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THE FUTURE OF INDUSTRIAL DESIGN HIGHER EDUCATION DRIVEN BY MODELS OF DESIGN THINKING AND REASONING

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ABSTRACT
This conceptual paper argues that the future of industrial design education is determined by the ability of design programs to consciously position themselves according to higher education trends. Whether a design program chooses to be part of a scholarly University, or practice-oriented higher education system, depends on the choice of design thinking models and related processes and methods to be taught, researched and practiced.
From a design thinking perspective, it can be argued that a positivistic approach towards problem solving is a typical trait of design programs, which have subjected themselves to a University system of research and education. These programs advocate problem solving and participative models of design thinking. Design programs, who are part of a practice-oriented higher education system, tend to support the reflective and hermeneutic design thinking approaches towards designing.
However, a common dedication of faculty members towards mentorship and scholarship being able to promote learning and inquiry from a theoretical, collaborative and process perspective is also important, irrelevant what strategy has been adopted.

Keywords: Design school, higher education, models of design thinking and reasoning

1 INTRODUCTION

The rapid pace of globalization changed the context of higher education quite dramatically. Being at the crossroad of tradition and new possibilities, higher education is challenged to adapt to emerging trends such as the increasing mobility of students and scholars, the movement of academic programs and institutions across borders, the extraordinary impact of technology, and above all massification
Hereby, future trends in higher education are centred on how educational, creative and explorative activities in design are to be adapted to the formal requirements of higher education and research.
Prevalent four global trends are:

- Provision of Mass-Education and Rationalisation
- Increased links between Education and Research
- Globalisation and Internationalisation
- Intensification of Collaboration with Industry

Being classified under professional practices and having its roots in the visual and plastic arts, it has been debated many times, whether Industrial Design should or should not be part of formal University education. However, since the introduction of a scientific approach in design at the Ulm School, designers have carved out responsibilities in new areas such as Management, Marketing, Ecology, Human Factors, etc. The traditional designer, perceived as a creative genius or stylist, has evolved into a team member, interpreter of complex systems, communicator and problem solver.
However, dependent on the choice of design educational strategies, faculty and students should decide whether to adopt a scholarly or practice attitude towards life-long learning and designing. Hereby, respective design programs should position themselves according to the type of design thinking models and processes to be associated with. This strategic positioning would automatically imply whether the design program should be incorporated in a University education or better suited to be part of a traditional design school curriculum.
The first section of this article describes the present and future context for industrial design education to adapt to trends in higher education. The second section maps out the various design models with

respect to worldviews, processes and methods. It also discusses how these models help in explicitly determining the direction positioning of different types of design schools

2 HOW INDUSTRIAL DESIGN EDUCATION SHOULD ADAPT TO FUTURE TRENDS IN HIGHER EDUCATION

In this paragraph future trends in higher education, which have been mentioned in the introduction, will be discusses more closely in conjunction with the following aspects:

- General Required Competencies of Industrial Designers
- Implications of Mass-education and Rationalisation on Design Education
- The Link between Design Education and Design Research
- Collaboration with Industry

2.1 General Required Competencies of Industrial Designers

Vinke defined a competency as 'the ability of an individual to select and use the knowledge, skills and attitudes that are necessary for effective behaviour in a specific professional, social or learning situation [1].'The ICSID (2003) suggests that a comprehensive ID education program should at least educate students in three categories of competency [2]: 1) generic attributes—problem solving, communication skills, adaptability to rapid changes, etc.; 2) specific industrial design skills and knowledge- design thinking and design process, design methodologies, visualization skills and knowledge, knowledge of product development processes, manufacturing, materials and processes, design management, environmental awareness, model making, etc.; 3) knowledge integration—strategies of system integration. It is also claimed that (product) designers not only need the individual cognitive skills and overall skill displayed in execution of design process, but also require other skills, such as negotiation with clients [3]. As a result, higher level of generative design roles is emerging because the nature of design profession tends to integration, which enables it to play a critical and active role in the product development [4].

