Changing the emphasis of learning through making in Technology education

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Changing the emphasis of learning through making in Technology Education

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Planning the teaching of design process inevitably leads to the iterative process of design development broken down into finite steps during discussion, if not during an active design project itself. Design development is often focussed in the sketch development and rough modelling stage, with working drawings produced and final outcomes fixed before the student embarks on making a prototype. Making is valued in Technology studies as a medium for learning about the constraints and characteristics of different materials and processes, however, the additional benefits of learning through making in terms of its impact on design development can be overlooked. This paper considers the challenges and opportunities of expanding further the role of learning through making as a design development tool and broader implications of learning through making in Technology in schools.

1. Introduction

The success of social media, such as Facebook, Twitter and You Tube, has led to students and school pupils becoming increasingly immersed in online activities. As Web 2.0 (interactive online media) becomes the dominant paradigm for everyday interaction for this age group, interaction with people and objects in the real world has to compete with those that are web based and even forays into the real world tend now to be expressed through online sharing. With this immersion, there is a danger of a growing disconnect between this age group's abstract view of the world interpreted through the Internet and their experiences of the environment they physically interact with. There is a possibility that these embryonic adults could become increasingly divorced from the mechanisms of their physical environment.

This possible disconnect has implications for design. More broadly it has negative implications for the environment and social values. As the distance between the understandings of individuals of how objects become manifest increases, so the connection between the individual and the objects they interact with decreases. Invested design, defined in Sustainable by Design [Walker: 2006], illustrates that increasing the connection between the user and the object improves the lifecycle of the object as the user is more likely to maintain the object, increasing its lifespan and improving its embodied energy.

In addition to the lack of emotional investment in the objects around them, any disconnect also reduces the sense of responsibility of the user. Objects that are made in a distant place, in ways that are unimaginable, as part of a mass production system that is beyond the control or influence of the individual removes the sense of control of the user and therefore the sense of responsibility – both for it being brought into existence and for its fate at the end of life. A lack of understanding of how objects are fundamentally

constructed results in an inability to repair objects and also reduces the likelihood that they will be disassembled and the materials reclaimed. A lack of basic understanding results in the undermining of any confidence in the next generations to even attempt to deconstruct objects. This is added to by aesthetics in commercial design that tend to hide the workings of an object to increase its perceived sophistication.

2. Empowering the user

To support a change in thinking and reconnect individuals with the objects they use, there needs to be more consideration of empowering the user through improving their understanding of the working and production of objects. On its most basic level, improving the visibility of the mechanisms of products contributes positively to empowering the general public, with products such as the Dyson Vacuum cleaner, with its cyclone technology on show, illustrating the approach [Dyson: 2012].

On a broader scale, the increase of a distributed manufacturing approach that places manufacturing in regional areas, supports the relocalisation of manufacturing globally and a smaller, more responsive approach to production overall would improve the connect between the user and the product and affect decision making and the relationship between the user and the product on a cradle to cradle basis, as described by McDonough [McDonough, Braungart: 2002] in his book on the reuse and reclamation of materials at the end of life, over a cradle to grave default.

For this approach to build, individuals need to be empowered to interact on a more fundamental level with everyday objects, to develop their understanding of construction and deconstruction, material behaviours and characteristics. This is beginning to happen in societies through initiatives such as MIT's FabLab [MIT: 2012] with the internet ironically providing the communication tools to spread the ideas globally in a relatively short space of time. The basis for these initiatives is the empowerment of the individual in their relations to objects – using, maintaining, repairing, deconstructing and the reclaiming of materials. Hands-on deconstruction of electronic products, the building of component parts, the use of advanced technologies by non experts in customised design projects creates a new, grounded approach to understanding what goes into the production of everyday and complex user objects and the implications of their design and construction. If this continues, and the benefits of recent advances in additive manufacturing live up to their potential, the entire relationship of users to products, design and production, consumption and product service system thinking (where companies provide services using products over products, as discussed in Natural Capitalism [Hawkins, Lovins and Lovins: 2008]), could be reorganised in ways that reduce environmental impacts, improve quality of life for communities and empower the individual.

3. Learning through making

For a democratisation of design and production, emerging generations of users and decision makers need to be equally empowered. Their relationships to materials, processes, objects and their built environment need to be strengthened in the face of the disconnect of mass production and most recently Web 2.0. Technology education in schools provides an opportunity to enhance the connections between pupils and the

reality of the objects they interact with, rather than to add to that disconnect, and that requires a priority approach to the use of learning through making in schools that conflicts with what is happening in the training of teachers in higher education and the current use of workshop practice in schools.

