions from their peers, feeling insecure in their own value-base or the lack of vocabulary for such expression. Ask them to indicate personal responses and make statements of taste in a large group of strangers and one can anticipate a further reduction of willingness to participate.

On scrutiny of national cohorts of students presented for Intermediate and Higher Craft and Design/Product Design (approximately 3250 candidates each year), the SQA Principal Assessor reported that students were having difficulty in providing extended answers, opinion and discussion based comments in response to product design related questions in the exam and in their design assignments. Questions on aesthetics were answered poorly; 'Little understanding was shown of how aspects of shape, colour, form, texture, balance and proportion would affect the desirability of a product.' (Principal Assessor, SQA, 2003:5). Support is needed to help students develop an appropriate vocabulary and be able to articulate their responses to such matters. A range of creative teaching and learning approaches are needed to encourage meaningful and progressive evaluation and critiquing in the design and technology curriculum.

The curriculum states that students have to identify, discuss and detail products in the context of manufacture, materials, processes, performance, aesthetics, and economic and environmental issues. The students have to develop an understanding of 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 technology teacher. The SQA Principal Assessor's reports indicate that students are able to answer exam questions requiring facts and direct knowledge of materials and manufacturing processes. However, a significantly large number of candidates are under performing when understanding needs to be applied to design situations. It is evident that the difficulties lie in helping the learner to make connections between design decisions related to manufacturing processes and materials, and other design factors such as aesthetics, semantics, function, cost, etc.

In addition, through some bad press, commercial manufacturing has developed a negative image (MORI/EMTA, 1998 & 2001). It is seen by many as being dirty, boring, dangerous, low paid and hard work (Manufacturing Foundation, 2003:11). However, this report notes that young people 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 Manufacturing Foundation survey indicated that, generally, the youngsters (and parents) rated working as a 'forensic scientist' as the most interesting, the most difficult, the best paid, required the longest training and offered the best career prospects. (Manufacturing Foundation, 2003: 22). One can only presume that this image is gleaned from television programmes and detective mystery novels which draw heavily on forensic science to collect clues, prepare evidence and solve the case. The current popularity of, and fascination with all things 'forensic' provided a potential hook on which to hang some ideas for developing interactive activities and 'joined up' teaching and learning approaches. The following case study explores these further.

Professional development and support for teachers

At the request of local authority education advisors and practicing technology education

teachers, a continuing professional development (CPD) course, 'Design for Commercial Manufacture', was designed specifically to support the presentation of the new curriculum content. 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 through product evaluation. The course aimed to challenge the existing practices and exemplify a pedagogy where teaching and learning approaches can potentially explore and exploit current perceptions, social and culturally inculcated values and emotional responses.

The CPD course designers were mindful of the negative image of manufacturing and the depersonalised and often 'formulaic' approach taken when evaluating a product (McLaren, 1997, 1999; Stables, 2001). An analogy of looking for clues, collecting evidence, assembling a 'back-story', and preparing an argument for presentation, as if to a court of law, was adopted. This led to tasks that required participants to explore their visceral and emotional response to a product, arriving at initial conclusions about, for example, who it would appeal to, who would buy it, how much would they pay for it, what it was used for, and how would it be used. Using this hypothesis and further investigation of clues provided by handling and disassembling the physical product itself, the participants determined materials and methods of manufacture. Each statement had to be supported by 'evidence' ascertained from the examination of the product. The main purpose was to develop a motivational pedagogy as described by McLean (2003). One that did not merely transmit facts but one that developed higher order thinking skills through responding to and exploring value judgments, observing, evaluating options, connecting cause and effect, sorting and analysing information, logical surmising, drawing conclusions and providing justification, i.e. inductive reasoning (Atherton, 2005). The evaluations received from teachers on completion of the CPD course (total 88, to date) indicate

an increased confidence and willingness to engage their students in an active enquiry method of learning about manufacturing. The experience of exploring personal, emotional reactions and story-making, and progressing to the technicalities of manufacture through a 'forensic' theme has been adopted positively by their students.

