DESIGN METHODS TOOLBOX: SUPPORTING SELF-DIRECTED LEARNING THROUGH INNOVATIVE TEACHING AND LEARNING RESOURCES

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ABSTRACT:

This paper presents a resource developed as part of an innovative teaching and learning project aimed at developing, facilitating and supporting student-directed learning in the Product Design programme at AUT University, Auckland New Zealand. The paper outlines and discusses the background, development and implementation of the Design Methods Toolbox, an innovative Adobe Flash/PDF based teaching and learning resource. The Design Methods Toolbox provides students with a readily accessible resource containing a conceptual model of the design process, and design methods

that are core to the pedagogy of the Product Design studio programme. The resource becomes a 'gateway' for students to better understand and further explore the design process and associated design methods. Each method provides an introduction, a step by step rundown, best practice examples (including video), and links to other methods and related resources. The paper also outlines the evaluation process and the next steps for further development, enhancement and publication.

Key Words: Student-Directed Learning, Design Process and Design Methods

1. BACKGROUND

The AUT University Charter states that there needs to be a focus on developing students with "diverse learning skills and styles, through the blending of traditional and new learning and teaching technologies, including on-line learning" and help ensure "that our graduates are skilled in communication, problem-solving, critical analysis, are information literate, and can use the relevant technologies" (AUT, 2007, p. 7).

The taught component of papers at AUT has reduced significantly in the last number of years, through the reduction of semester length from 14 to 12 weeks and also the reduction of taught teaching hours (TTH) allocated to each paper, leading to a parallel increase in the allocation and focus on student-directed learning time. This has resulted in a number of growing pressures for both students and staff, including time constraints in the delivery of programme content, the teaching of concepts, skills and processes, and the ability of staff to provide academic counselling for individual students.

According to Fischer and Scharff (1998) "a lifelong learning perspective implies that schools and universities need to prepare learners to engage in self-directed learning processes because this is what they will have to do in their professional and private lives outsides of the classroom" (Fischer & Scharff, 1998, p. 2). Student (or self) directed learning can be broadly defined as a process where students begin to take responsibility for their own learning processes. Knowles (1975) formulated a often cited definition of student-directed learning: "a process in which individuals take the initiative in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes" (cited by Lunenberg & Korthagen, 2005, p. 4).

According to Taylor, (1986) the process of transition to a greater focus on student-directed learning can be problematic and needs to be managed carefully. "A study of learners weekly reports of experience in a course which promoted self-direction in their own course work revealed a considerable personal transition, something of a cultural Journey" (Taylor, 1986, p. 55).

In reaction to the increased need to focus on student-directed learning within AUT University, an opportunity was identified to develop a strategy to more clearly define individual study time and provide enhanced learning support processes that encourage students to drive and manage the student-directed component of the Product Design studio programme of study. In 2010 the AUT University, School of Art and Design received a grant from the Centre for Learning and Teaching (CFLaT) to develop, implement and evaluate a teaching and learning project with undergraduate Product Design students. The aim of the project was to support students to begin to develop, manage and drive their own programme of study through the use a number of strategies including electronic portfolios, and

innovative teaching and learning resources as part of a broader University-wide teaching and learning strategy promoting student-directed learning. The project was undertaken over the second semester of 2010, with 50 second and third year Product Design students. The development of the Design Methods Toolbox resource played a key part of this innovative teaching and learning strategy. The project was undertaken in 2010 with the majority of the development in the first semester and implementation and testing with students in the second semester. The project will be evaluated at the end of the second semester 2010.

2. PRODUCT DESIGN AT AUT

The three-year undergraduate Product Design programme at AUT University was developed in 2007 and launched with the first intake of students in 2008. In 2010 the programme will have 75 students across the three years as well as five students studying at postgraduate level. The programme is structured around design studio papers comprising half the programme with the additional support papers in areas such as technology, CAD and business.

