Future Directions in Interior Design Education

Abdul Samad Alkhalidi

UNIVERSITY OF SHARJAH

Abstract

Design and Art schools today are facing challenges they have never faced before to educate graduates who are relevant in the 21st century. Today's Designers are entering into a world marked by rapid and global change, exponential advancement in information and computer technologies, complex ethical issues, borderless global competition, changing demographics, sustainability, and a multitude of problems that only emerged in the new millennium. Just as business as usual will not survive in the 21st century, education as usual will also not get us there. This paper briefly explores challenges in global Interior Design practice in the 21st century, before laying down the status quo in Design education. From here, based on numerous Design education reports that have emerged from various parts of the world, the requirements as well as issues to overcome in educating Designers of the future will be developed. This paper calls all design educators to reflect on what have we done in the past, address the current issues and challenges as well as generally make recommendations that requires proper planning and action plans. It must be realized that, business as usual will not be beneficial if we wish to see our next generation of designers can effectively play an important role in the society at large.

Keywords: Educational Transformation, Professional standards , Grand challenges, Interior design Education

Introduction

Interior design has changed significantly over the past 20 to 30 years and has established itself as a recognized profession(Martin,1998).this profession has evolved from one predominantly concerned with surface ornamentation to one based on designing for human behavior. As a profession, interior design exhibits common professional characteristics. These characteristics include jurisdictional boundaries of knowledge and skills, an educational pathway, a code of ethics, professional organizations, name change, and legal recognition (Abbott, 1988).

The education of the professional interior designer aims for the highest levels of creativity and skill in designing for our increasingly complex and technological society. Interior designers are actively responsive to issues that concern our societies, and this planet. These professionals have a commitment to conveying energy, ending pollution, preventing global warming, and recycling our recourse (Kilmer, 1992). The author believes that the key to solving these issues lies in educational transformation. This means that, above and beyond the currently recognized curriculum requirements for the first professional degree, we must prepare future designers to practice with the depth of knowledge required to solve complex interdisciplinary problems of human behavior and design (Guerin & Thompson, 2004). Educators must be prepared to teach future practitioners the value of research that adds to the body of knowledge .Thus, the bridge between practice and education can be strengthened, in turn sustaining the profession and providing the foundation for an academic discipline. A roadmap for educational transformation has been precipitated by an assessment of architecture practice and education. Ernest Boyer and Lee Mitgang conducted this assessment and reported their results and recommendations in building community: a new future for Architecture and practice (1996).

The two authors are renowned scholars on teaching excellence, scholarship in higher education, educational reform, and the connections among teaching, scholarship, and engagement. There commendations in the report provide us a measuring stick against which to examine interior design education (Guerin & Thompson, 2004).

Boyer and Mitgan's recommendations can be summarized in the following way:
1. An enriched mission that connects schools and the profession more effectively to the changing social context.
2. Diversity with dignity to celebrate the varied strengths of programs originating in different administrative units, and strengths of faculty scholarship that reflects creativity and practice as well as research.
3. Standards without standardization that support the discovery integration, application, and sharing of knowledge.
4. A connected curriculum that encourages the integration, application, and discovery of knowledge inside and outside the profession, and that reflects the changing needs of the profession.
5. A climate of learning for faculty and students to share common learning goals in an environment that is open, just, communicative, and caring.
2. A more unified profession to encourage partnership between schools and profession that enriches schools, supports experience, and sustains learning.
3. Service to the nation to establish a climate of engagement, clarity the public benefits of design, promote the creation of new knowledge, and stress the importance of ethical, professional behavior (Boyer & Mitgang, 1996).

I suggest that these recommendations are also appropriate considerations for interior design educators dedicated to meeting the challenge of producing quality graduates prepared to enter the interior design profession of the 21st century.