Pedagogy in practice

The designers of the CPD course trialled the interactive activities with secondary school students at the first of what subsequently has become an annual event. Each year, the 'Design Day' event brings together approximately 100 students undertaking SQA, Product Design courses. These students, aged 16-17 years old, are from all six secondary schools across one local education authority. The aim of the two and a half hour long workshop under discussion in this paper was specifically to develop greater understanding of the complex interplay of factors which influence the design decision making process required to bring a commercially manufactured product to the market place. The workshop was planned to stimulate an initial emotional response from the student 'audience' as consumers, and progress to the detail analysis of the technical and economic hypotheses of material and manufacturing processes. Underpinning the session was an implicit story of the way designers utilise and manipulate values, create 'needs' and desires to generate sales and profit. A range of motivational devices borrowed from popular culture and the media were incorporated to capture and sustain interest in the topic.

The students came to the workshops in large numbers; approximately 50 students attending the morning session and another 50 students attending the afternoon session. This meant that each student knew, at most only ten of their peers. In the first year of presentation of the workshop (2001), many of the students provided no overt response to introductory

‘emotional response’ questions. They did not participate readily in votes that required them to put their hands up to indicate personal preferences and opinions. The majority seemed to adopt the role of spectator, waiting to see how others reacted before making their own selection of response. Consequently, to address this, an electronic voting system or personal response system (PRS), using individual participant hand-sets, was incorporated to encourage greater interaction when the ‘Design Day’ was repeated in subsequent years (2002, 2003, 2004).

Transforming personal opinion into critical thinking

The following section illustrates the way in which the electronic voting system (PRS), which the students had not used previously in school, was incorporated into the learning activities in order to help develop personal opinion. The PRS was introduced through several ‘warm up’ tasks to familiarise the students with how to the use of the buttons on the handset, recognise their allocated number and colour as it was acknowledged by the transmitter and logged onto the screen. The data collected for each question was presented graphically to the whole group by a histogram, following a 30 seconds response time. Familiarisation continued with multiple choice questions presented on a screen as slides. For example, 96% of the student audience stated that they owned a mobile phone. 34% declared they bought the phone because it was the latest model. Additional commentary on this familiar product type served as the introduction to the topic for the workshop. An illustrated timeline story of the development of the telephone in terms of function(s), form and styling, together with advances in technological capabilities, materials and processes was presented. This was used to raise awareness of the complexity of influences and generators of change, including social, economic and political demands. This section of the workshop concluded with issues of market creation, competitive enterprise and other factors impacting on product development.

The students were then presented with a series of screen images which required them to respond, via their PRS handsets, to the questions posed. Some slides explored the aesthetics, some required 'reading' the product for meaning and some requested preferences. Other slides asked the students to relate the product to the perceived designer's intention based on style, form, material, detailing, function and/or anticipated target group (figure1). For example, the image of a Phillips/ Alessi coffee maker (1994) was selected because the researcher considered it unusual and provocative. The students were given no commentary or explanation about the image at all.

Who is it targeted at

1.old folks
2. students in shared flat 3.rich couple, no kids
1 business man
2 business woman
3 family home maker

Figure 1. 'prompt' slide exploring targets

Select the word that best describes the look of this product

1 friendly
2 comical
3 efficient
4 homely
5 modern
6 futuristic
7 scientific
8 state of the art

Figure 2. 'prompt' slide for 'Krups' kettle

Students were later asked to select a descriptive word for the image of a Krups kettle (figure 2). The PRS results indicated that the students 'read' the product, on image alone, as the designer had intended. Two-thirds of the cohort opted for 'modern', 'state of the art' or 'futuristic'. The

students were informed that kettle, from the late 1950s, was styled to give the impression it was 'state of the art' technology, 'Buck Rogers' comic book style, but in performance it was much the same as its market place competitors. (Woodham, 1997: 21)

Is it a

1 Coffee percolator/pot?
2 tea pot?
3 kettle?
4 thermos jug?

Figure 3. Prompt slide for 'ambiguity'