While the development of a new academic programme provides many organisational and operational challenges, it also presented a unique opportunity to develop new approaches to teaching and learning without the constraints of institutional history and tradition. An innovative pedagogical approach to product design is currently being developed in the Product Design programme at AUT that expands the definition of a 'product' to become a range of outcomes i.e., 'the product of' a creative design process. The emphasis is on design thinking and design processes as outcomes, rather than necessarily on the tangible, physical 3D products. Another key emphasis is

the empowerment of students through student-directed learning including a focus on the utilisation of sound goal setting, planning, project management, design methods and reflective practices.

Product Design students work in an open studio environment where students are allocated a personal workspace for the year. Students are encouraged to spend as much time as possible in the studio environment and to work openly and collaboratively, mimicking a professional studio environment. Students work on a number of applied product design projects throughout each semester, usually of about six weeks of length from research through to resolution. Students are encouraged create many 3D prototypes and models in addition to drawing and other creative work. This creative environment can also be chaotic, messy and not necessarily conducive to a highly organized work spaces. The Blackboard Online Learning system is used to deliver extra content and teaching and learning material to support the physical studio environment.

3. DESIGN PROCESS MODEL

The pedagogy of the studio programme of study in Product Design at AUT University is underpinned by constructivist philosophy, a student-owned, student-centred approach to learning, and a structured approach to the teaching of design processes, as characterized by an 'idealized' but simplified, human-centred design process map/model (see fig 1). This model has been developed and adapted from number of recognized process models (Dubberly, 2004; IDEO, 2010; Visocky O'Grady & Visocky O'Grady, 2006). At the heart of the process is sound research leading to 'insight driven' outcomes, whether classic, 3D products or hybrid systems/service. Overall a period of time, programme staff have utilised and developed a

number of design methods to support this conceptual design process model. These are currently delivered to the students as part of the studio teaching programme through lectures and workshops.

Figure 1: Fundamental design process conceptual model.

Lawson (2007) notes that while conceptual design process models often "consist of a sequence of distinct and identifiable and identifiable activities which occur in some predictable and identifiably logical order" (Lawson, 2007, p. 33), the reality of this is questionable, and the design process is far more complex, context related, and is not logical or linear. The use of a conceptual model, and the breaking down of the design process into key steps however, provides a useful framework for the planning, undertaking and management of design projects. More importantly, a conceptual is an essential 'vehicle' for the teaching of and about design. In response to this number of variations and adoptions of conceptual model are presented to students to enhance this teaching and learning approach (for example see figs. 2 and 3).

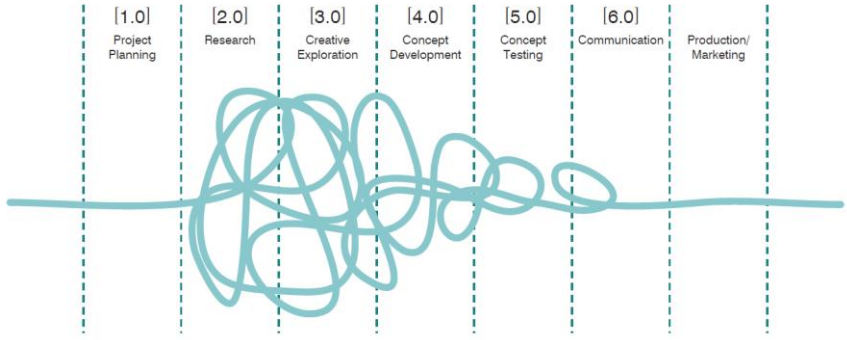

Figure 2: Variation on fundamental design process conceptual model.

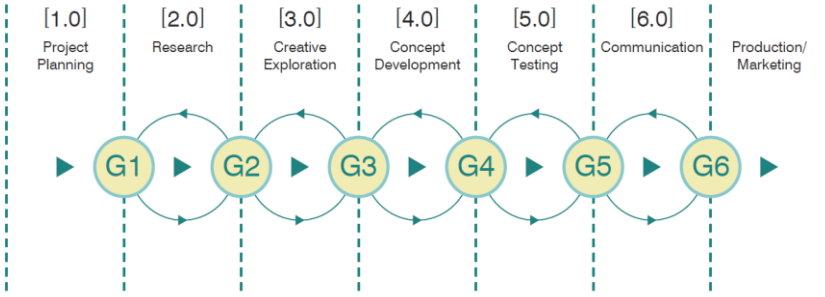

Figure 3: Variation on fundamental design process conceptual model.

