Using the continuum of design modelling techniques to aid the development of CAD modelling skills in first year Industrial Design students

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Summary

Industrial Designers need to understand and command a number of modelling techniques to communicate their ideas to themselves and others. Verbal explanations, sketches, engineering drawing, CAD models and physical prototypes are the most used communication techniques. Students first encounter these techniques at school, typically as part of their Design and Technology education, where they tend to be delivered as part of a linear design process with project work progressing through the techniques one after the other. In addition, the range of modelling techniques presents a steep learning curve for the students at the beginning of their studies. Within each modelling technique, similar behaviours are used, such as describing: volumes, cross sections and proportions. At Loughborough Design School, the first year Design Practice 1 (DP1) module applies lessons learnt from design practice in industry (Storer, 2005) and teaches several modelling techniques in parallel. Its aims are to provide the students with an introduction to form analysis and creation through two design and build projects, with a focus on using modelling techniques as a continuum and not a linear process.

In order to assess the effectiveness of the approach, the authors inspected the drawing and modelling outcomes of all the students to identify how often the technique of key cross-section identification and creation had been used. It was found that the vast majority (> 90%) of the students had grasped the concept of key cross-sections and were able to identify these on images of existing products (see Figure 1). Again, virtually all of the students became very competent in iterating between 2D sketches and a 3D foam model, where they would derive the key sections from their model, re-sketch the shape they wanted and modify the foam accordingly (see Figure 2). When it came to 3D CAD modelling, only a small proportion of the students (less than 10%) took the opportunity of using this technique to support their manual activities. Those students who did use CAD showed a clear ability at “importing” their 2D sketches into CAD but not necessarily the ability to convert these into the same organic form created in their foam model.

There are numerous approaches to the teaching of sketching from freehand artistic through to prescriptive isometric. They typically give little consideration as to how the 2D sketch would offer an accelerated route to creating a 3D model. There are some exceptions to this, e.g. where the decomposition of the human body into 2D profiles as shown in the books of Andrew Loomis (Loomis, 1943), (Loomis, 1956). The inherent flexibility of sketching means that it is easier to modify the way it is taught rather than recreate on-line CAD tutorials or change engineering drawing standards. This is the route that was followed at LDS and the results achieved to date are promising, particularly in relation to 2D images and 3D physical models. However, when it comes to

CAD modelling, the ability to identify and even create key sections is not enough. As previously observed by Rynne et al (2010), placement of sketches must be done correctly and must be accompanied by adequate surface or solid modelling skills to achieve a complete model.

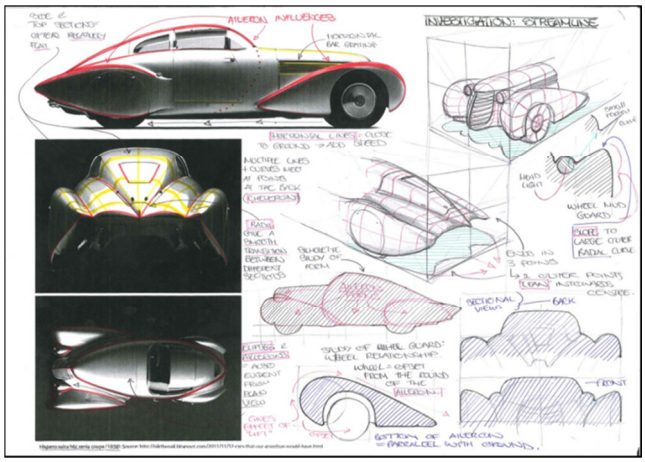

Figure 1: Example of student's identification of key cross-sections in an existing product

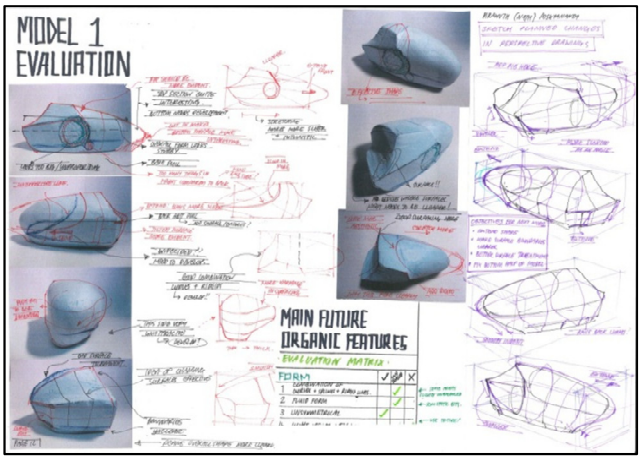

Figure 2: Example of student's iteration between sketches and foam model