This reading of products was explored further with a product that was deliberately design to be ambiguous in form (figure 3. Hollington's, 1986, Jug-kettle). There was evidence, from the PRS data, that the styling of the product did indeed send out mixed messages regarding its primary function; although a significant majority recognised it as a kettle, 23% of the students thought it was a coffee pot, 25% a thermos jug, 17% a tea-pot. Following the display of these results, it was revealed to the students that this particular kettle design was created in the attempt to sell kettles in non-tea drinking countries, hence the coffee pot aesthetic. The students were asked to select a favourite from six images of kettles of various styles. The Alessi /Richard Sapper,1983, kettle was a clear favourite polling over 50% of the students overall. [The details regarding the issues arising from the poor ergonomics of the handle and the danger in the metal lever becoming too hot to handle to raise the lid were given later.] They were asked to use the PRS to date products. For example, with no additional detail provided verbally, an image of a chromium plated steel and bakelite kettle from the 1940s was shown for the students to date in terms of design and manufacture. Although results were spread, a significant majority of the students supposed that the product they were looking at was from more recent-times e.g. 72% believed it dated from 1960 onwards with as many as 27% dating

it from the 1990s.

As illustrated above, at specific times throughout the activity session, the presenters provided some additional information as feedback. This included some background about the designer's intentions, the client's specification, or constraints placed on the designer. As Frank Nuovo, chief designer at Nokia, says, '…..take a functional tool and turn it into an object of desire. After all, it's the emotional response from the consumer that makes them choose something. …….. You have to create the spirit of an object, and conjure 'want' out of 'need'.'(interview, Bennet, 2003) As plenary to this phase of the workshop, the importance that industry and design consultancies place on gauging the consumer's first impressions, evaluating and analysing existing products was conveyed to the students. Various research and evaluation methods designers employ

(e.g. user trips, video-ethnography, technical analysis/de-engineering) were described to help to gain some insights into manufacturing methods, costs, assembly performance, in order to identify shortcomings, successes and advantages of existing products. The activity was structured to motivate the students initially by the novelty of the PRS and progress by encouraging all participants not only to consider the questions and prompts posed but also respond. Thalheimer (2003) suggests that it is the action of cognitively processing such questions *and* answering them that constitutes active learning. The next phase of the learning developed following socio-constructivist principles.

Progressing from values and emotions to technicalities

On completion of the PRS section of the workshop, the students were introduced to the 'forensic autopsy' task. In small groups of 3 or 4, the students were asked to discuss their initial emotional responses to a physical product provided, and 'read' it. By applying the approach of the previous PRS experience, they were asked to piece together a context for the

product. The context could include the target market/ user; the function(s) [not always apparent]; an alternative product that does the same job; the retail cost; issues of need or desire; impact on society, lifestyle of individual and so on. This required the students to question, seek out clues and evidence, articulate personal opinions, think out loud and involve themselves in deductive reasoning and justifying. By way of development, the task for this smaller group work was structured around open-questions, provided on a task sheet. The groups could call on facilitators at any time.

figure 4. a cocktail strainer after autopsy figure 5. tools of forensic autopsy

Against this hypothetical ‘back-story’ they were to conduct a ‘product autopsy’ and investigate further detail (figures 4 & 5). They were to gather forensic evidence that justified their deductions regarding the materials and manufacturing processes involved in the commercial production of such product (McLaren & Juster, 2004). Central to the learning of this phase of the workshop was the inter-relationships between the technical choices and constraints of commercial manufacture and influences and impacts on aesthetics, costs, function and user perception. The groups tackled the task and engaged with the products from the outset, conducted ‘autopsies’ enthusiastically. Reference materials, codes and classification sheets were used appropriately and discussion was well focussed.

Discussion: Effectiveness of approaches in practice

The intention of incorporating the use of an electronic response system was to engage the large student group simultaneously and encourage greater inclusion, reduce peer pressure and illustrate the value of emotional response in design. The technology enabled a complex psychological aspect of design to be explored and made more explicit through a high level of interactivity. The students all engaged readily with their handsets and transmitted personal responses to each of the given scenarios and questions. Such electronic response systems are familiar to many from the popular media. The students see such systems used on television shows which involve the studio audience to vote or make a selection, e.g. 'Who wants to be a millionaire?' The workshop presenters explored the novelty aspect to create some fun and curiosity. However, caution was taken in order to maintain the integrity of the pedagogy. To sustain motivation, the presenters sought an appropriate balance of lecture (tell), dialogue (share), Q&A (query), and interaction (do). Students were asked to engage in mental processing throughout the session. The PRS demanded overt responses from the students from the outset and although each individual remained anonymous, every interaction was displayed publicly, as a histogram of 'voting' results. This provided immediate feedback which the students themselves could decipher and personalise. This also allowed each individual to place their own response in context of the group as a whole. The additional information provided by the presenters could develop or alter the initial reactions of the student, privately. The students were in a low threat climate due to the non-judgemental nature of the system which did not 'expose' the answer they had given. Instead the anonymous response allowed each student to use the questions posed as a prompt to explore personal thoughts rather than display competence. In this way the system reduced what motivational theorists call 'performance avoidance', where the student takes action to avoid appearing to be less able than others and withdraws their effort, places little value on the experience and gives up easily (Elliot,1999;