21st century Challenges in Engineering Practice

The 21st century brings (about) major changes in the global environment. Marked by rapid development in technology, explosion in information generation, borderless economic and business operations, issues in sustainability and security, and many other complex, novel problems that have never been seen before, the way businesses, governments, and various entities have to change their modus operandi (NAE, 2005; Duderstadt, 2008). To remain competitive, industries produce over thousands of new products a year that caused the existing products to be obsolete within a short period of time. This gradually put the product development time down, causing pressure on Designers to deliver novel solutions quickly. Increasing prices of resources, such as raw material and energy, place urgency upon the need for efficient and optimized processes, leaving little room for error. Global competitiveness and the quest for low production cost also result in outsourcing of design services to places that can provide the best value for money, turning it to a global commodity (National Science Board, 2007). At the other end of the spectrum, intensive knowledge and high technology research and development activities, a trademark of knowledge economy, are clustered around nations that can provide highly capable, "renaissance" engineers who are innovators with professional skills, as well as in touch with business and community needs. A study commissioned by the UK Royal Academy of Engineering described in the 2006 report, Educating Engineers for the 21st century : The Industry View, in the first two years, engineering graduates are involved in all phases of product lifecycle, from research and development (R&D), to design, manufacturing, project management, and even sales. While R&D and design dominate the jobs companies assign to engineering graduates, 15% of the companies surveyed in the study reported assigning graduate engineers roles in sales because they need people who can understand and

recommend the correct solution to customers in selling high tech products (Spinks, Silburn and Birchall, 2006).

The need to remain competitive in these demanding times cause many developed nations to invest heavily in efforts to transform engineering education. Engineers, as problem solvers and innovators, are seen as assets to a nation's economy. As stated in the next UK Royal Academy of Engineering report in2007, Educating Engineers for the 21st century:

> "No factor is more critical in underpinning the continuing health and vitality of any national economy than a strong supply of graduate engineers equipped with the understanding, attitudes and abilities necessary to apply their skills in business and other environments."

To be competitive and taking role of leadership today and in the future, interior design graduates must have world class design education that equip them with the latest technical knowledge and tools, and have adequate understanding of the social, economic and political issues that affect their work. More than ever, design decisions affect local communities, be it in construction, manufacture of products (which may be hazardous), automation (cutting down labor), energy source and generation (impact on energy demand versus the environment), waste treatment and many more. Many recent design mistakes that results in catastrophic disasters, showed how costly these mistakes can be to millions of people. Clearly, design graduates of today and the future need to understand their ethical and professional responsibilities, not just towards industries, but also towards the well-being of the communities, nation, and the whole world, in general. The extent of challenges faced by future designers are aptly summarized by Duderstadt (2008), in his report on Engineering for a Changing World, in the list of Grand Challenges as shown in Table 1.

Table 1: The Grand Challenges The Grand Challenges

	The Grand Challenges	
1	Global Sustainability	• Destruction of forests, wetlands, and other natural habitats • Global warming • Ballooning global population
2	Energy	• Unsustainable fossil fuel • Sustainable energy technologies • Alternative energy technologies • Energy infrastructure
3	Global Poverty and Health	• Green revolution • 1/6 population - extreme poverty • Globalization
4	Infrastructure	• Aging infrastructure • Urbanization • Manufacturing to knowledgeservices • Systems integration

21st century Requirements of Design and Engineering Graduates
The rapid changes 21st century requires that graduate engineers be equipped with the necessary skills, such as information mining, knowledge integration, ideas creation, and especially problem solving. In an increasing global workplace, engineering graduates are expected to function on multinational and multidisciplinary teams, have global perspective, and to be culturally and linguistically literate (Spinks,

Silburn, and Birchall, 2006; Duderstadt, 2008). Industries, such as IBM and Siemens, define the need for T-shaped" engineers - those with deep knowledge and expertise in their discipline, with a broad breadth of cross-disciplinary knowledge and boundary crossing capabilities, such as an understanding of business context and human as well as social aspects of engineering, communication, systems perspective, lifelong learning skills, ability to innovate, able to adapt to changing environment and requirements and many more. The South Korean government also echoes this, which stress that designers who create new technology and knowledge at the local and international level, are the key to a nation's competitiveness (Song, 2012). In order to achieve this, they need design graduates who (Song 2012):

- o Can adapt to open innovation
- o Are equipped with knowledge and information in their own field, humanities, social science, art, etc.
- o Proactively respond to changing environment
- o Are able to interact with the global level.

