ADAPTING INDUSTRIAL DESIGN EDUCATION TO FUTURE CHALLENGES OF HIGHER EDUCATION

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ABSTRACT

This paper discusses how Design Education should be adapted to the future challenges of higher education. Four (4) trends will be presented on how prospective design programs are to be developed. These are (1) Mass-Education and Rationalisation, (2) Links between Education and Research, (3) Globalisation and Internationalisation, (4) Intensification of Collaboration with Industry and Commercialisation of Research. In terms of manpower resources, the following academic configuration is proposed:

- Faculty inclined towards mentorship and scholarship, able to promote inquiry from a theoretical and process perspective.
- Faculty engaged in mentorship and service, capable of expanding their design programs beyond the “Physical home-based classroom”.
- Professional designers, who can contribute in skills development and design thinking based on experiences from practice.

On the receiving end, students should be trained to commute from generic to specialist and from abstract to concrete modes of working. Comprehensive studio projects should be implemented as platforms, where social and interdisciplinary learning can develop in line with selected design themes, processes and methods.

Keywords: Design Education, Higher Education and Research, Trends, Globalisation

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 [1]. Trow identified three basic stages of higher education development worldwide; elite, mass, and universal access. He argued that most nations, at varying times, will move toward mass or universal participation in post-secondary education [2]. Entry rates in higher education in the OECD member countries were only about 10% around 1960; at the end of the 20th century, however, entry rates in tertiary education eventually reached about 45% and graduation rates were on the level of 25% on average [3]. The "logic" of massification is inevitable, and includes an overall lowering of academic standards, greater social mobility for a growing segment of the population, new patterns of funding higher education, increasingly diversified higher education systems in most countries, and other tendencies [4]

In various countries, enrolment in higher education has reached such a high level that formulations such as “The Forgotten Half” were employed recently in addressing the employment and social situation of persons without tertiary education degrees. There are indications that in some countries – e.g. Norway, Finland and the United States – preparation for all occupations “above” manual skilled labour is on the way to be provided by higher education and that an enrolment rate of about 70% of the corresponding age group is accepted as appropriate [5]

Internationalisation became a key issue in debates on higher education in most European countries during the 1990s, and it is likely to remain high on the agenda in the near future [6]. In terms of design, the universally preferred face-to-face nature of the classroom still exists but the one to one relationship with the student is no longer always possible. This has meant that traditional design education, which assumed trust and was based upon the apprentice-master model, had to change and education became more explicit and formal. [7] Given this overall trend, educational design

institutions are challenged to choose between the paths of University higher education or remain a traditional, practice-driven design school. Both directions carry consequences in terms of type student intake, funding, academic activities of faculty, etc. Ongoing discussions have revealed that choices are difficult to make and dependent upon employment prospects and ambitions of the respective design institutions.
This article discusses how Industrial Design education should adapt its teaching and research strategies to the ambitious and professionally conflicting requirements from higher University education.

2 FUTURE TRENDS IN HIGHER EDUCATION

Written from an academic rather than a managerial perspective, the choice of topics for discussing future trends in higher education is centred on how educational, creative and explorative activities in design are to be adapted to the formal requirements of University research and education.
The following global trends, which will be addressed, are:

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

2.1 Mass-Education and Rationalisation

Diversification in the process of expansion in higher education has been a key policy issue since the 1950s when growth of enrolment rates challenged the dominance of teaching and research-oriented universities [8]. In the past few decades, it has fundamentally transformed the higher education system worldwide. Differentiated academic systems have emerged, with various institutions serving quite different purposes and roles within each country. Participation in post-compulsory education has expanded exponentially throughout the world during the last several decades. Globally, the percentage of the age cohort enrolled in tertiary education has grown from 19 percent in 2000 to 26 percent in 2007. [1]. Hereby, it was suggested that higher education was likely to diversify in the process of expansion of higher education in order to protect the traditional functions of “elite higher education” amidst “mass higher education” and subsequently also those of “mass higher education” when “universal higher education” was realised [9].