Urdan et al, 2002).

PRS systems are commonly used in a higher education setting of the lecture theatre of maths, physics and engineering to encourage student to student discussion when in large group settings (e.g. Draper & Brown, 2004; Boyle & Nicol (2003); Witt, 2003). The system allows tutors to allocate the same handset to the students each session and therefore track responses and data as it is collected. In the 'Design Day' trial discussed in this case study, such student tracking was not conducted. Only the students themselves knew the number of the handset they were using and therefore could check if their response had been successfully transmitted. The format of the workshop aimed to motivate, engender high confidence, set the scene for authentic learning and encourage exploration of vocabulary both emotive and technical in a low risk environment. Thus the PRS allowed a more comfortable, anonymous and private way to enable the students to explore initial 'emotional engagement' or 'emotional ergonomics' (Seymour, 2003; Norman, 2004) which are embedded in consumer products to create an innate desirability. There is increasing interest in the effectiveness of the systems for descriptive subjects and for a wide variety of uses and settings (Roschelle et al, 2004).

The PRS, as incorporated in this trial, required a speedy individual response. This is supported by Goleman (1996) who stated that '…in the first few milliseconds of our perceiving something, we not only unconsciously comprehend what it is, but decide whether we like it or not, the cognitive unconscious presents our awareness with not just the identity of what we see, but an opinion about it….' Initially, in the PRS activity, no justification of each personal response was necessary. It is often through interaction with others that an awareness of the range of opinion and responses other than one's own becomes apparent. However, the behaviour and language of others in the discussion can

influence opinion and exert an insidious influence. The PRS offered the potential to reduce this, and build personal confidence in advance of the small group discussion task which followed.

The illustrative products selected for the PRS activity introduced the way in which designers use product semantics and assign meaning, reflect culture or use consumer self image. The subsequent small group discussion task developed understanding of how the design decision making processes influence perception and response, how the role of story-making and story-telling, and how looking for clues, can be used to support propositions. The students were given opportunities to discuss and share ideas about the values they thought were embedded in the products they were examining. Indeed the content and dialogue in the group discussions suggests that the students were making connections and exploring relationship between aspects such as the market, added value, technical and aesthetic factors, and manufacturing constraints. In terms of SOLO taxonomy (Biggs & Collis, 1982), the observed evidence suggests the students were performing at 'relational' level i.e. they were making meaning and appreciating the relationships of the various components and aspects of the learning task and integrating them as a whole.

Additional details and issues were revealed to the students incrementally. These issues ranged from sustainability of the product under scrutiny, environmental impact, working/production conditions it was produced in, the retail cost versus production costs, the source of the raw materials required for manufacture, the specific target market, the year of design, the label/ brand of producer/ retail outlet, to the faults and failures of the product. The time available the workshop only allowed for a tentative approach to explore whether personal perceptions of artefacts change as more information is learned about it. Further research is planned in this area.

The pedagogy explored in this case study facilitated discussion and demonstrated the potential to engage students in some complex aspects of design education. However, there are several issues arising from the use of educational technologies such as the system described here. The novelty element of PRS has been the focus of several researchers (e.g. Draper & Brown, 2004; Boyle & Nicol, 2003). Results to date indicate, at university level, it can be sustainable with careful integration and authentic application. The question type used to engage the students using PRS has to be carefully devised and anticipated. It must be incorporated only where it enhances learning and increases interactivity. Increased attendance and participation has been noted. Student response has been positive (Draper & Brown, 2004; Roschelle et al, 2004; Judson & Sawada, 2002). Research literature also explores the way in which PRS contributes towards the creation of collaborative learning through dialogue and debate that is so central to the social constructivism concepts of cognitive science of learning. Judson & Sawada (2002) note that 'there is a shift away from the technology being a catalyst of students' achievement and attitudes towards an emphasis on effective pedagogical constructs that can be supported by electronic response.'(Judson & Sawada, 2002:173) In the case study discussed in this paper, the PRS served as only one aspect of the developmental experiences designed to prepare the students for a collaborative activity.