Royal Academy of Engineering (RAE) report on Educating Engineers for the 21st century in 2007 stated that Industries requires graduates with deep understanding of technical knowledge that is underpinned on the fundamentals of the discipline and mathematics along with the necessary thinking (eg critical, analytical and creative thinking) skills and ability to apply the knowledge to real life, as well as professional skills that are essentially enabling skills that allow them to effectively function at the work place, such as communication skills, team working skills, people management skills, etc. The 2006 RAE report defined the "Renaissance Engineer" of the new Millennium (Spinks, Silburn, and Birchall, 2006) as:

- • Engineer as specialist - Engineer graduates as technical experts in their discipline
- • Engineer as integrator - Engineer graduates who can work and manage across boundaries inboth technical and organizational requirements of a complex business environment
- • Engineer as change agent - Engineer graduates who can play a critical role as the impetus for innovation in steering the industry towards success and harmony in a sustainable future.

In the later report, the RAE (2007) put forth their finding that the top most quality desired by industries is the ability to apply Design knowledge to solve real industrial problems. They must be able to take a holistic approach to problems involving complex and ambiguous systems, and to employ creative problem solving skills (Katehi, 2005).

Council for Interior Design Accreditation (CIDA) requires Interior design programs with the following outcomes in the 2014 Interior design Program Accreditation Manual (Professional Standards):

1. **Critical Thinking, Professional Values, and Processes**: Interior designers have a global view and weigh design decisions within the parameters of ecological, socio-economic, and cultural contexts.

2. **Human-centered Design**: The work of interior designers is informed by knowledge of human factors and theories of human behavior related to the built environment.

3. **Design Process**: Interior Designers need to apply all aspects of the design process to creative problem solving. Design process enables designers to identify and explore complex problems and generate creative solutions that optimize the human experience within the interior environment.

4. **Collaboration**: Interior Designers engage in multi-disciplinary collaboration.

5. **Communication**: Interior Designers are effective communicators.

6. **Professionalism and Business Practice**: Interior Designers use ethical and accepted standards of practice, are committed to professional development and the industry, and understand the value of their contribution to the built environment through the following points:

- - The contributions of interior design to contemporary society.
- - Various types of design practices.

- The elements of business practice (business development, financial management, strategic planning, and various forms of collaboration and integration of disciplines).
- The elements of project management, project communication, and project delivery methods.
- Professional ethics.

7. **Core Design and Technical Knowledge**: Interior Designers apply knowledge of interiors, architecture, decorative arts, and art within a historical and cultural context.

8. **Space and Form**: Students effectively apply the elements and principles of design to:

a) Two-dimensional design solutions.

b) Three-dimensional design solutions.

c) Students are able to analyze and communicate theories or concepts of spatial definition and organization.

9. Interior Designers apply **color principles and theories**.

10. **Environmental Systems**: Interior Designers use the principles of lighting, acoustics, thermal comfort, and indoor air quality to enhance the health, safety, welfare, and performance of building occupants.

11. **Building Systems and Interior Construction**.

12. **Regulations and Guidelines**: Interior Designers use laws, codes, standards, and guidelines that impact the design of interior spaces.

In contrast, Interior design accreditation standards are continually assessed and revised through a practice and education partnership handled by the Council for Interior Design Accreditation (CIDA). However, with each revision of CIDA standards the breadth and depth of required content increases substantially without a corrective decrease in extant content. For instant, in the mid-1990, CAD became a requisite skill with no concurrent decrease in standards of manual drafting competency. As the complexity of the profession grows, so grows the necessity of including content in areas such as sustainable design, codes, structures, and mechanical systems. Without any comparable decrease in existing content requirements, Interior Design educational programs cannot cover all required areas in four years while simultaneously providing entry –level practitioners firm grounding in liberal education (Guerin & Thompson, 2004).