2.2 Links between Research and Education

According to the core values of the classical European University model, education should be built upon the outcomes of research [10]. This “Humboldt” model is also strongly supported by British, American, and Australian universities [11]. The strong integrationist view holds that to be a good university teacher one must be active in research. In other words, scholars who are energetically occupied in creating or reinterpreting the knowledge of their subjects will be competent lecturers: teaching based solely on the research of other people is dull and fails to inspire students. The Robbins Report, for instance, asserted simply that 'There is no borderline between teaching and research; they are complementary and overlapping activities [12]. The principle of providing a research environment for all academic staff to complement teaching programs is regarded as fundamental to academic excellence'.
However, strong opinions against the existence of an affinity between teaching and research in higher education have been expressed for many years [13]. Recently, the generally accepted 'integrationist' view has come under a more sustained attack. According to the Leverhulme Report, where the individual academic is concerned, there is no causal relation, no essential congruence: doing research does not make someone's teaching better. It is merely a 'marriage of convenience' [14]. Proponents of this position also point to the fact that excellent research does take place, in the absence of undergraduate teaching, in research institutions throughout the world; and that first-rate teaching does occur in higher education institutions in which most of the staff pursue little in the way of research at all - as is still the case in many polytechnics and colleges.
The world of higher education is increasingly dominated by economic imperatives. Where teaching and research complement each other, a sharp utilitarian flavour has been acquired, driven by demands for increased selectivity of funding in order to increase the rate of return to the investment in higher education [15]. Even in Norway, where institutions of higher education are very well state supported,

research and teaching have grown to be more separate. On one hand, Universities will be allocated state funding based on number of students passing exams; while on the other hand, research is mainly funded by research councils [10].
From a personal ambition and career's perspective, the following quote is commonly shared among researchers and educators, who are employed at institutions of higher education, which has been subjected to a performance –based management system, driven by internationalisation and business.

> *Your job includes two primary tasks. Task one will earn you an increased salary, will secure your professional mobility, will enhance the reputation of your employer, will result in invitations to attend interesting conferences nationally and internationally, and can be done on a flexi-time basis and at home. Task Two is unlikely to enhance your salary, save your tenure decision, or increase your professional mobility significantly and may, if pursued with too much enthusiasm, undermine these [16].*

However, discussions on the scholarship of professional practices are re-emerging. Teaching activities of the scholarly educator are essential to the success and growth of an academic environment and require appropriate academic recognition. According to Boyer [17], the following four ingredients of scholarship within an academic scholarly environment are:

- Discovery: the search for new knowledge and definition of what remains to be discovered.
- Integration: the interpretation of the meaning of knowledge and fact and interconnecting knowledge into concepts and structures.
- Application: the utilisation of knowledge in solving actual problems or altering and evolving knowledge to resolve a problem.
- Teaching: the knowledge transformation to build understanding and flexibility, so that ideas are transformed into usable concepts.

2.3 Globalisation and Internationalisation

Universities have been international institutions from their medieval European origins, attracting students and faculty from many countries. The rise of nationalism and the nation-state after the Protestant Reformation focused academe inward. Later, the emergence of the Third World from colonialism in the mid-20th century stimulated the establishment of national universities. In the past, these national universities have not generally been perceived as highly competitive: over the last half-century, the huge state-funded growth of higher education has damped down any need for competition. In most cases, institutions' capacity to compete was limited in practical terms, even if they might have wished to extend their territory [18].
Recently, changing demands in the workplace, because of globalisation and technological advancement, have triggered Universities to compete again, but differently. As postgraduate studies and continuing professional development will develop further, with increasing numbers of students registering for part-time studies linked to career progression, opportunities for distance learning and the establishment of branch campuses have emerged [19]. In this context, higher education reforms, initiated in the 1990's, have managed to regain their international scope and direction.
The new phenomenon of European integration has challenged higher education studies to integrate the international dimension into frameworks that tend to concentrate on the single nation state and domestic policies even where international comparisons were made [20]. The challenges of internationalisation or globalisation in higher education are hereby two fold:

- They confront developing countries at a time of major national transformation and re-structuring [21]. These countries are searching for means to support the further expansion and "nationalisation" of their higher education system, to redefine its role and situation in the regional context, and to struggle with the impact of global forces confronting it.
- They also provide opportunities for higher education institutions in industrialised countries to be more market oriented in an integrated world economy, in terms of knowledge transfer and manpower development, IT, increased mobility for students, faculty, programs, and providers.

Besides the commercial advantage motivations for internationalization include brand building, knowledge and language acquisition, enhancing the curriculum with international content, and many others. Specific initiatives such as branch campuses, cross-border collaborative arrangements, programs for international students, establishing English-medium programs and degrees, and others have been put into place as part of internationalization [22].