3.1 Current practice in schools and the training of teachers in higher education

Learning through trial and error is a fundamental part of the design process and accepted as an invaluable tool in a designer's skill set. An axiom of IDEO, one of the world's leading design consultancies, is 'fail often, to succeed sooner' [Kelley, Littman, Peter: 2001], with studio modelling and workshop models a major part of that approach. James Dyson, for example, used studio modelling to create large numbers of prototypes in order to gain an understanding of how the cyclone principle could work for his design ideas. Even the Apollo program, one of mankind's biggest technical undertakings, made use of wooden models throughout to test and develop design ideas.

Learning through making has been part of formal design education since the beginning of the 20th century and has its roots in the training of craftspeople since the Guild system in the middle ages. In some specific disciplines, such as furniture design, making is still the mainstay of formal education and students and students are introduced to working with resistant materials alongside design process. In most design teaching, however, and particularly in the teaching of Technology in schools, the role of workshop tasks in design development processes tend currently to loosely reflect industrial models, where students are required to execute the making of design models in resistant materials, such as wood and metal, only in the latter stages of a project.

This separation of the two realms of design and workshop has its roots in traditional industrial models that have developed since the industrial revolution. Wedgewood, credited with being instrumental in the development of the designer as a professional [Sparke: 2009], was aiming to reduce the influence of the individual craftsman on the consistency of the output by breaking down the making process into repeatable, small steps and so deliberately distanced the designer from the maker. Workshop making has therefore been predominantly associated with the execution of a near completed design, as designed by a professional designer and made by a specialist prototype maker. In copying this approach, the workshop and classroom are regarded as completely separate realms where design development is undertaken in the designing stages of a project only and then students move into the workshop to execute the 'completed' design. This approach is inconsistent with a student centred learning approach [Biggs, Tang: 2007] to making where the student develops their understanding by connecting with the construction of the object, rather than by emulating a mass production approach which is itself losing traction in industrial practice.

3.2 Rethinking workshop practice in education

Design development in the classroom combined with studio making without direct engagement by students early in the process with actual workshop exploration can only go so far for the student towards predicting how materials will behave in reality and what the challenges of working with specific processes will actually bring. It is difficult to see how students unfamiliar with materials and processes for a particular design development can be expected to predict how these materials will perform in a finished design. In the

dominant school model where students complete their design work using studio modelling and sketching to a 'finished' concept, then take the working drawings into the workshop for construction, there is still acknowledgement of design development in the final stages of workshop making but in order to support experimentation and Dee Fink's definition of significant learning [Dee Fink: 2003], where the students' perspective is altered by the experience, the inclusion of making at the final stage of the student project comes too late in the process. Often a connection with making itself, prior to sketch development work, provides the inspiration for initiating ideas for groundbreaking designs and even on a more basic level, that connection influences creative thinking in the development of all practical design projects from their first imaginings to their development into design ideas. Students need to be introduced to a 'culture of making' as this introduction will provide them with a genuine knowledge of materials and their characteristics and as a consequence their use. Rote learning through making pre-existing designs deprives students of the vitally important discoveries that come about through experimenting with materials, and equally taking a 'finished' design into the workshop restricts the opportunities for constructive failures in design and a workshop approach to exploration that is currently missing in the overall curriculum. Human evolution has been directly related to an ability to learn through making, progress through trial and error, and the development of tools that change the human relationship to the environment. This should to be encouraged at this time of disconnect, not abstracted.

The design process is well understood and documented, for example by Popovic [Popovic: 2004], as a combination of problem solving and reflective practice. A vital part of this design process is having some progress to reflect upon and students and professional designers alike can be at a loss for inspiration, feeling they have to complete one process before moving onto the next. The role of the informed, contemporary professional designer is to pre-empt or foresee potential problems with individual designs, using a combination of experience and knowledge gained through experimentation. It is difficult to see how students unfamiliar with manufacturing processes and different materials can successfully design products that then contain these very materials. It is arguably these forays forward into the various aspects of a project that bring back invaluable new knowledge to further inform and therefore develop design activities.

In contrast to practices in the progressive model of a project's development, workshop activities should not be restricted to the latter stages of a project but rather should be introduced at the outset to expose students to a culture of making and experimentation. Instead of adhering to traditional models of industrial practice, learning through making should be a significant learning part of a much more holistic process with students being free to move between workshop and studio, with activities between these places to be much more integrated.