Educators utilize many strategies to meet the increased demand in curriculum within the limited span of four years. One common strategy to inject more (content) into studio courses is the creation of projects that address multiple issues: e.g., emphasizing sustainability in a design project; requiring both hand-drafted and CAD drawings at different phases of a project; or creating a project for construction in another country. The difficulty with this approach is that it lessens the emphasis that can be placed on problem –solving, critical thinking, and design communication –all of which are essential components of a bachelor's degree program. These components separate degree programs from others and, are the elements that practitioners value most in entry –level designers. A second strategy used by educators to address the demand for content is (double dipping) within liberal education requirements; e.g., using a composition course that focuses on writing about cultural diversity to meet both the writing and cultural diversity liberal education requirements. In addition, we must eliminate elective opportunities for students in order to address expanded content requirements. In other words, four year bachelor's programs have used every strategy possible to reflect current practice by adding new content through coursework or studio integration. However, they have done so at the expense of a rich liberal arts foundation that emphasizes synthesis (Guerin & Thompson, 2004).

Current and Future Interior Design Education

Given the current and future challenges in Interior Design practice, as well as the requirements on Interior Design graduates, Interior Design education clearly needs to be transformed from the current practice. While technology and Design practice have clearly changed by leaps and bounds, the way Interior Design students are taught has hardly changed. Lectures and recipe-type laboratories are very much the predominant method of delivery in Design education. It is not surprising to hear the numerous complaints from industries and regarding the absence of critical skills among graduates. While it is always easy to complain about the quality of graduates, industries also have a major role to plan in educating Interior Design students through participation in curricula as well as extra curricula activities. Although transformation is clearly needed, it is not always obvious what Interior Design education needs to transform into, and how to do it.

Today, everybody tends to agree upon the necessity of including art, science, and technology in a design curriculum. But disagreement will soon arise, on the one hand, as to their relative importance, and, on the other hand, as to their respective function, i.e., the way they should be articulated (Findeli,2001). A third and highly critical aspect inevitably will provoke even stronger disagreement, a factor without which no curriculum, be it as filled with theoretical courses, workshops, seminars, and studio work as possible, will ever find its coherence: the overall purpose of design education and practice. The questions to be asked are: To which meta-project (anthropological, social, cosmological, etc.) does a design project and a design curriculum contribute? For what end is design means? How autonomous can design be? All these questions are related to the ethical dimension of design, which will be discussed later.

Based on Interior Design education reports, a summary of the challenges and the attributes of effective graduates of the 21st century can be seen in Table 2. To get the required attributes, Interior Design education has to change towards the desired characteristics shown in the last column of Table 2 (SyedAhmad Helmi, 2011; Duderstadt. 2008; NAE, 2005). With the current state of Design education, which is rooted in the traditional approach of teacher-centered courses taught in silos with mostly written examinations as the only means to assess students, Interior Design educators will have to honestly examine the commitment to move Design curricula (which includes teaching and learning methods used, as well as proper assessment) towards the desired characteristics as shown in Table 2.

Table 2: Design and Interior Design Education of the 21st century

Challenges of the 21st century	Attributes of Effective Interior Designers	Desired Characteristics of Interior Design Education
• Knowledge economy • Globalization • Breadth &depth of knowledge • Demographics • Technological change • Evidence –based design • Technological innovation • Global sustainability • Energy • Global poverty and health • Interior space infrastructure • Awareness of cultural	• Analytical skills • Practical ingenuity • Creativity • Communication • Leadership • Team working • Professionalism • Dynamic, agility, resilience and flexible • Lifelong learners • Function in global economy • Principles of business and management • Ethics	• Learner-centered • Discovery-based or • constructivist Learning • Systems perspective • Avoid content orientation • Learn how to learn • Inquiry-based scientific methods • Team-based problem solving • Prepare Designers into the • sustainable design • Linkage to the real projects

• differences		

Interior Design Education of the future requires innovative efforts to deliver the required characteristics as shown in Table 2. While program outcomes, in accordance with Outcomes-based Education (OBE)mostly matches the attributes of the future graduates given in the middle column of Table 2, the curricula of the majority of Interior Design programs, unfortunately, are not aligned to support the attainment of these outcomes. Most program owners choose to take the strategic approach of simply documenting the traditional curricula to suit OBE, rather than embrace the philosophy of OBE to transform the curricula. Assessment and evaluation are taken at a purely mechanistic level to somehow quantify measurements of all outcomes using numbers or percentages, without fully understanding what they mean, as well as their validity. These lofty 21st century outcomes, however, will just remain on-paper if the delivery and assessment remain as they were as in the 20th century.