4. DESIGN METHODS TOOLBOX

A multi-disciplinary team of staff members was established and a project brief developed to support the development of the Design Methods toolbox. In essence the Design Method toolbox project built upon and extended the work that was already undertaken to develop a sound pedagogy to support the Product Design programme teaching process.

To support the development, a literature review undertaken to identify, publications and websites focusing on design processes. Findings from the review indicated that while there are many design process resources available, there is a lack of a specific 'best practice' book or resource that is directly applicable to support the needs of undergraduate product or industrial design students. A number of good models and frameworks were identified during this process.

The project team also worked through a number of workshop sessions to review the current studio teaching approach, and to review design methods that could become core (but not necessarily replace other) methods in the programme pedagogy. A total of thirty-six key design methods were identified as part of the current six stage conceptual design process model (see figure 4). While there was some debate

over the actual number, and the selection of specific methods, it was agreed that this was an appropriate start for the project and would be reviewed and modified, based on the feedback from students and staff at the end of 2010. An overall, holistic plan was also developed to identify the appropriate semester/year in the studio programme when each method would be introduced to the students. Fig. 4 presents the final selection of design methods.

1.0 Project Planning	2.0 Research	3.0 Creativity & Exploration	4.0 Concept Development	5.0 Concept Testing	6.0 Communication
1.1 Design Process	2.1 Lit Review	3.2 Role Playing	4.1 3D Models	5.1 Task Analysis	6.1 Reports
1.2 Goal Setting	2.2 Survey	3.2 Mind Mapping	4.2 3D Prototypes	5.2 In Situ Placement	6.2 Story Boards
1.3 SWOT Analysis	2.3 Interviews	3.3 Brainstorming	4.3 Computer Aided Design (CAD)	5.3 CAD Simulation	6.3 Presentation Boards
1.4 Gantt Chats	2.4 Observation	3.4 Lotus Blossom	4.4 Design for the Environment (DFE)	5.4 Life Cycle Analysis (LCA)	6.4 Video
1.5 PESTLE	2.5 Trends Analysis	3.5 Six Thinking Hats	4.5 Rapid Prototyping	5.5 Product Costing	6.5 Animation
1.6 Project Brief	2.6 Personas	3.6 Concept Ideation	4.6 Matrix Selection	5.6 IP Protection	6.6 Reflective Journal

Figure 4: Selected design methods

The project team considered that it was important that the toolbox would have high design values and would be 'branded'. An overall 'look and feel' was developed including the development of a logo, selection of typeface and color system. After further review, discussion and experimentation it was agreed that each of the design method resources would consist of an individual PDF document (constructed in Adobe Indesign) for ease of construction, transferability and printing. The use of Indesign and PDF's also allows for continual updating and modification.

Once the branding had been completed a structure or template was developed for each method selection to provide consistency, ease of use and navigation. This was based a hierarchy of information and associated numbering system as follows:

1. Introduction and background to the method
2. Key steps in use the of the method
3. Examples based on 'best practices' by other students.
4. Variations – links to other related methods
5. References
6. Key links to more detailed resources and examples are provided for students independently further explore
7. Templates and/or other resources to aid in use.

A number of initial documents were created to test the layout and readability of the individual documents. Specific attention was given to the design of branding and diagrams, providing overall consistency and to aid in readability. Fig. 5 shows an example of a typical layout of a sheet including diagram, numbering system, and step by step instructions.

6. INTERFACE AND ONLINE INTEGRATION

The Blackboard Online Learning system is currently used as the primary gateway to electronic learning at AUT University and is extensively utalised by the students and staff of the Product Design programme. The careful integration of the Design Methods Toolbox into the current Blackboard structure and interface was identified as important including the placing of links in appropriate class pages (see fig. 6). Blackboard also offers an extensive content management system allowing for the storage, management and updating of documents.