Especially in the high tech industry, increasingly complex technologies and demanding awareness of consumers, requires devotion to design research in order to understand user needs and introduce more user-friendly products or systems. Additionally a new designer in the 21st century will need to fulfil the roles of intelligent maker, knowledge worker, sustainable entrepreneur, and active citizen concerned with issues of environment, society, commerce, network communication, etc. [5].

With respect to the education and training of future industrial designers, the objective is not only to improve the faculty's classroom, but also to advance the practice beyond it. According to Hutchings and Shulman [6], excellent mentorship requires a kind of 'going meta' in which faculty frames and systematically investigates questions related to student learning and practice. Such questions comprises of: the conditions under which it occurs, what it looks like, how to do it, how to deepen it, and so forth.

2.2 Implications of Mass-education and Rationalisation on Design Education

Over recent years, higher education (HE) in the United Kingdom has developed towards a mass educational model of provision [7]. From 1995 to 2003, HE in the UK experienced a 39% growth in the number of students on full time and part time courses [8]. In conjunction, for many subject areas this has followed changes in the Student Staff Ratio. Design and Creative Arts, for example, had a Student Staff Ratio of 1:14.7 in 1994/1995, which increased to 1:20.3 by 2003/2004 for programmes taught at an undergraduate level.

Although the context for HE has changed considerably in comparison to a decade ago. Approaches such as project-based enquiry continue to serve as a distinct and valued feature for design education. Established upon the tradition of an Atelier model of learning [9], design education still aspires to values and pedagogies, which emphasise the need for low Student Staff Ratios, one-to-one tutorials, small group critiques, and significant quantities of individual formative feedback and guidance [10]. However, to continue as an "elitist" type of study may not be sustainable for every design institute. Only a privileged few will be able to survive as a stand-alone educational entity, immune from University intrusions. Financially, the majority of design programs may need to seek refuge under the umbrella of University higher education, being steered to revise their values and pedagogies to cater for the needs of mass- and universal education.

2.3 The Link between Design Education and Design Research

The role of industrial design in the product development process has changed and extended. Besides emphasising the training of knowledge and skills, personalities of caring and daring should be developed among design students of the 21st century. They should be motivated to solve real problems for human beings in innovative ways [11].

As design educators are not able to predict the possibilities of technology, it is necessary for design students to emphasize on inquiry-based learning in order to adapt to changes. Therefore, ID education today should not simply emphasize form giving, drawing and model making, but should place more value on the design process and conscious problem solving [12]. On one hand, due to the rapid development of technology, 50% of the skills that students are learning in schools today will be out-of-date when they are employed [13]. As Swanson claims, 'the design students of today will be the inventors of the design field of tomorrow' [14]. On the other hand, approximately 70% of the competencies of industrial designers are acquired through the on-the-job experience [15]. Given these industrial circumstances, the goal of educating design students in universities is then to cultivate their abilities in problem solving, lifelong learning and reflective thinking so they will be better able to adapt to future changes and challenges [13].

Research in the field of design is to be carried out for design, through design and into design. This means that not only scholarly research leads to new knowledge, but also products and artefacts by themselves should be considered a form of knowledge [16]. Unfortunately, there is no consensus in the literature on the definition and scope of design research. Should design research follow the model of traditional academic disciplines, or should it seek a new model, based on the intimate connection among theory, practice, and production, which is the hallmark of design [17]?

2.4 Collaboration with Industry

Currently both companies and research communities call for collaborative work practices and user-centred approaches in various design fields. There are several challenges and issues to be taken into consideration. For instance there is a need to find ways of collaborating across various competences, interests, responsibilities and perhaps professional languages both within one organization, between several organizations and between the organizations and a group of (potential) users [18]. Globalisation issues, privatisation and market-like behaviour in the public sector have led to major changes for Higher Education policy-making and practice 19]. In addition, a service attitude has shifted knowledge production to cross-disciplinary, application driven, non-linear and transient collaboration, expanding the number of research or knowledge actors [20]. Therefore, a science-based design education, where problem-solving process linked to effective methods for design development is needed if design faculties want to engage in industrial collaboration [12]. This statement is supported by Beuckers, emphasising that research and development collaboration with industry is the key factor for methodological exercise in design studies [21].