In terms of delivery, for example, among the most desired characteristic of Interior Design education in the future is learner centeredness. Learner centered refers to framing the delivery of the knowledge in a learning environment that takes into account the background, preconceptions (which are often misconceptions), connections to prior learning or existing knowledge of students, as well as difficulties that they go through in learning the new knowledge, and how to help them understand and develop mastery (Bransford, 1997). What is of utmost importance is what students actually learn, rather than what is transmitted by the instructor. Students actually go through an aligned learning process to match the outcome, while instructors facilitate to support deep learning (Biggs, 1996; Biggs, 2010). There area range of techniques in varying degrees of learner centeredness to support the attainment of different levels of outcomes. Higher level outcomes, such as the ability to solve complex problems, require methods that are more intricate to conduct so as to support students in developing the required outcomes. Nevertheless, the current willingness and ability to conduct learner centered methods among Interior Design academics are rather dismal. Learning does not occur in a vacuum - students cannot attain lofty outcomes on their own without being guided in a supportive environment. Transformation in delivery will also not take place without institutional commitment, support and will. Commitment at all levels is necessary if curricula transformation is to take place successfully.

Today Interior Design Programs must take into account that in the future, students will learn in a completely different way (NAE, 2005). Until today most Interior Design Programs have developed curricula by creating scenarios or predicting the problems we expect to face. In doing so, the focus is more on knowledge rather than skills. According to Bransford (2004), curricula based on specific knowledge are built from the bottom up. Interior Designers whose education is built from the bottom up cannot comprehend and address big problems (NAE, 2005). As mentioned by Katehi (2005), "the future engineering curriculum should be built around developing skills and not around teaching available knowledge. The focus must be on shaping analytic skills, problem-solving skills, and design skills. Interior Design educators must teach methods and not solutions". Jonassen (2006) directed his work "towards design theory of problem solving" to come up with how to prepare our future designers to solve work place problem. Stroble (2008) urged design education researchers to better understand the nature of work place problem solving especially for instructional and educational strategies thatheavily utilize problems like PBL. Savery (2006) related constructivism (which is the philosophical view of how people came to understand), to the practice of instruction. He examined problem based learning, which he considered the best exemplars of constructivist learning environment.

The change toward innovative and meaningful curricula is even more important nowadays to attract the current Generation-Y into engineering. With very little exposure to the importance in the role of engineers, and the blame on engineers for major accidents, the Gen-Y do not see engineering as attractive. The high difficulty level of the content, tortuous learning environment with disjointed curricula that is estranged from the actual application in industries, coupled with relatively minimal reward and recognition compared to other fields are driving away the young generation from engineering. It is therefore not surprising to see efforts in developed countries from North America to Europe, parts of Asia (such as Japan, Korea and Singapore) and Australia, to promote engineering from the school level, even introducing engineering concepts and thinking at the primary school level, such as the Inspire Institute under the School of Engineering Education, Purdue University in the US. Realizing the challenges ahead, there have been concerted efforts among governments and engineering related NGOs as well as institutions to take the lead in providing leadership for innovations in design education. Initiatives to enhance the quality of graduates, such as service learning, cooperative programs, global student exchange and summer school programs, design centric curricula, entrepreneurship, professional ethics, problem or project based curricula, a variety of active learning methods, industrial involvement in various aspects of the curricula, etc are among innovations that are being implemented. Nevertheless, there are also calls for innovations to be properly thought out and studied for real, meaningful impact.