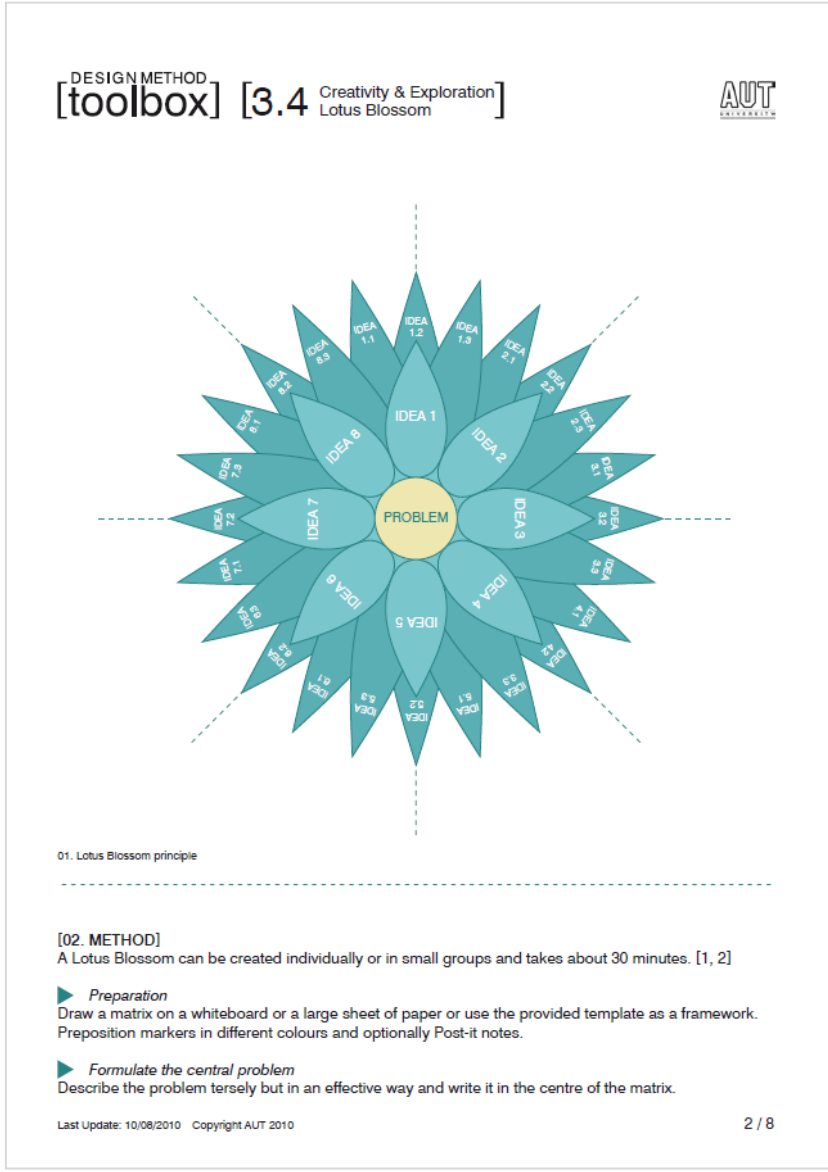

Figure 5: Example of typical page

Following from the development of the brand, structure and initial work, an interactive 'dial' type interface was developed using Adobe Flash. Access through the flash interface on Blackboard opens up individual design methods PDFs.

