

Reforming Architectural Engineering Education in Taiwan: Contexts, Opportunities, and Concerns

Tsung-Juang Wang

Department of Architecture
National Taipei University of Technology, Taiwan

Introduction

Architectural education has traditionally included interdisciplinary courses to encourage students to improve their competency in fields related to the discipline areas (Erman et al., 2004:51, 52; Bronet & Schumacher, 1999:97, 100) and provide the basis for a wider vision of the field and its role in society. Architectural education has always struggled to fit the preparation for practice demanded by professional institutions with the principles of liberal education and a wider scope of scholarship for university students. The aim of architectural education is to help them develop in-depth knowledge of theory and practice in the discipline as well as the breadth of knowledge provided by liberal studies (Anthony, 2002:258; Glasser, 2000:251; Back & Sanders, 1998:139). Meanwhile, educators and professionals attempt to fuse theory and practice (Kaufman et al., 2000; Finn, 2002:88, 89) in the expectation that students will apply in their practices what they have learned about the larger demands of society.

Higher education in Taiwan is now at a critical juncture because of increased global competition and the prospect of external confrontation. The nation's competitive strength is its assurance that it will be able to meet these challenges, but it cannot stand still. Without continuing progress, the nation will suffer setbacks that might have been avoided had more professionals possessed the requisite knowledge to understand larger issues and contexts. The Ministry of Education (MOE) of Taiwan, in response to the challenges of the new century, has proposed new directions for the development of higher education to serve as the basis for the administration of higher education. Among these initiatives, the arts and the humanities have been re-emphasized in universities' planning and development processes (MOE, 1998).

Because Taiwan faces unprecedented challenges of economic and social transition and a clear need to transform the system of architectural education, we must adopt new modes of thinking and managing resources (NSC, 2003). To arrive at a new era in architectural education, we need to establish cultural values and incorporate them in university curricula. The need for reform is not limited to architecture. Reform in other disciplines is important to architecture because architectural projects do not take place in a vacuum. Students majoring in other disciplines such as management, the natural sciences, and engineering should also develop artistic and humanistic qualities to complement their technological competencies. Major projects almost always require the combined efforts of business managers, scientists, and engineers for their successful completion. Reform of all disciplines at the university level should aim to provide balanced and diversified learning experiences, as well as help students learn ways to contribute to the betterment of society.

Adapting the content of curricula to the current needs of society has always been crucial to modernizing and democratizing educational systems (Bransford, 1999:114; Gettinger, 2003:300; Cowan et al., 2004:445). The task becomes more difficult as the pace of changes taking place in global economic systems quickens. An effective response will require that educators develop both the ability and the inclination to adapt quickly.

Concurrent with international efforts to reform architecture education, Taiwan has embarked on its own efforts to reform the field. The present paper portrays current efforts to reform architectural engineering education in Taiwan in the context of global changes and institutional changes in Taiwan itself.

Finally, the paper addresses the need to develop uniform standards in architectural education and incorporate local resources that are especially relevant to Taiwanese needs, realities, and culture. Architecture is uniquely positioned as a discipline to combine professional design skills with local understanding of public needs in designing public spaces and developing infrastructure that is aesthetically pleasing and accessible to local populations (Allen & Feldman, 2000:128, 129).

2. Strategies of Context in Architectural Education

2.1 The Context for Global Change in Taiwan

Rapid social changes, democratization of the Taiwanese government, swift economic growth, structural shifts in production, and the proliferation of diverse value systems have in recent years confronted institutions of higher education with serious new challenges, including re-examination of the leadership role of such institutions. The Taiwanese educational model for architecture has evolved from apprenticeship systems into a studio-based tutorial environment. The design studio is currently viewed as a learning environment in which skills and values can be brought to bear within a spirit of open inquiry (Glasser, 2000:252; Doherty et al., 1991:73). The model has served well in many respects, but students and professionals need ways to incorporate rapidly advancing technologies in both education and practice. Incorporating substantial components from the arts and humanities into educational programs can help meet that need.

Traditional architecture schools did not prepare architects to market their businesses. Some might view that as a good thing, but architecture graduates needing help with marketing are mostly left alone and find they are unprepared for the task on their own. The need to market services is fairly new in this newly open society and economy, and the challenges are amplified by economic swings from boom to recession and back.