2.4 Intensification of Collaboration with Industry and Commercialisation of Research

Ongoing globalization has made national and regional governments even more aware of their competitiveness, increasingly relying on universities to become an anchor in their national and regional innovation systems. This has resulted in a University-Industry engagement, which is broader than the initial focus on intellectual-property (IP) licensing or start-ups. The key policy question no longer consists of a narrow issue on how to make universities work better with industry but a broader one on what they can perform in innovation and economic development [3].

Today different types of universities have varying functions, based on their capabilities and industrial contexts [23]. Research-intensive universities differ from teaching-focused institutions and today regions and nations see inputs from both types as important. Universities in developing countries are quite different from universities in industrialized contexts.

Besides this, universities are no longer expected to work in isolation; rather, they are perceived to be interactive players who work closely not only with industry but with community and government. They are an integral part of the national or regional innovation systems and a critical component of the evolving triple helix in which universities, government, and industry change their roles through interaction [24].

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

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. According to Roth, the traditional view of the designer as creative genius or stylist is evolving to a perception of the designer as team member, interpreter of complex systems, communicator and problem solver [25]. In line with a survey conducted by NTNU Industrial Design graduates, project management, communication and product development have been included as core activities of a designer to be stressed upon [26].

3.1 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 [27].’The ICSID (2003) suggests that a comprehensive ID education program should at least educate students in three categories of competency [28]: 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 [29]. 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 [30]. However, some large companies have divided the ID function into specialization based on different design tasks in the product development process [31].

Particularly 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. [32].

To summarise, “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.” [7].

3.2 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 [33]. From 1995 to 2003, HE in the UK experienced a 39% growth in

the number of students on full time and part time courses [34]. 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 [35], 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 [36]. 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.

3.3 The Link between Design Education and Design Research

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 [37].

As design educators are not able to predict the possibilities of technology, it is necessary to emphasize the design process based on the inquiry approach and continuous learning of new knowledge and skills for design students in order for them to adapt to these changes. In particular, there should be greater emphasis on the process, regarding products as media instead of a final purpose. The role of industrial design in the product development process has changed and extended. Therefore, ID education today should not simply emphasize form giving, drawing and model making, but should place more value on the design process of inquiry based and conscious problem solving [38]. 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 [39]. As Swanson claims, 'the design students of today will be the inventors of the design field of tomorrow' [40]. On the other hand, approximately 70% of the competencies of industrial designers are acquired through the on-the-job experience [41]. 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 [39].

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 [42]. However, 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 [43]?

According to Cross, Design Research can be classified into three main categories [44]:

- The study of designer behaviour, including theoretical deliberation and reflection on the nature of design ability.
- The study of the processes of design, and the development and application of techniques, which aid the designer
- The Study of the form and configuration of artefacts, which is recently complemented with studies on the design of services and systems.

As design education is emphasising processes and new media, and research-based learning is being advocated through models of scholarship and mentorship [62], an emphasis should be placed upon the study of design processes, methods, behaviours referenced to social, economic and cultural contexts.

3.4 Implications of Globalisation and Internationalisation on Design Education

Globalisation of higher education, including the emergence of courses that exploit the power of web-based delivery, had an immediate, initial impact at postgraduate level. The evolution of the computer made it possible to extend the designer's mental as well as physical capabilities [45].

For example in Norway, web casting and "pull" technologies are extensively used in higher education, particularly distance education [46]. Although more research should be conducted on the use of ICT in

teaching to improve the satisfaction and motivation rate among students [47], experiences from The Open University revealed that technologies are now ubiquitous in offering particular opportunities to assist students with their learning and design processes. The implementation of ICT delivery tools and mechanisms, such as Jing and Open Design Studio (ODS) will enable flexible peer support and allow groups to form with loose and tenuous connections. At a time when there is increasing pressure on resources and physical studio space in face-to-face settings, these opportunities can positively shape future design education if supported by the design education community [48].
From a franchise academic perspective, design programs have been offered in developing countries, particularly in India and East Asia where the demand for mass higher education and formal qualifications is high.

