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REMODELLING THE PRODUCT DESIGN CURRICULUM RELATIVE TO THE EVOLVING SKILLS PROFILES OF INCOMING STUDENTS

D. Rutter

ABSTRACT

This work forms part of an ongoing MA Consumer Product Design research study at the University of Central Lancashire. As such, this paper outlines work to be conducted and is presented for discussion of methodology.

Analysis of student records shows a marked change in the academic make-up of first year undergraduates and their aptitude across the curriculum. Students are demonstrating an increasingly diverse range of competencies and there has been a significant drop in the number of students enrolling from foundation courses. Does the curriculum still reflect the competencies students arrive with?

This paper presents an overview of the current curriculum and how it has been restructured in response to evolving student skills profiles. Analysis of the academic profiles of first year Product Design undergraduates will identify key developments in this profile for comparison. Finally, critical curriculum development opportunities are to be outlined and teaching materials designed, implemented and evaluated.

Keywords: curriculum development, product anatomy, skills profiles

1 INTRODUCTION

A preliminary investigation into Computer Aided Design (CAD) interfaces for higher education Design raised a more fundamental question: What CAD skills do students have upon arrival at university and how does this relate to the current curriculum? Before research could be conducted into potential CAD interface developments, it would first be necessary to establish the skill level intake and the skills required for the successful integration of graduates into professional practice.

Simultaneous to this research, Industrial and Product Design were restructuring to integrate into a single course (Product Design) and to update the syllabus. This process led to the creation of a replacement module for Design with Technology and Design with Materials: Product Anatomy. This module aims to develop understanding of technology and materials from a designers' perspective and directly integrate CAD solutions.

These course developments present an ideal opportunity to research and design teaching materials for this module, appropriate to an enhanced understanding of the student skills base.

2 BACKGROUND

2.1 Current course structure

The curriculum is structured according to the University's modular framework. Two courses, Product and Industrial Design, currently exist with a common first year and module variations thereafter.

Table 1. Industrial Design Curriculum

First Year	Second Year	Third Year
Industrial and Product Design Studies	Industrial and Product Design Studies	Major Project
Design with Technology	Design with Materials	Speculative Design Futures
Design with Materials	Commercial Applications	Dissertation
Presentation and Visualisation	Presentation and Visualisation	Presentation and Visualisation
Elective	Elective	

Table 2. Product Design Curriculum

First Year	Second Year	Third Year
Industrial and Product Design Studies	Industrial and Product Design Studies	Major Project
Design with Technology	Design with Materials	Design Detail
Design with Materials	Design with Technology	Design with Technology
Presentation and Visualisation	Collaborative Design	Design Management
Elective	Elective	

2.2 New course structure

The new course structure incorporates common department modules and replaces Design with Materials and Design with Technology with Product Anatomy. Industrial and Product design have been merged combining the strongest elements of each.

Table 2. Restructured Product Design Curriculum

First Year	Second Year	Third Year
Creative Thinking*	Design Studies	Major Project
Contextual Studies*	Contextual Studies*	Design Futures*
Product Anatomy	Product Anatomy	Design Futures 2
Presentation and Visualisation	Presentation and Visualisation	Presentation and Visualisation
Elective	Elective	Product Anatomy

(* indicates common department modules)

2.3 Introduction of Product Anatomy

To date, the Design with Technology and Design with Materials modules have been delivered by specialists in the relevant fields. Consequently, the content of these

modules has been driven from Engineering and Materials Science perspectives. Students seem decreasingly inclined to be creative with technology and materials. A 'guru culture' has evolved where guidance from the experts in these fields is seen as the only answer to design issues.
The course team would like to reverse this trend and conduct more inquisitive and exploratory activities with technology and materials. To facilitate this, the two modules have been combined to form Product Anatomy and control of the content of this module has been fully regained. It is now drivable from a design perspective.

3 OUTLINE METHODOLOGY

The research activity to be conducted will investigate, design, implement and evaluate the following:

1. Academic profiles of first year undergraduates
2. Module Aims and Learning Outcomes
3. Lesson plans
4. Exploratory studio activities with technology and materials

This research will focus on the first year module with extrapolation to the next two years dependent on its findings.

3.1 Academic profiles of first year undergraduates

This research activity is scheduled to take place between April and May 2004. The hypothesised outcome is that students are arriving with an increasingly expansive and detailed knowledge of technology, materials and associated scientific issues than was previously the case.
The extent of student knowledge in this area will be estimated through analysis of the National Curriculum syllabus. This will facilitate the development of more detailed teaching materials for Product Anatomy and ensure that they are aimed at the appropriate level.

3.2 Module Aims and Learning Outcomes

Module aims, learning outcomes and syllabus have been defined for the Year One module as:

3.2.1 Module Aims

- To introduce students to the concept of contained technologies and material selection.
- To place technological identification and material selection within the design process.
- To enable the identification of correct solutions in terms of appropriate technology and material properties and their impact on the manufacturing process.
- To develop technical skills relating to the creation of technical detail within appropriate CAD software.
- To support the design development of the student in other modules.

3.2.2 Learning Outcomes

1. Identify appropriate technologies for a given design requirement.
2. Demonstrate secondary issues associated with the placing and operation of contained technology.

3. Justify the selection of an appropriate material for a given design requirement.
4. Identify primary material processes and specify secondary forming processes to suit a required design.
5. Demonstrate an ability to describe technical details and solutions using appropriate CAD software.
6. Appreciate the advantages of using appropriate CAD software in the definition of technical solutions.

3.2.3 Syllabus Content

- What is technology?
- What causes materials to be different?
- Basic manufacturing processes for metals and plastics.
- How products go together and come apart.
- How technology shapes the products we use.
- Introduction to CAD.
- CAD as a design development tool.