How architects approach change in this transitional society will be important to their careers and prospects for success. Their training should help students deal with rapid social transition and technological advances, the competitive pressures of globalization, and major demographic and societal shifts (Vaira, 2004:489). The educators who meet these challenges will be open to breakthroughs, plan with vision and foresight, and help their students and the nation open new frontiers.

2.2 Institutional Change in Taiwan

Architects themselves have done little research on architecture education and even less on pedagogical practice (Boyer & Mitgang, 1996:155,156). Regrettably, most education professionals as well have been uninterested and have not taken advantage new opportunities for experiential learning. Likewise, architecture schools, usually isolated from other colleges at universities, have largely failed to interact with other disciplines. They have therefore been unaware of the findings of researchers in education and other related fields. That is changing though. Taiwanese universities are responding to the more open political and economic climate by becoming more pluralistic, liberal, democratic, and international in tone. They are less authoritarian, more open, and less monolithic.

Modern universities have mostly evolved from medieval European models and are steeped in that tradition. The social changes of the Industrial Revolution have been followed by rapid acceleration in science and technology, increased prosperity, greater political freedom, and changes in social values, especially over the last decade. These changes have been magnified in the university environment as challenges to the traditional model of university education have forced an abandonment of the ivory tower in favor of programming that produces thoughtful and socially responsible practitioners.

2.3 The Context of Architectural Education in Taiwan

The artificiality of maintaining separate realms for academic training and the professional practice of architecture has become an increasing concern of many in both arenas. In their view, educators and practicing architects should work cooperatively toward shared goals. Educators are obliged to promote not only technical excellence, but social enlightenment and broad learning across relevant disciplines. Such breadth is a true hallmark of educational excellence. Therefore, the objectives of architectural education should include four basic purposes:

1. To prepare architects to fill multiple roles in preserving valuable cultural traditions and enabling continuing evolution of the culture in response to internal and external mandates,
2. To foster independence and intellectual freedom,
3. To contribute to an individual sense of self-fulfillment, and
4. To promote the sustainability of architectural education.

Students should be encouraged to defend the processes and products of their investigations. Reforms already underway in Taiwan have shifted architectural education from the concrete to the abstract, from the general to the specific, and from the literal to the figurative.

Educational reform worldwide is taking many shapes, but most reform movements appear to recognize that separating the academic and practical aspects of professions is an outmoded approach. Architecture is both academic and practical, requiring constant updating of technologies and design concepts by even its most experienced and successful practitioners. Good architectural plans respond to specific contextual needs as well as design ideals. Thus, the knowledge required for successful practice often has nothing to do with solving technical problems and everything to do with understanding and responding to social and historical contexts. Taiwan's program to reform architectural education, therefore, could influence the way many other Taiwanese view the world.

The reform of architectural education in Taiwan should incorporate the following strategies:

1. Professional education for teaching studio-based courses: Teaching and learning-assessment committees should be created to assess the teaching competence of faculties and solicit recommendations from students. Teaching subcommittees at each school should be established to monitor and improve the materials and methodology of fundamental and common courses.
2. Supporting diversity and collaboration: A well-planned schedule of classroom work should reduce duplicate classes and increase opportunities for students to enroll in elective courses that expand learning opportunities and horizons. These electives should emphasize what McCormick (2004:166) describes as "collaborating to learn" and "learning to collaborate" in the modern practice of architecture. In the modern world, almost all design and technological development is collaborative, and learning how to do that with colleagues in different disciplines is critical to success and learning (McCormick, 2004).
3. Providing a diversified curriculum: It will be increasingly important to create courses that utilize traditional classroom instruction and online supporting materials from disciplines, to define standards for courses shared across disciplines, and make available distance-learning opportunities that increase opportunities for diversified education. For example, during the first year program in architecture students can choose from among 10 courses in each of several disciplines to earn approximately 30 credits. Students majoring in architecture must earn credits from architectural development, two or more two architecture courses, and optional courses from other departments. The student must complete a total of 126 credits before receiving the diploma. Requiring a concentration of courses in the core subjects test student commitment to architecture but also provides opportunities for diversity.