3.5 Collaboration with Industry and Commercialisation of Design and Design Research

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 [49]. Globalisation issues, privatisation and market-like behaviour in the public sector have led to major changes for Higher Education policy-making and practice [50]. 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 [51].
From a design pedagogical perspective, the challenge is to shape an effective inquiry-driven process of designing that yields effective outcomes. 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 [38]. This statement is supported by Beuckers, emphasising that research and development collaboration with industry is the key factor for methodological exercise in design studies [52]. Complementary to the above, the Department of General Engineering at the University of Illinois at Urbana-Champaign described a long-running senior design team project. The program provides students with experience in solving a real-world, industrial design problem, working as part of an engineering design team, and communicating their work in written and oral form [53].
As the world becomes more interdisciplinary and our students more diverse, design education will need to address more aggressive methods for integration. 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 [54]. In this context, “Social Learning”, is to be extrapolated as a social activity, complementary to interdisciplinary teamwork in design projects and research, affecting different social groups and stakeholders [55]. Social learning theory focuses on the learning that occurs within a social context. It considers that people learn from one another, including such concepts as observational learning, imitation, and modelling [56]. According to Wenger, learning is defined as an inter-play between social competence and personal experience. It is a dynamic, two-way relationship between people and the social learning systems in which they participate [57]. To be more specific for Industrial Design, social learning is to be embodied through project-based learning and master/apprentice relationships This can for example be realised through Systems Thinking, Vertical Learning and Teamwork based upon Communities-of-Practice, and Legitimate Peripheral Participation (LPP) [58].
At this juncture, where design is attempting to gain a stronger foothold in research and at the same time still dependent on financial support from industry, design departments should convince University management to adapt their “project” and “research” contracts to facilitate industrial collaboration. However, with the hope of being blessed with more relaxed rules towards Universities having to “own“ intellectual property rights, lower overhead and man hour rates, design departments should also be more sensitive towards “competition” issues with the design profession [59].

4 DISCUSSION

European systems of higher education are moving toward American models. The Bologna agreements manifest this. The commitment to a fixed-term first degree, the transferability of credits, and common

criteria for access are only the most visible of the tendencies toward convergence on American models. European systems move in that direction not because the United States is rich and a superpower, or because of the power of American popular culture. It is because American higher education as a system is simply better adapted, normatively and structurally, to the requirements of a "post-industrial" age, which puts a great premium on the creation and wide distribution of knowledge and skills. It is marked by such rapid social and technological change that decision makers in all countries saw the necessity for broader access to post-secondary education [2].

The rising relevance of research in professional graduate education and interdisciplinary fields is serving as a catalyst for enhanced engagement between research and teaching functions in new and different areas. Looking from outside the design domain, Slagstad claims that since the end of the 19th century, existing professions have experience academic drift [60]. The search for a higher status by branding themselves as scientific has resulted into a quasi-scientific treatment of theory, when modelled on a positivist conception of natural science. This is most likely with Industrial Design, causing detrimental effects to the identity of the individual profession.

As it now stands, different views of how Industrial design should be positioned within the arena of higher learning are not expected to come to a consensus. Presently three types of design schools can be broadly identified. Types 1 are the Art and Design schools or 'Kunsthochschule' in German. These schools are not affiliated to any University, usually offering a wide variety of Art and Design Courses. Type 2 design schools are partly independent. They are affiliated to a University, but have managed to convince top university management to operate and to be administered according to different criteria. Examples of such design schools are: Umeå Institute of Design (Sweden), Academy of Arts & Design, Tsinghua University (China), Nanyang Technological University, School of Art Design and Media (Singapore). The third type of design schools is fully immersed in a University system. They follow the University's rules and regulations concerning teaching and research. The education supporting this research is scientifically oriented. Examples of Design Universities are for example the Norwegian University of Science and Technology (NTNU), Delft University of Technology (TUDelft), National University of Singapore (NUS) and Technical University Eindhoven (Netherlands).

Referenced to this third type of design schools, there is still an ongoing debate whether designers should be educated as generalists or specialists. Two design programs demonstrate different educational approaches. The School of Design at Carnegie Mellon University in the U.S. is one example of the generalist-oriented programs, whereas the ID department at the Technical University Eindhoven (TU/e) in the Netherlands is a prototype for the specialist-oriented model. By multiple general curricula and the interdisciplinary collaboration with the departments of engineering, management, and social science on campus, the former may educate design students to have a higher level of generative design expertise [61]. The latter is based on the educational goals of 'competency-based learning' and 'student as a junior employee'. It enables students to learn within a simulated professional environment by executing specific design projects and intensive contacts with the industry [27].