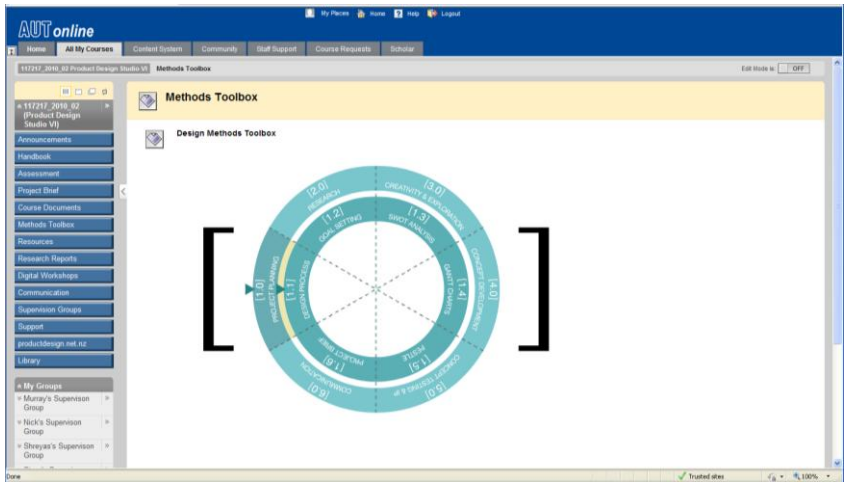

Figure 6: Design Methods Toolbox interface, showing integration with Blackboard.

7. INTEGRATION WITH TEACHING

Following the initial development work and a 2 month testing period for usability and appropriateness, a total of 24 prioritized individual design process methods PDF documents were developed and integrated into the Blackboard system for initial trialing.

Central to the successful use of the Design Methods Toolbox was the integration with the individual studio project briefing and teaching process. A process was developed to aid in this. When product design projects were developed for the second semester careful consideration was given to the selection of appropriate design methods to be used by students in the design project (see fig. 6.)

DESIGN METHOD
[toolbox]

Throughout this project you will need to access and utilise the following methods (highlighted) from the Design Methods Toolbox:

1.0 Project Planning	2.0 Research	3.0 Creativity & Exploration	4.0 Concept Development	5.0 Concept Testing	6.0 Communication
1.1 Design Process	2.1 Lit Review	3.2 Role Playing	4.1 3D Models	5.1 Task Analysis	6.1 Reports
1.2 Goal Setting	2.2 Survey	3.2 Mind Mapping	4.2 3D Prototypes	5.2 In Situ Placement	6.2 Story Boards
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1.6 Project Brief	2.6 Personas	3.6 Concept Ideation	4.6 Matrix Selection	5.6 IP Protection	6.6 Reflective Journal

Figure 6: Matrix used as a part of project briefing.

Firstly the method is introduced as part of the project introduction or as part of background lecture/class discussion. Diagrams, text, and images can be taken directly from the PDF's, which aids in development of lectures and lifts overall staff productivity. It also provides a more cohesive and constant structure to the teaching and learning delivery. Following this, the individual method is then further explained and discussed through a 'hands on' workshop the studio context.

8. DISCUSSION

To date the resource has been used by two design studio groups in the Product Design programme and integrated into a number of design projects. Informal feedback during the semester has indicated that there has been an enthusiastic response from students and in the short period of time that the resource has been available, student use has been good. Anecdotal feedback from students has indicated that the students have enjoyed the interactive nature of the interface and the quality of the documents. Feedback also indicates that

students have appreciated the effort that programme staff are putting in to core resources.