4. Using technology to create an increasingly flexible learning experience: Institutions should adopt bylaws that define the circumstances in which study may be suspended for a time, perhaps to provide opportunities for work. They should also recognize courses and subjects undertaken at other institutions both at home and abroad. Recent developments in communication technology have increased the pace and intensity of interaction among academic institutions and expanded scholarly exchanges among nations.
5. Placing equal emphasis on liberal studies, engineering studies, and professional studies in architecture: The curriculum should be equally divided between liberal studies, engineering, and architecture theory and practice, allowing students hands-on experience in architecture within the context of other studies that integrate the technical and management aspects of practice with considerations of how their practice fits into the values and aesthetic contexts of community.

3. Unique Challenges and Opportunities of Architectural Education in Taiwan

Social change refers to any changes in social processes or structures, including changes in political and economic systems and human relationships (Erman et al., 2004:52; Hindle & Rwelamila, 1998:151). People form affiliations within a larger social structure. When basic social structures undergo drastic change, perceptions of individual value, ethics, behavior, and attitudes also change. And as a result, educational institutions must also change in response. Taiwan has recently experienced significant changes in its political structure. Accordingly, Taiwan should embark on programs to transform education in general.

Education in architecture is particularly ripe for a transformation so that it reflects the needs of the society it must serve. Unless the industry changes in response to larger changes in Taiwanese society, it is likely to enter a period of decline. Ultimately, such changes must incorporate the technological advances of the day in order to make its transformation successful. The goal should be a refined and professional industry in a knowledge-based economy and society rather than an industry that retains its tradition but on which the sun is slowly setting because of declining profits or reduced demand for its products (Ezulike & Hoare, 1998:146,148). Whether an industry becomes such a “sunset industry” depends on both internal and external factors. Some factors may be beyond its control. For example, an industry may not be able to convince the larger economy or society of its value in the larger scheme of things. But assuming that it is valued in the larger society, how effectively it manages the form and content of its professional training programs will be extremely important in its efforts to sustain itself. In the case of architectural education, programs should facilitate a connection between the industry and both local and global environments and resources.

Professional education in architecture must facilitate advances in technology related to the discipline. Educational programming that most effectively accomplishes that will take into account the special qualities of technologies in architecture, which utilize both high-tech design processes and scientific developments from many other disciplines. Developments in information and communication technology (ICT) often result in reducing the time and space requirements of projects and greater cost efficiency (Vaira, 2004:492; Andia, 2002:8; Bell, 2000:13). Using information and communication technologies to developing and present curricula in architectural education would be among the most productive uses of those technologies (McCormick & Scrimshaw, 2001:45; Dirckinck-Holmfeld & Lorentsen, 2003:92).

The effects of new information and communication technologies span many disciplines, and this reach makes that discipline rather a special case. The challenge for professional education in architecture is to harvest the full potential of the new technologies in curricula. Institutions themselves should explicitly recognize the potential benefits of melding the new technologies with architectural education. In no other area is the potential impact on the goal of creating a sustainable economy and environment more evident. To take full advantage of the opportunity to utilize resources effectively and change society in beneficial ways, institutions should promote partnerships and interactions between educators and other

professionals. By doing so, they will be helping to lead Taiwan to a position of leadership in science and technology.

Davidson (2003:733) and Barro (1998) explore further challenges to the development of scientific technology, especially how student performance subsequently affects efficiency and quality in the workplace. According to *Educause*, published in September 2004, "It is a race of technology and speed as well in the industry of hi-tech". High efficiency and quality are essential for sustained development throughout the nation, but they are also critical to individual companies and institutions. Taiwan traditionally is viewed as lagging behind in its concern for product quality. Educational programs should directly address the need for consistent levels of efficiency and quality in all disciplines, especially including architecture. Providing quality education should be the ultimate target of educators, and architecture as a discipline should be no exception.

New information and communication technologies afford special opportunities in architecture. They provide opportunities for practicing professionals to return to school, learn cutting-edge technologies, and grow continuously in their profession. Such growth is critical to sustaining a high quality of life and, ultimately, to the survival of the society itself.