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 in Universities. Design programs should choose to position themselves to be elitist, mass or universal oriented in their educational approach. Hereby, clear objectives are to be defined for undergraduate and postgraduate design education with respect to massification trends in higher education.

In line with Sigurjonsson´s and Holgersen´s thoughts [26], practicing designers should be more involved in tutoring if "designing" should remain the core subject of the educational curriculum and if time and opportunities for research are to be created for tenure-track and tenured faculty. A suggestion is to pair up faculty and practicing designers in the course management, teaching and tutoring. Project management, processes and methods are to be inculcated by faculty, whereas skills, philosophies and experiences from practice are to be communicated by the practicing design tutor.

If properly managed and executed, the move to direct faculty to become specialist in certain areas of design through research would encourage an atmosphere of mentorship and scholarship. This will expose students to a research-based learning environment, focussing on the study of behaviours, cultures, processes and methods. Hopefully, students will then be more conscious in selecting preferred worldviews to support their designing activities.

In collaborative design projects and research with various stakeholders, students should be exposed to "social learning", which is complementary to interdisciplinary teamwork. This would then positively

encourage mentorship and scholarship, leading to an engaged way of learning and working that nurtures a shared commitment and motivation for the ethic of inquiry and intellectual rigour, to the excitement of speculation, creativity and discovery. To be more specific for Industrial Design, social learning is to be embodied through project-based learning and master/apprentice relationships.

5 CONCLUSION

The adaptation of Industrial Design education in the "Corporate World" of higher learning and Research should be taken seriously. Students should be mentally prepared to commute from generic to specialist as well as, from abstract to concrete modes of working and vice versa. Comprehensive and complex studio projects should be implemented as platforms, where social and interdisciplinary learning practices can develop in line with selected design, themes, processes and methods.

From a design education resource perspective, it is recommended to establish a team with the following roles and qualities:

- Faculty inclined towards mentorship and scholarship [62], able to promote learning and inquiry from a theoretical, collaborative and process perspective.
- Faculty engaged with mentorship, management, dissemination and promotion of their design programs beyond the "Physical home-based classroom", by capitalising on media technologies for distance education as well as by exploiting market opportunities in developing countries through the initiation of franchise design programs.
- Professional designers, who can contribute in skills development and share design experiences from practice, supported by design thinking

REFERENCES

[1] Altbach, P.G., Reisberg, L., Rumbley, L.E., Trends in Global Higher Education: Tracking an Academic Revolution. A Report Prepared for the UNESCO 2009 World Conference on Higher Education Published with support from SIDA/SAREC

[2] Trow, M. Reflections on the transition from elite to mass to universal access: Forms and phases of higher education in modern societies since WWII. J.J.F. Forest and P.G. Altbach (eds.), International Handbook of Higher Education, The Netherlands, Springer. 2006. pp. 243-280.

[3] Organisation for Economic Co-operation and Development (OECD), 2007., The Assessment of Higher Education Learning Outcomes. Higher Education and Regions: Globally Competitive, Locally Engaged. Paris.

[4] Altbach P.G. The logic of mass higher education. P.G.Altbach (ed.), Tradition and Transition: The International Imperative in Higher Education, Netherlands, Sense Publishers. 3-22. 2007

[5] Teichler, U. The Future of Higher Education and the Future of Higher Education Research, Tertiary Education and Management Vol. 9, No 3, pp.171-185, (2003) Kluwer Acad. Publishers.

[6] Scott, P. Massification, Internationalisation and Globalisation. In P. Scott (ed.), The Globalization of Higher Education. (1998) Buckingham: SRHE & Open University Press.

[7] Stephen Trathen, S. and Varadarajan, S. Taking on Australian Industrial Design Education: Current Practice and Future. Proceedings of the International Conference on Engineering and Product Design Education, 2009, University of Brighton, UK

[8] Teichler, U. Diversity of Higher Education. International Encyclopedia of Education 3rd ed., pp. 347-353 (2010)

[9] Trow, M. Problems in the Transition from Elite to Mass Higher Education. In OECD (ed.), Policies for Higher Education. Paris: OECD, pp. 51–101. (1974).