To summarise this paragraph, design education will need to address more aggressive methods for integration as the world becomes more interdisciplinary and our students more diverse. Connecting subjects, people and disciplines is not only timely in relation to professional trends, but also necessary if design hopes to find itself closer to the centre of the university education model. Hereby, it is essential that students are adequately prepared for a world in which collaboration, negotiation, and compromise are valuable skills [22].

3 MODELS OF DESIGN REASONING, PROCESSES AND METHODS

In this paragraph six models of "Design" reasoning will be described and mapped against underlying design approaches, as well as possible processes and methods, as shown a in figure 1.

The selection of these six models was based upon their relevance for design practice [23]. The models of "Design" reasoning are:

- ***Problem-solving Model***. This model represents a systematic and deterministic approach to the design process inspired by engineering, the natural sciences, and the rise of the computer sciences in the mid-1900s. Hereby, the design process is partitioned into smaller sub-processes or sub-problems, which then can be solved through problem-solving methods [24].

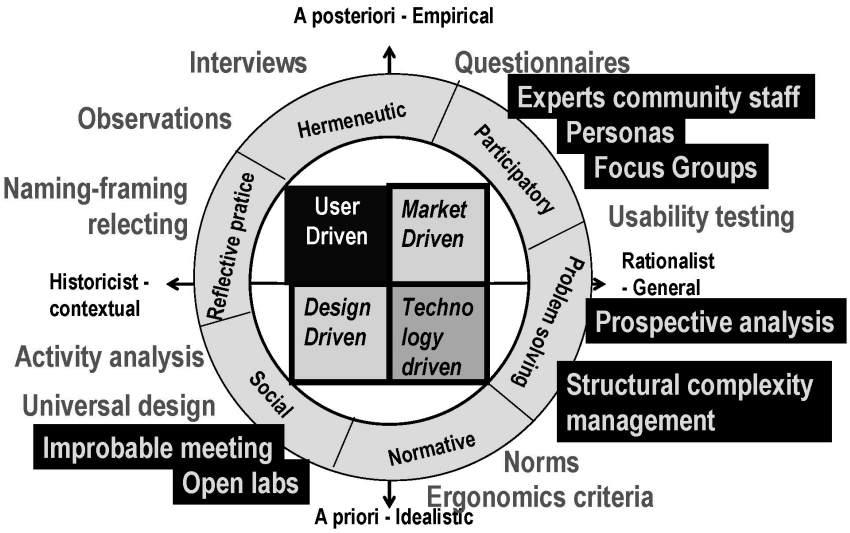

Figure 1. Models of Design Reasoning within the Context of Design Approaches, Processes and Methods

- ***Hermeneutic Model.*** This model of design has been proposed on several occasions in design theory [25, 26]. The central challenge of design work is to gain an understanding of the designed product; its contexts, its values, and its functions. The hermeneutic model implicitly posits the designer's personal experience of the design process as a central element, as well as provides a focus on how designers should think about their projects.
- ***Reflective Practice Model.*** The constructionist reflection-in-action theory is perceived as a reaction to the rational problem-solving philosophy [13]. As design problems are unique and difficult to generalise, it focuses on the designers' or developers' actions and efforts, with respect to reflective and conjectural conversations with the situation to reinterpret and improve the problem as a whole. Methods applied by the designer are to be based on acquired knowledge, experience and reasoning.
- ***Participatory Model***. Designers act as facilitators to mend the gap between their own perception and understanding of "Design" problems and those of stakeholders. In this cooperative or participatory design activity of interpretation, information gathering and facilitation, users make critical decisions in the design process [27]. Sanders and Stappers [28] provided an historical overview of participatory design and co-design, as they underline a transition from a user-centred approach, towards a user that actively participates in the design process
- ***Social Model.*** As design activities are enabled by the social community in which they are situated, a growing conscience of the designers´ role in the society marked the beginning of a social model of the design process [29]. Hereby, professional reasoning is not a personal competency, but based on the collective wisdom of a community of practitioners, where the scope was more than to promote social and economical sustainability.
- ***Normative Model.*** In this prescriptive model, "Design" solutions are fitted to certain standards, values and conventions in accordance to their role and responsibility. The normative framework can be understood as guidelines that should be followed in order to satisfy certain criteria.