As stated by Jamieson and Lohman (2012) in the ASEE report, "Innovation with Impact": If a "grand challenge" for Interior design education is "How will we teach and how our students will learn all that is needed to tackle the challenges of today and tomorrow?", then the issue is NOT simply a need for more educational innovations. Indeed, implementing innovations without taking the scholarly, evidence-based approach can be costly and disruptive for students learning. Care must be taken because changes made in engineering in education will bring about impact on students, be it positive or negative. What is desired are innovations that are rooted on strong educational principles that are properly studied, and thus evaluated for effectiveness according to the desired outcomes. The study of innovative practices can lead to further improvements in implementation, which can in turn lead to a virtuous cycle of research. The move for conducting rigorous research in Interior design education gained momentum in the first decade of the 21st century. In the United States, the National Science foundation allotted millions to fund design education research, as well as initiatives to train Interior design academics to conductrigorous educational research. The European Society for Engineering Education (SEFI) received similar funding for conducting and training rigorous educational research among design academics.

The Korean government currently funds sixty nine innovative centers for engineering education, with five hubs to gather and lead the centers under the hub, each with different innovation emphasis to properly implement and conduct research on the effectiveness of innovations made (Song, 2012). At the international level, the Research in Engineering Education Network (REEN) is a world-wide network which aims to promote and support rigorous research in design education. Clearly, attaining the desired quality of graduates depends heavily on academics that design the curricula, teach, and perhaps study innovations made at their own institution. Streveler, Borrego andSmith (2007) classified the levels of academics in design education as follows:
- Level 0 Teacher who teach as he/she was taught
- Level 1 Effective Teacher who applies accepted teaching theories and practices
- Level 2 Scholarly Teacher who evaluates performance of students and makes improvements
- Level 3 Scholar of Teaching and Learning who conducts educational experiments and documents the results in the form of presentations or papers
- Level 4 Design Education Researcher who conducts rigorous design education research and publish papers in peer reviewed journals.

While not all Interior design educators are required to be at Level 4, the OBE approach requires that instructors can at least be classified to be in Level 2. Since those at levels 3 and 4 will obviously be beneficial to the design education community, it is imperative that institutions encourage and reward this type of work, especially in providing a promotion track for those heavily involved in design education. This is of utmost importance in enabling innovation with impact in Interior design education for developing designers that are suited for the 21st century.

This paper calls all Interior design educators to reflect on what have we done in the past, address the current issues and challenges as well as generally make recommendations that requires proper planning and action plans. It must be realized that, business as usual will not be beneficial if we wish to see our next generation of Interior designers can effectively play an important role in the society at large. Change is inevitable, to stay competitive, there is the need to discover new knowledge and technology through rigorous research and innovation in Interior design education. We must be able to prepare graduates that will make new discoveries, bring new products and services, design, and deliver to serve the communities and innovate continually to support the industries. Hence, the fundamental sciences, engineering principles and analytical capabilities of the students should be enhanced through several active learning approaches and use of current tools and technology. Humanities, arts and social sciences are essential for graduates to be creative, explorative and be open-minded. We must also make Interior design education exciting, innovative, entrepreneurial, creative, adventurous, challenging, and demanding and empower situational environment more than just specifying curricular details. The key success factors to all this is we need to understand and engage ourselves in issues pertaining Interior design education, be committed, work in teams and enjoy all the challenges ahead. Although the purpose of this paper is to lay some foundations for a renewal of design education and research, but, the author indicates some directions for further research and constructive work. Let's sum up the principal stages of the above discussion.

An archetypical model of a curriculum for Interior design education has been described in the form of a three-part structure, art/science/ technology, enclosed within a general purpose for design. In order to figure out what the content of these three components would be and how they should be articulated, it is necessary to establish an epistemological/methodological model for the design process or project. If we further accept the fact that the linear, causal, and instrumental model is no longer adequate to describe the complexity of the Interior design process, we are invited to adopt a new model whose theoretical framework is inspired by systems science, complexity theory, and practical philosophy. In the new model, instead of science and technology, I would prefer perception and action, the first term referring to the concept of visual intelligence, and the second indicating that a technological act always is a moral act. As for the reflective relationship between perception and action, I consider it governed not by deductive logics, but by a logic based on aesthetics.