4. The Roles of Teacher and Student in Taiwanese Schools and Society

Today's university students will be the backbone of tomorrow's society, and university education should be committed to the lofty ideals of seeking knowledge, fostering creative understanding, and nurturing the whole personality. Educators must cultivate humanity in students. Students should leave the university with senses of ethical responsibility and the aesthetic and qualitative standards they will need to contribute to society and enjoy meaningful lives. In short, education should be an agent for social change and growth.

Architectural education in Taiwan can contribute in important ways to social change and help lead the larger society in new directions. Globalization has recently contributed to a democratization of higher education. In doing so, it has forced the recognition that traditional, elitist models no longer serve the needs of a pluralistic society. Taiwan has moved toward a thorough reconsideration of educational systems and a more holistic model. That trend should continue in response to continuing changes in Taiwanese society and its position in the world economy. The need for life-long education and pluralism will become more evident, and adult education programs can help meet that need.

Investment in education, especially in continuing education in architecture, will be critical in helping reach a societal consensus on sustainable development (Chodikoff, 2004:6; Back & Sanders, 1998:141). Continuing education programs that extend broadly across disciplinary boundaries can help professional architects remain current with the aesthetic and ethical issues surrounding developments of various types. Architects are almost uniquely positioned to assist society in creating awareness and understanding of the ethical and physical issues involved in making future development sustainable. But for them to be effective in creating that understanding their educations must be broadly based and continue over the course of their careers. Both degree-granting and continuing education programs must integrate environmental, ethical, and aesthetic values as well as an understanding of political, social, and economic issues that affect public policy. Sustainable development must be a value that is encouraged at all levels of professional training and practice. Thus, while education in any of these areas might be carried on independently, education and professional practice in many fields will be more closely attuned to community and national needs if they are approached in a unified manner.

Often, it seems, faculties from other countries are more capable of accurately assessing and predicting new trends in the global business environment. This author believes this is because they are more inclined to initiate interactions with business and industrial leaders outside their own communities. They are able to integrate what they learn in these interactions with their own professional experiences and to arrive at conclusions about the larger picture. They then share what they have learned with their students and encourage them to develop their own

styles of design and working based on a broader perspective.

Unfortunately, architectural education in Taiwan has sometimes discouraged such interactions outside the immediate community. It has too often been confined by more traditional university models in which promotion and tenure were assured only by complying with the relatively narrow perspectives of an already-tenured and insular faculty. Few young faculty members have had the intellectual stamina and courage to challenge prevailing views regarding the educational mission. Individual ideas have been tolerated only as long they have not challenged traditional educational strategies. The limitations posed by such attitudes must be removed. Architectural education in Taiwan will be vastly improved by encouraging regular interaction with faculties and practicing professionals outside the country, and new information and communication technologies can facilitate such exchanges.

The function and mission of professional education in both architecture and technology should be reviewed for their potential to affect social development in four ways:

1. How architectural education can incubate talents required for development of the larger society,
2. How it can guide social change,
3. How it can facilitate the advancement of technology, and
4. How it can contribute to the sustainability of architectural education.

Architectural education should incubate the broad range of talents required by the nation to compete in a global, 21st century economy. To accomplish that, educational programs must respond speedily to competitive pressures, a process that is best enabled by a collaborative educational model and a diversified curriculum (McCormick, 2004:164; Castellano et al., 2001). Such a model will be consistent with models of both practice and education in business technology, especially as it relates to human resources management and collaboration across organizational lines. Such collaboration will be a vital catalyst guiding economic development and encouraging the flexibility required in a rapidly changing global environment. Because architectural design often defines the direction of organizations themselves, collaborative approaches in architectural education will often spread to other disciplines. In this way, teaching and practice in architecture is often mirrored in the development of society itself, encouraging integrated social and economic development.

An advanced and credible accreditation system will be important in guiding Taiwanese architectural education. Such advanced nations as the United States, Canada, Germany, Japan, Swiss, and France have already created professional accreditation systems to assure compliance with high standards in most professional fields, including architecture and information and communication technologies. Accreditation systems enhance employment opportunities for those who meet institutional standards and create public perceptions of trustworthiness and professionalism. Taiwan should adopt similar standards.