4. Challenges to an emphasis on workshop based learning through making

If learning through making is such a fundamental part of our development and progress a human being and is so intrinsically linked with an understanding of the surrounding world around, why are design educators in schools and higher education increasingly turning

away from it as a fundamental design tool? Reasons that need to be challenged by the educator include:

- The quality of the presentation of CAD & renderers to produce seemingly finished products undermining the perceived need for workshop construction.
- In an era of compensation culture having students working with potentially dangerous machinery presents increasing risk for educational institutions.
- Traditional making techniques are seen as outdated and no longer relevant by stakeholders.
- An overreliance in new design technologies creating perceived distance from manufacturing reality.
- Students' reluctance to enter an alien workshop environment to undertake such work.
- Preference of students to work in virtual environment over a practical one.

Workshops are increasingly seen as rigid, dangerous places with the growing number of restrictions surrounding their operation. Students need to spend time in the workshops in order to feel comfortable and at home in that environment, to create confidence so that learning through making becomes second nature. The aim should be that students should feel as at home in the workshop as they do in the classroom. In order to do this, students should be introduced to tools and materials as early as possible - preferably as early as possible in their education generally - so that this confidence and knowledge can be developed and reflected on by the students in informing decisions.

The challenge presented to design educators is how, in the light of these challenges, to re-integrate and encourage learning through making and shift the emphasis of assessment to reflect the importance of that learning through making and away from 'instant', visualisation based design resolution.

5. Using assessment as a tool for changing practice

Assessment needs to be managed so that the vital nature of learning through making can be brought to the fore as an inseparable part of the design process. To do this, the assessment model must move the emphasis from 'finished' objects and the idea of 'completely resolved' designs, towards a weighting that rewards learning through experimentation. Assessment tasks that promote engagement of materials outside their traditional uses would be an example of how to foster a culture of making and experimentation. The expectation that students can learn about how materials react when manipulated based on research theory is akin to teaching someone to learn to swim in a classroom. First-hand knowledge of the type gained through repeated exposure to materials and tools is vital for this type of knowledge to take root. Rather than reducing students time spent in the workshop we should be increasing it and promoting a 'culture of making' with students confident in their ability to make and design.

The highway code, published by the department of transport in the UK in the 1970s and early 1980s, contained a section in the back titled 'If No Car' and was a series of instructions on how the Learner driver could to teach themselves to learn how to drive if they did not have access to a car. Thankfully learner drivers no longer learn to drive this

way and this type of educational strategy has been discredited, but the example represents a poignant analogy for where design education could be heading as workshop practice is eroded rather than enhanced, taking the student experience ever further away from the reality of materials and their characteristics.

6. Conclusion

Teaching in higher education and in schools is currently dependent on a business model of practice. The reality is that workshops in either environment are expensive to run, litigation is a reality for both the institution and the individual educator, and alternative, virtual forms of the visualisation of products are seductively forgiving. With life lived through Web 2.0 as the dominant paradigm for younger generations, it is not surprising that the economic drivers of universities to move away from workshop practice, and the familiarity of the 3D CAD environment in contrast to the potentially dangerous environment of an unfamiliar workshop have aligned to move not only programs but student numbers away from practical based subjects towards virtual ones.

However, focusing on seductively forgiving 3D CAD models, not tested through reality and more fundamentally not informed in their development through workshop practice grounded in experimentation front and centre of their practice, will result in generations of adults who are divorced from the objects that surround and support them. Creating effective designers is not the only issue here. Creating connected users is the greater imperative. At a time when Technology in schools is threatened as a subject, it should really be expanded to be compulsory education for all pupils to ensure that successive generations are equipped to rediscover the benefits of connections to materials, processing and construction. The integration of workshop practice and learning through making into the fundamentals of designing is a vital part of this teaching.

REFERENCES

Biggs, J. Tang, C 2007 3rd edition. *Learner centered teaching* Berkshire: Open University Press.

Dee Fink, 2003 *Creating significant learning experiences* San Francisco: Jossey Bass.

Dyson http://www.dyson.com.au/vacuums/ accessed on 18.10.12

Fablab http://fab.cba.mit.edu/ accessed 18.10.12

Hawken, P. Lovins, A. & Lovins, L.H. 2008 2nd edition *Natural capitalism, the next industrial revolution* London: Earthscan.

Kelley, T, Littman, J. 2008 *The ten faces of innovation* London: Profile Books.

McDonough, W. Braungart, M. 2002 *Cradle to cradle* 2002 New York: North Point Press.

Popovic, V. 2004 Expertise development in product design-strategic and domain-specific knowledge connections *Design Studies* Vol. 25 Issue 5 527-545 Amsterdam: Elsevier

Sparke P. 2009 *The genius of design,* London: Quadrille Publishing.

Walker, S. 2006 *Sustainable by design* London: Earthscan.