[10] Kjeldstadli, K. (2010). Akademisk kapitalisme. Forlaget Res Publica. 1.utgave, 2. oppslag

[11] Williams, R. J. P. 'Science in universities: teaching, research and autonomy', Studies in Higher Education 16, pp. 15-22. (1991).

[12] Robbins, L. Report of the Committee on Higher Education. Cmnd 2154. (1963) London: HMSO.

[13] Feldman, K. A. 'Research productivity and scholarly accomplishment of college teachers as related to their instructional effectiveness: a review and exploration', Research in Higher Education 26, pp 227-297. (1987).

[14] Williams, G. and Blackstone, T. Response to Adversity. Guildford: SRHE (Leverhulme Report Vol. 10). (1983).

[15] Ramsden, P. And Moses, I. Associations between research and teaching in Australian higher Education. Higher Education 23: 273-295, 1992. Kluwer Academic Publishers. Netherlands.

[16] Andre, R. and Frost, P.J. Researchers Hooked on Teaching: Noted Scholars Discuss the Synergies of Teaching and Research, Thousand Oaks, Sage. (1997).
[17] Boyer, E. Scholarship Reconsidered: Priorities of the Professorate. Princeton, New Jersey. The Carnegie Foundation for the Advancement of Teaching. (1990).
[18] Dill, D.D. and Sporn, B. 'The Implications of a Post-industrial Environment', in Dill, D.D. and Sporn, B. (eds.), Emerging Patterns of Social Demand and University Reform: Through a Glass Darkly. Oxford: Pergamon Press. (1995).
[19] Jeffries, K. K. Diagnosing the creativity of designers: Individual feedback within mass higher education. Design Studies, 10(5), 485–497. (2007).
[20] Enders, J. Higher education, internationalisation, and the nation-state: Recent developments and challenges to governance theory Higher Education 47: 361–382, 2004. Kluwer Academic Publishers. The Netherlands.
[21] Moja, T. and Cloete, N. 'Vanishing borders and new boundaries', in Muller, J., Cloete, N. and Badat, S. (eds.), Challenges of Globalisation. South African Debates with Manuel Castells. Cape Town: Maskew Miller Longman, pp. 244–270. (2001).
[22] Altbach, P.G. and Knight, J. The Internationalization of Higher Education: Motivations and Realities. Journal of Studies in International Education (2007) vol. 11 no. 3-4 pp. 290-305
[23] Hatakenaka, S. "The Role of Higher Education in High Tech Industry Development: What Can International Experience Tell Us?" Proceedings of the 2008 Annual Bank Conference on Development Economics, South Africa. (2008).
[24] Etzkowitz, H., and Leytesdorff, L. Universities in the Global Economy: A Triple Helix of academic-industry-government relation. London: Croom Helm, 1997.
[25] Roth, S The State of Design Research. Design Issues 15(2), 18 – 26) (1999).
[26] Sigurjonsson, J.B. and Holgersen, T.D. What do they do? A survey of employment and work situation for "IDE" candidates. Proceedings of the International Conference on Engineering and Product Design Education 2010, Norwegian University of Science and Technology, Norway
[27] Vinke, D. Industrial design at TU/e: the student as a junior employee, Interim report (2002), retrieved September 15, 2003: www.industrialdesign.tue.nl/education/downloadableFiles/theStudentAsAJuniorEmployee.doc
[28] International Council of Societies of Industrial Design (ICSID), retrieved January 22, 2003: http://www.icsid.org/
[29] Lewis, W.P. and Bonollo, E. An analysis of professional skills in design: implications for education and research, Design Studies 23 (2002), pp. 385–406
[30] Sethia, N. K. Generating and exploiting interdisciplinary knowledge in design product development and innovation in the new economy The 2001 IDSA National Education Conference (CD ROM). (2001)
[31] Yang, M-Y, You, M. and Chen, F-C. Competencies and qualifications for industrial design jobs: implications for design practice, education and student career guidance. Design Studies Volume 26, No. 2, 2005, pp 155-189
[32] Press, M. and Cooper, R. The design experience: the role of design and designers in the twenty-first century, Ashgate Publishing, UK (2003).
[33] Taylor, J. Changes in teaching and learning in the period to 2005: the case of postgraduate higher education in the UK, J. of Higher Education Policy and Management. Vol 24 (2002), pp. 53–73.
[34] UUK, Higher education in facts and figures, Universities UK, London (2004).
[35] Design Council, Creative & Cultural Skills, 2006, Creative & Cultural Skills, Design a new design industry: design skills consultation
[36] Swann, C. Nellie is dead Art, Design & Communication in Higher Ed. Vol. 1 (2002), pp. 50–53.
[37] Ratner, E. Design because you care, design because you dare: compassion and courage in the industrial designer The 1998 IDSA National Education Conference (CD ROM). (1998)
[38] Friedman, K. Design education in the university: Professional studies for the knowledge economy. Re-inventing design education in the university. Proceedings of the Perth Conference. School of Design, Curtin University of Technology: Western Australia (2001). pp.14-28
[39] Schön, D.A. Educating the reflective practitioner, Jossey-Bass Publishers, London, UK (1988).
[40] Swanson, G. Is design important? International Design Education Conference Reinventing design education in the university. (2000)
[41] Lin, H. L. An identification and validation of competencies for industrial designers in Taiwan