5. Culture, Value, Economy, and Social Change in Taiwan

Investigations into human resource utilization and labor relations by the Council for Economic Reconstruction of Executive Yuan in Taiwan reveal a decrease in agricultural employment from 1986 through 1996, a small decrease in manufacturing employment from 1996-2000, significant growth in employment in information and communication technologies, declines in the building and construction trades, and gradual growth in the service sector through the year 2003. These general trends are expected to continue, with far-reaching implications for the society as a whole, reflecting an increasingly information-based economy. Architectural education should reflect these changes and help meet the need for sustainable national economic development. The allocation of educational resources should therefore anticipate ways in which jobs will be allocated in the larger economy and provide workers with the skills and knowledge needed to match expected opportunities. Presently, the system supplies the middle level of professional educators in architecture adequately, but those trained to assume baseline and top management roles are

lacking. Individuals with the needed interdisciplinary skills are in short supply.

To meet the needs, university architecture departments and curricula should be restructured. The present structure has not changed for many years and is incapable of meeting the new needs of either the society or the industry. Based on studies published over the previous two years and supported by the National Science Council of Taiwan (Wang, 2004), undergraduate programs in architecture should be revised to include the following three components: Liberal Studies, Engineering Studies, and Pedagogical or Professional Studies in equal proportions of 42 total semester hours each.

Standards for qualifying faculty, evaluating student performance, and developing curricula should more closely reflect current reality in the world at large. Manufacturing industries and the educational programs that support them are already experiencing such a readjustment, which has been in progress for several decades. The changes in that environment have included both technological and philosophical changes across many related disciplines, including architectural design and the information and communication technologies that support manufacturing. The challenge has been how to control those changes and ensure a positive restructuring (Anthony, 2002:262). Comprehensive solutions await the removal of remaining barriers to social and educational reform.

Critical to maintaining competitiveness throughout the economy, the entire work force must continuously update its knowledge and skills to ensure that it can cope with rapid scientific and technological changes. The profession of architecture can contribute to this process by creating work and learning experiences conducive to what MOE (1998) called a "Life Learning Society". In such a conceptual framework, the general public would be encouraged to learn throughout life, and this would in turn ensure the place of Taiwan in the international economy. Architecture can contribute to this effort.

Gurel & Basa (2004:194,200), Barris (2001:229, 230), and MacDonald (1998:229) describe the possible strategic relationships between architecture and culture in an environment of political and social change. Educational development has been keeping pace with social transformations, producing many changes. Knowledge remains the most important element for societal and economic growth, and Taiwan is now experiencing serious imbalances due to the shifts in economy, production, and the social-cultural and political spheres. Responding effectively to these challenges requires improved education for the entire population, which will, in turn, spur social development and change. But Taiwanese universities and professional programs often lack modern perspectives and remain mired in traditional methods so that both teaching and professional practice fails to meet the nation's needs. Universities, including their extension services, must thoroughly reassess their goals and how they are achieved.

The education of professional architects has played a major role in our nation's modernisation and reconstruction. It has in some ways been among the leaders in academic research and development of information and communication technology. It also plays an important role in redefining social values, building good models, and promoting social and psychological reconstruction. Professional education programs should continue to promote democracy and political stability, help in economic development, and create opportunities for social interchange leading to cultural renewal and progress. By doing so, professional education in architecture can help provide a good environment within which the nation's modernization can continue.

6. Toward Excellence in Architectural Education

Professional education in architecture can play as important a role in the society as upgrading industry often plays. Training of professional architects should encourage free enquiry and critical thinking, which, in turn, will result in creativity, imagination, and innovation. Teaching and learning methodologies should aim to sustain enquiry, critical thinking, creativity, and imagination over the course of an entire professional career. Effectively, this means that professionals should remain students throughout their careers,

"Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition

Copyright © 2005, American Society for Engineering Education"

sharing their experiences in cooperative learning environments, reviewing projects in total context, and promoting social awareness. A continuous learning experience should reinforce professional skills; environmental ethics and sensitivity; the value of interdisciplinary approaches; and concerns for regional, global, and local issues (Galligan, 2001:12; Guy & Farmer, 2001:146; Back & Sanders, 1998:141). Ultimately, architectural education must encourage architects to evaluate and design projects with environmental, social, and economic sustainability as primary considerations in each case. Mere technical skills do not achieve that, but a curriculum that includes broad instruction in aesthetic and social values will. Architectural practice and intellectual discourse should not be viewed as separate entities, but should be brought into harmony through the educational process.