3.3 Learning Styles

In 'Psychology and the Teacher', Child explains how:
"…no one learning theory provides us with all the answers. Furthermore, all the theories put together do not provide us with all the answers. The only course of action we can justifiably take is a pragmatic one, choosing from among the experimental findings the points of clear relevance to our task." [1]
Therefore, selection of teaching styles and methods is dependent on the task in hand. A move away from singularly 'talk and chalk' lecturing is desired and more interactivity required so students can "satisfy their desire to explore and manipulate their surroundings." [1] This dictates the inclusion of practical demonstrations of principles and opportunities for replication and adaptation in the teaching strategy.
The following template seeks to incorporate these issues and provide a framework for constructing lesson plans. It should be used as a guide and adapted accordingly under different circumstances.

- Introduce the topic for discussion orally
- Demonstrate a principle physically
- Facilitate replication of the principle by students
- Extrapolate findings and apply to different areas
- Review and evaluate what has been learned

Given that the syllabus is intended to be driven from the designers' perspective, it seems reasonable to adopt a simplified model of the creative process to inform the construction of lesson plans.
"Graham Wallass…recognized four stages in the creative cycle, namely preparation, incubation, inspiration (or illumination) and verification.
The forerunner of the preparatory stage is the ability to spot a problem. The existence of a problem often excites and obsesses the creative mind so much that it becomes restless and disturbed." [1]
Utilizing a combination of single and multiple timetabled sessions to cover different topics presents the opportunity for appropriate incubation periods between the preparatory and illumination stages.

It is proposed that a series of lectures titled 'An introduction to…' be designed, which effectively identify the relevant design problems for the students. The decision has been taken to restrict the content of these to products we see around us and utilise on a frequent basis as:
"optimum interest can be gained where information is unambiguous and the curriculum is designed to engage children [students] in pursuits that have everyday relevance." [1]
For the purposes of this module, this means mass produced consumer goods, probably electrical, mechanical or both, and which are generally produced using polymers and/or metals and the associated manufacturing techniques. Further exploration of materials and technology will be conducted when circumstances dictate and certainly at levels two and three.
It is expected that limiting study to everyday products at this stage will enhance clarity and motivation and minimize the amount of abstract material to be assimilated by the student. Clearly identified and communicated aims, outcomes and content will also assist in this regard.

3.4 Lesson Plans

3.4.1 Introduction to CAD

1. Introduction to CAD
    a. Historical development
    b. State of the Art overview
2. Demonstration of CAD usage
    a. Produce parts and tools in Solidworks
3. Replication of CAD usage
    a. Reproduce parts from drawings
4. Extrapolation of knowledge to consider alternative tasks and solutions
    a. Modify parts to incorporate customizations or improvements
5. Evaluation

3.4.2 Introduction to polymer moulding

1. Introduction to polymers and moulding techniques
    a. Polymers and their properties
    b. Fabrication techniques
    c. Parts and moulds – design for manufacture
    d. Case Study: Dyson vacuum cleaner
2. Demonstration of tool production and injection moulding
    a. Field trip
    b. Small scale demonstration models – desktop miller and injection moulding machine
3. Replication of polymer part production
    a. Students use desktop miller to produce a mould from CAD
    b. Students use injection moulding machine to create part from mould
4. Extrapolation of mould production and injection moulding
    a. Modification of mould in CAD
    b. Output mould using miller
    c. Use mould to produce a part
5. Evaluation of injection moulding

3.4.3 Introduction to metal fabrication

1. Introduction to metals and metal fabrication
2. Demonstration
    a. Field trip
    b. Stainless steel kettle – body, element and cable
3. Replication of stampings, extrusions, and castings
4. Extrapolation of forming processes
    a. Paperclip designs
5. Evaluation of the use of metals in everyday products

3.4.4 Introduction to electronics and mechanisms

1. Introduction to basic electronics and mechanisms
    a. Electricity
    b. Circuits and microprocessors
    c. Motors, pulleys, cams, and levers.
2. Demonstration of technology and materials employed in everyday products.
    a. Dyson
    b. CD player
3. Replication of utilizing simple technology to complete tasks
    a. Assemble components to complete a task – e.g. use Lego Technic to model the action of a CD player drawer mechanism.
4. Extrapolation of knowledge to consider alternative tasks and solutions
    a. Reconfigure components to perform a different task
    b. Try to reduce the number of components used
5. Evaluation of the uses of electronics and mechanisms

4 ASSIGNMENTS

4.1 Assignment One – CAD Utilisation in Product Design

- Report and presentation demonstrating:
    - An appreciation of the advantages of using appropriate CAD software in the definition of technical solutions.
    - An ability to use CAD to describe technical details and solutions.
    - An ability to output appropriate 3D models from CAD to aid communication of these issues.
    - Work from workshops to be used to discuss these issues.

4.2 Assignment Two – Materials and Technology Selection in Product Design

- Report and presentation showing evidence of:
    - Identification of appropriate technologies to complete one of the workshop tasks.
    - Knowledge of secondary issues associated with the placing and operation of this technology within a product.
    - Justification of the materials selected for the task.
    - Specified primary material processes and secondary forming processes to suit the design.

5 ACTION PLAN

The new course structure will be implemented in September 2004. Product Anatomy lectures will be delivered using the plans outlined in section 3.3 and be evaluated continuously.

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REFERENCES

[1] Child, D. (1981) *Psychology and the Teacher*. London: Holt, Rinehart and Winston.

Contact Information

Daniel Rutter
Department of Design
University of Central Lancashire
Preston, Lancashire
PR1 2HE
United Kingdom

Tel: +44 1772 490944
Mobile: 07732602818
E-mail: drutter@uclan.ac.uk