Proceeding of 10th National Technological and Vocational Education Conference category of industry VI pp 259–270. (1995)
[42] Frayling, C. Research in Art and Design. Research Papers: Vol. 2. London, UK: Royal College of Art. (1993)
[43] Buchanan, R. (1996) Book review: "Elements of Design" in Design Issues 12:1, 74-75.
[44] Cross, N 'Design Research: A Disciplined Conversation. Design Issues, Vol. 15, No. 2, Design Research, pp. 5-10 (1999)
[45] Owen, C. Design education and research for the 21st century, Design Studies 11 (1990) (4), pp. 202–206.
[46] Bingen, H.M. and Aasbrenn, M. Fleksibel undervisning. UNIPED, 32 (2), pp.68-77
[47] Tjørve, K.M.C., Sutterud, E., Midtskogen, B.,Kruger, A.F., Fulton, N., Ellefsen, S. The Use of Technology in Teaching: Student Satisfaction and Perceived Learning.
[48] Holden, G. Design at a Distance. Proceedings of the International Conference on Engineering and Product Design Education, 2009, University of Brighton, UK
[49] Brandt, E and Messeter J., Facilitating collaboration through design games. Proceedings of the eighth conference on Participatory design: Artful integration: interweaving media, materials and practices – Vol. 1, Pg: 121 – 131, 2004.
[50] Ntshoe, M. Higher education and training policy and practice in South Africa: impacts of global privatisation, quasi-marketisation and new managerialism. International Journal of Educational Development. Vol.24, No. 2 pp. 137-154. (2004).
[51] Laurillard, D. (2000). Students and the curriculum. In: Scott, P., Editor. Higher Education Re-formed, Falmer Press, London, pp. 133–153.
[52] Beuckers, N. Research Skills as Basis for industrial Collaboration in Design Education, International Engineering and Product Design Education Conference Delft, 2004
[53] Carnahan, J.V., Thurston, D.L. and Ruh, R.L. Experiences with an Industrially Sponsored Project Course, 1992 Frontiers in Education Conference
[54] Niederhelman, M. Education through Design. Design Issues Vol. 17, No. 3 (2001), pp. 83-87. The MIT Press.
[55] Rittel H.W.J., and Webber, M.M. Dilemmas in a General Theory of Planning. Policy Sciences, 4, pp. 155-169. (1973).
[56] Ormrod, J.E. (1999). Human Learning (3rd ed.). Upper Saddle River, NJ: Prentice-Hall.
[57] Wenger, E. (2000) Communities of Practice and Social Learning Systems. Organisation Articles. Vol. 7(2): 225-246 SAGE, London
[58] Brown, J. S., Collins, A. and Duguid, P (1989), "Situated Cognition and the Culture of Learning," Education Researcher, 18, 1, pp. 32-42
[59] Liem, A, Professional, Industrial and Educational Perspectives on Sponsored Studio Teaching. Proceedings of the DESIGN 2010 11th Int´l Design Conf. The Design Society 2010 pp. 581-590
[60] Slagstad, R. Høyskolen som kunnskapens hus , SPS arbeidsnotat nr. 1/2007
[61] Buchanan, R (2000) The problem of character in design education: liberal education and professional specialization in International Design Education Conference Reinventing design education in the university, (2000).
[62] Liem A, (2008) Developing a win-win mentorship-scholarship, higher education model for design through collaborative learning. UNIPED (Tromsø);Volum 31.(3) s. 32-45

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