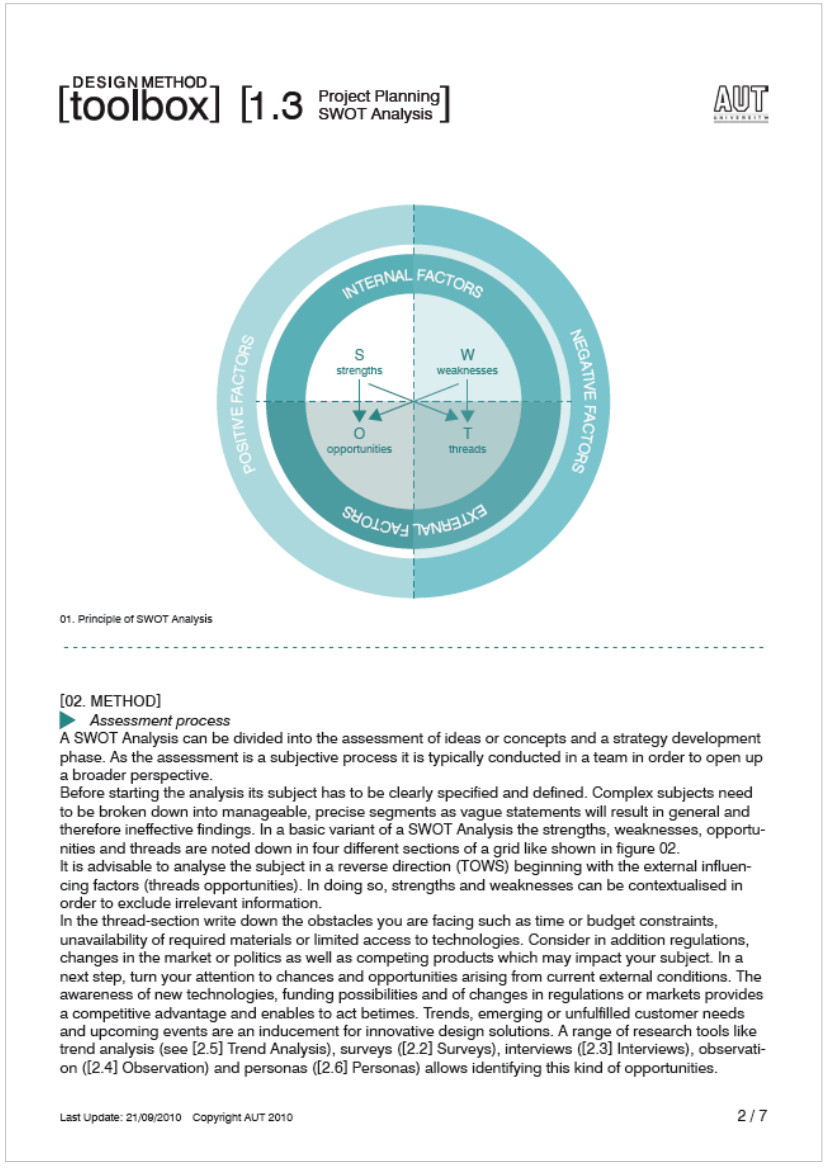
The development team has noted a number of issues arising from the development process. One of the challenges, given that this is a relatively new programme, has been the lack of examples of 'best practice' student work to populate across the individual methods documents. The development team has been careful to only use images of student work from AUT University. This allows long term ownership by the Product Design programme. Permission has been sought from students before publication online. The lack of work will be alleviated over the next couple of years as student groups move through the programme levels.

Given the 'living' nature of the resource, another issue has been the management of individual document files. A system has been instigated whereby all documents are carefully date/iteration numbered before uploading to the content management system. This system will be important as more staff become involved in future development.

The development team has also noted that given the relatively short period of development time, the need for careful evaluation from both staff and student perspectives is essential. This is important for not only for the overall approach, but also for individual design process documents in terms of content, examples and links. This evaluation/feedback loop will ensure ongoing relevance and currency.

9. EXAMPLES

The following is example pages from the Design Methods Toolbox.



DESIGN METHOD [toolbox] [1.3 Project Planning SWOT Analysis]

AUT UNIVERSITY

01. Principle of SWOT Analysis

[02. METHOD]

Assessment process

A SWOT Analysis can be divided into the assessment of ideas or concepts and a strategy development phase. As the assessment is a subjective process it is typically conducted in a team in order to open up a broader perspective.

Before starting the analysis its subject has to be clearly specified and defined. Complex subjects need to be broken down into manageable, precise segments as vague statements will result in general and therefore ineffective findings. In a basic variant of a SWOT Analysis the strengths, weaknesses, opportunities and threads are noted down in four different sections of a grid like shown in figure 02.

It is advisable to analyse the subject in a reverse direction (TOWS) beginning with the external influencing factors (threads opportunities). In doing so, strengths and weaknesses can be contextualised in order to exclude irrelevant information.