There is value in engaging and exploring visceral reaction as a way into design thinking and design for manufacture education. The combined tasks of the 'ask the audience' and a 'forensic autopsy' of the 'Design Day' workshop indicate a general willingness of students, supported initially by the PRS, to question products, question their own choices and develop literacy skills for product evaluation and analysis. Immediate emotional reactions to products, systems and environments offer a rich source of study which will enable students to acquire a higher level awareness of how aesthetics, styling, marketing, and semantics can influence value

judgements. This in turn can develop greater understanding of how 'want makers' operate and the role of the media in creating desire and markets by playing on emotion and values. The workshop presenters provided some scaffolding to help student make direct relationship between the phenomenon of emotional response to issues of consumer appeal, market segmentation, choices and manufacturing detailing. The subsequent group discussions and evaluations indicated that the majority of the participants appreciated the relevance of such discussion. The virtual nature of the presentation of the products did not allow for any engagement with the products at either 'behavioural level' or 'reflective level'. Norman, (2004) describes 'behavioural level' as requiring a higher level of analysis than the visceral level as it is where the brain not only analyses and responds to the object but it may alter behaviour as a consequence or call upon a well learned routine or perform a subconscious skill to use and interface with the object automatically. He describes the 'reflective level' as the highest level of engagement, where one contemplates ones accomplishment in using the object and interprets the pleasure or discomfort felt from the operation of the object. The subsequent small group 'forensic' task of product handling, clue seeking and deducing created the opportunities for both behavioural and reflective levels of engagement.

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. Black & Aitken (1996) noted that teachers who feel insecure in their own knowledge base may rely heavily on published resources or revert to limited teaching and learning strategies which inhibit connection with wider learning. Motivation is central to capturing interest and creating a willingness to participate in learning, for both teacher and student (Dweck,1986; Gagne,1985). There are particular challenges in teaching a 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 a school workshop.

Brochocka, Baynes and Smith (2001) argue, '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 the case study draws directly on popular culture and media tools in an attempt to counteract stereotypical prejudices that are all to common towards commercial manufacturing. It aims to contribute towards a repertoire of strategies appropriate for design education. The role the students were asked to adopt during the learning activity, that of a team of forensic 'scientists', required them to seek clues and validate any deductions in direct relationship to this evidence. This role demanded thinking and meaning making, demanded cooperation and, based on the students involved in the 'Design Day' to date (total n=400 over 4 years), generated the motivation necessary for an authentic learning activity to be undertaken with enthusiasm.

The language of the media and popular culture can be borrowed too. In this case study, the terms 'emotional ergonomics' and 'forensic autopsy' are used blatantly to conjure up associations beyond the classroom. They were used explicitly as titles for learning strategies that together developed a model of approach which demands complex and multi-faceted understanding. From the observed response of the students, it was evident that using the PRS helped to create a non-threatening environment and provided an element of useful, inclusive fun for the students. The novelty encouraged all the students to respond, thus so many more were more attentive and actively involved than was evident with a 'hands-up' voting system. The products, displayed on screen, were explored from a visceral, subjective stance which

demanded emotional 'reading' of images of product and externalising conclusions. The approach granted students 'permission' to have a private, personal, 'peer-pressure-free' response to a product. It illustrated how many different tastes and preferences, values, opinions and ideas a product can generate on visual impact alone. By relating the activities directly to issues such as consumer appeal, and to the value and meaning embedded in products the students indicated an increased appreciation of the relevance of manufacturing detailing design.

The approaches examined through this case study suggest that the language, digital and electronic tools borrowed from popular media and culture have educational potential. They offer opportunities to create effective and creative teaching and learning experiences which explore emotional responses, product semantics and value judgments, and progress to the technicalities of commercial manufacturing.

Word count 5016

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