The second aspect at stake is the specific training necessary for perception, action, and their relationship to be carried out adequately and consistently by students. I believe that visual intelligence, ethical sensibility, and aesthetic intuition can be developed and strengthened through some kind of basic Interior design education. However, instead of having this basic design taught in the first year as a preliminary course, as in the Bauhaus tradition, it would be taught in parallel with studio work through the entire course of study, from the first to last year.

Conclusion

The explosion in technological development since the second half of the 20th century results in rapid changes and novel challenges throughout the world. To remain relevant in the 21st century, Interior design education has to rise up to the challenge and transform the curricula as well as the way Interior design students were taught. To attain the attributes of Interior design graduates of the 21st century, design education has to match the desired strategies that can produce the desired quality of graduates. While there are numerous innovations that are being implemented to enhance Interior design education, what is of utmost importance is to ensure that these are innovations with impact. This requires proper research into the significance of the innovations, through which others can also learn and follow suit. Just as Interior design innovations requires the path of a scholarly approach, innovations for transforming design education also can be best determined through systematic scholarly and evidence based approach.

References

Abbott,A.(1988).The system of professions: An essay on the division of expert labor, Chicago:University of Chicago press.

Biggs, C. (1996). Enhancing Teaching Through Constructive Alignment, Higher Education, 32, 347-364, 1996.

Biggs, J., and Tang, C. (2010). Applying Constructive Alignment to Outcomes-based Teaching andLearning, Training Material for "Quality Teaching for Learning in Higher Education" Workshop forMaster Trainers, Ministry of Higher Education, Kuala Lumpur, 23-25 Feb, 2010.

Bransford, J., Vye, N. and Bateman, H. (1997). Creating High-Quality Learning Environments:Guidelines from Research on How People Learn, National Academy of Sciences, 2004, pp 159-197.

Duderstadt J.J., (2008), Engineering for a Changing World: A Roadmap to the Future of EngineeringPractice, Research and Education, The Millennium Project, The University of Michigan.

Findeli, Alain, (2001),Rethinking Design Education for the 21st century , Massachusetts Institute ofTechnology, Volume 17, Number 1 Winter 2001.

Guerin,Denise&Thompson,Jo Ann,(2004).Interior Design education in the 21st century ,Journal ofInterior Design ,V30,Number 1,2004.

Jameison, L. H. &Lohmann, J. R. (2012). Innovation with Impact: Creating a culture for scholarlyand systematic innovation in engineering education. Washington: ASEE.

Jonassen, D., et al., (2006), Everyday Problem Solving in Engineering: Lessons for EngineeringEducators, Journal of Engineering Education, April 2006, Vol 95, No 2.

Katehi, L. 2005, The Global Engineer. Address to the National Academy of Engineering, July 22-23.

Martin,C.(1998).Professionalization :Architecture ,interior decoration, and interior design as definedby Abbott.Master's thesis ,Department of design, University of Minnesota.

National Academy of Engineering (2005). The Engineer of 2020: Visions of engineering in the newcentury . Washington: The Academic Press.

The Royal Academy of Engineering (2007). Educating Engineers for the 21st century . London:The Royal Academy of Engineering

Savery, John R. (2006). Overview of problem-based learning: Definitions and distinctions.Interdisciplinary Journal of Problem-based Learning, 1(1), 9-20.

Song, Sungjung (2012). Presentation on SKKU Hub Innovative Centre for Engineering Education,January, UniversitiTeknologi Malaysia, Johor Bahru.

Spinks, N, Silburn N, and Birchall D, (2006), Educating Engineers for the 21st century , HenleyManagement College, The Royal Academy of Engineering, UK

Streveler, R., Borrego, M. and Smith, K. A., (2007), Moving from the "Scholarship of Teachingand Learning" to "Educational Research": An Example from Engineering, Improve the Academy, Vol.25, 139-149.

Stroble, J (2007) Compound Problem Solving: Workplace Lessons for Engineering Education,Proceedings of the 2007 Midwest Section ASEE Conference

Syed Ahmad Helmi, S H (2011), Enhancement of Problem Solving Skills through CooperativeProblem Based Learning, PhD Thesis, UniversitiTeknologi Malaysia.