In the thread-section write down the obstacles you are facing such as time or budget constraints, unavailability of required materials or limited access to technologies. Consider in addition regulations, changes in the market or politics as well as competing products which may impact your subject. In a next step, turn your attention to chances and opportunities arising from current external conditions. The awareness of new technologies, funding possibilities and of changes in regulations or markets provides a competitive advantage and enables to act betimes. Trends, emerging or unfulfilled customer needs and upcoming events are an inducement for innovative design solutions. A range of research tools like trend analysis (see [2.5] Trend Analysis), surveys ([2.2] Surveys), interviews ([2.3] Interviews), observation ([2.4] Observation) and personas ([2.6] Personas) allows identifying this kind of opportunities.

Figure 7: Example sheet from SWOT Analysis document.

DESIGN METHOD
[toolbox] [4.2 Concept Development 3D Prototypes]

AUT

[03. EXAMPLES]

According to designer Konstantin Grcic " *…the modelling phase represents the first serious test for a design. All the models are built to full scale, so that they provide an opportunity to engage with the actual substance of the design. Physically working on the objects means that you have to make quick decisions. I love this process of creation, when the product first takes shape, because it's so open and constructive. At this stage of a project, we're not bothered about whether the model looks good or not. We're only trying to verify an idea.*" [4]

02. Simple cardboard Prototype of a bandage

03. Testing of a more advanced Prototype

04. Fully working Prototype

05. Students working on foam Prototypes

06. Range of handle Prototypes to explore ergonomic aspects

07. Final Prototype of a handle design

Figure 8: Example sheet from 3D Prototypes Models document

10. CONCLUSIONS

A reduction in semester length and a reduction in teaching contact hours, leading to an increase in the allocation and focus on student-directed learning time, have resulted in a number of growing pressures for both students and staff in many academic programmes. This includes time constraints in the delivery of programme content, the teaching of concepts, skills and processes, and the ability of staff to provide academic counseling for individual students. This paper has presented a response to these emergent issues through the development and implementation of an innovative project by the Product Design programme at AUT University that promotes independent, student-directed learning.

The Product Design programme at AUT focuses on design thinking and design processes as an outcome, rather than necessarily on the tangible, physical 3D products. The Design Methods Toolbox provides a number of sound strategies to support this pedagogy and has the potential to facilitate independent, student-directed learning. This is specifically centred on a structured approach to the teaching of design methods over the three years of study. The resource achieves this by providing:

1. A branded resource, with good aesthetic design values and usability to encourage access and use.

2. A over arching, conceptual model with a consistent framework to aid in the introduction and teaching of the design process over the three years of undergraduate study.

3. A limited number (36) of key design methods to give students focus and build core competence in the design process.

4. Individual design method documents with hierarchal information and simple, clear diagrams to build deeper understanding and confidence.

5. Step by step instructions in the use of the design method to facilitate independent work beyond the studio sessions.

6. Examples of best practice student work to inform, inspire and motivate.

7. Templates for further independent work.

8. A 'gateway' to further research of resources and access to other design methods.

In addition the resource provides:

1. Coherence and structure to the pedagogy for staff, both tenured and for part time, teaching across a range of papers and levels.

2. A 'guide' to help plan, write and project briefs.

3. Productivity gains in the preparation and delivery of the studio teaching content.

4. A mechanism for the collection and archiving of excellent student design process work.

5. A set of design method capabilities that students will take with them into their professional lives.

At the time of writing, the implementation of the initial phase of the project is drawing to a conclusion. A selection of students and staff who have been using the resources will be surveyed about their perceptions of the usefulness, and their overall satisfaction with the resource. In addition, specific questions

will focus on student understanding, buy-in, appropriateness of the format, and most importantly the role that the Design Methods Toolbox plays in facilitation the of student-directed learning.

The findings of this research will be used to further develop and refine the resource. It is anticipated that the toolbox may be rolled out to include other design programmes in the School of Art and Design. In addition there has been initial interest in publishing the resources as a book or web based resource for use by other institutions

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