4 DISCUSSION

The creation of awareness concerning the value of "Models for Design Reasoning" among educators is important to determine the position and direction of design schools and programs.

Within the context "required competencies", Industrial Design education is not just about how to service the current needs of the manufacturing sector but to educate for understanding, an ever changing context of knowledge and skills, and through this to educate and prepare graduates for a changing world environment". This emergent approach towards the formation of design education programs calls for a more participatory and reflective practice approach towards design thinking. However, from an engineering perspective, such an emergent approach may be perceived as contradictory to a more positivist and structured way of problem solving and research.

The link between design education and research is often debated from various perspectives on research-based teaching and learning. A major tension field in the debate is whether research-based teaching should be supported by a structured problem-solving framework or advocated through models of scholarship and mentorship [30]. In the latter case, a joint mindset receptive of new ideas and readiness to invest time and effort to continually reflect on practices needs to be encouraged among faculty, practitioners and students. An emphasis should then be placed upon the study of design processes, methods, behaviours referenced to social, economic and cultural contexts

This scholarship and mentorship approach is usually situated within a context of project-based learning, where hermeneutic and reflective models are fundamental in facilitating a more customized knowledge and skills transfer in small-groups. However, this type of small-group teaching and learning is gradually becoming more difficult because of massification trends in education. Therefore, many design schools worldwide have opted to move towards a University based design education system, which is characterized by a strong design research emphasis. Such a system usually promotes a more structured problem solving approach towards design.

When readdressing knowledge dissemination, acquisition and practice, these models for design reasoning, processes and methods set the stage for collaboration, based on intentional network of pre-selected stakeholders, as well as their level of involvement and intensity. This network of stakeholders, which may comprise of educators, professional designers, collaborating companies, suppliers, etc., challenges design students to be mentally prepared to commute from generic to specialist as well as, from abstract to concrete modes of working and vice versa. Comprehensive and structured studio projects should be implemented as platforms, where social and interdisciplinary learning practices can develop in line with selected design, themes, processes and methods.

5 CONCLUSION

To address the future challenges of higher education, design school should determine which educational and profiling strategy to adopt. Whether profiling is pursued through excellence in research or practice, two issues are important to establish:

The choice of design reasoning model, which determine which explicit processes and methods are to be evangelized. From a design thinking perspective, it can be argued that a positivistic approach towards problem solving is a typical trait of design programs, which have subjected themselves to a University system of research and education. These programs advocate problem solving and participative models of design thinking. Design programs, who are part of a practice-oriented higher education system, tend to support the reflective and hermeneutic design thinking approaches towards designing.

Irrelevant of what strategy to adopt, a common dedication of faculty members towards mentorship and scholarship being able to promote learning and inquiry from a theoretical, collaborative and process perspective. Hereby, a master *(professional designer or faculty)* and apprentice *(student)* relationship is crucial, whereby desirable qualities of the former have been identified as follows: knowledge, enthusiasm, a genuine respectful interest, approachability and friendliness, patience, an ability to challenge and good communication skills [31]. Considering the needs of the apprentice, mentoring as a source of learning has become particularly relevant given the boundary-less nature of careers today, such as industrial design.

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