Design studio and theory should not be treated as though they are courses in two separate disciplines. Collaborative and interdisciplinary approaches are the keys for successfully transforming democratic and diverse societies. Gurel and Basa (2004:200) and Maira (2003) bring an increased understanding of how the multiple forces of technology and culture interact to influence changes in education. A truly interdisciplinary curriculum will help bring into being the higher level of education that Willinsky (2002:375) believes is required for the general public to participate effectively in the dialogues of modern democracies. Reforming education in architecture should aim for a consistent curriculum that takes full advantage of information and communication technologies.

Professional education in fields such as architecture can serve as a model for lifelong learning for the entire culture. Prosperity and sustained competitiveness in world markets make it essential that such professional education programs lead the way. The following points for reference will be useful in creating the desired interdisciplinary approach to architectural education.

1. Program capacity and teaching guidelines should be designed to meet the needs of the nation as determined by the Council for Professional and Technical Education in Taiwan.
2. Professional education in architecture should give equal emphasis to liberal studies, architectural theory, and practice.
3. The profession should encourage feedback strategies to utilize diverse channels that might include regular evaluation of licensing procedures, review of educational institutions for accreditation purposes, and messages to training advisory committees. National agencies and committees with the responsibility for economic development and national productivity should monitor both professional education and practice to ensure of the value of a professional degree.
4. The profession should encourage continued growth and improvement to prepare students to assume their places in the workplace with skills that are current.
5. The profession should participate fully in a future society characterized by the lifelong learning opportunities afforded by new information and communication technologies.
6. Professional education in architecture should continuously evaluate and respond to the demands of the ICT industry for creativity and innovation.
7. To seek balanced development of all industrial sectors, considerable resources must be devoted to enabling the high-technology industry to meet the needs of those other sectors.

References

- 1) Allen, B. and Feldman, R. (2000) Beyond expert culture. *Journal of Architectural Education*, 53(3), pp. 128-129.
- 2) Andia, A. (2001) Reconstructing the effects of computers on practice and education during the past three decades. *Journal of Architectural Education*, 56(2), pp. 7-13.
- 3) Anthony, K. (2002) Designing for diversity; implications for architectural education in the twenty-first century. *Journal of Architectural Education*, 55(4), pp. 257-267.
- 4) Barris, R. (2001) Contested Mythologies: The Architectural Deconstruction of a Totalitarian Culture. *Journal of Architectural Education*, 54(4), pp. 229-237.
- 5) Barro, R. (1998) Determinants of economic growth: a cross-country empirical study, Cambridge, Massachusetts: The MIT Press.

"Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition

Copyright © 2005, American Society for Engineering Education"

- 6) Bell, G. (2000) Towards a new art curriculum: reflections on pot fillers and fire lighters. *Journal of Art & Design Education*, 19(1), 10-18.
- 7) Boyer, E. and Mitgang, L. (1996) *Building Community: A New Future for Architectural Education and Practice* (Princeton, NJ: The Carnegie Foundation, 1996), pp. 115-116.
- 8) Bransford, J., Brown, A., and Cocking, R. (Eds.) (1999) *How People Learn: Brain, Mind, Experience, and School*, Committee on Developments in the Science of Learning, National Research Council, National Academic Press.
- 9) Bronet, F. and Schumacher, J. (1999) Design in Movement: The prospects of interdisciplinary design. *Journal of Architectural Education*, 53(2), pp. 97-109.
- 10) Castellano, M., Stringfield, S. and Stone, J. R., III. *Career and Technical Education Reforms and Comprehensive School Reforms in High Schools and Community Colleges: Their Impact on Educational Outcomes for At-risk Youth*. St. Paul: National Research Center for Career and Technical Education, University of Minnesota, 2001. <http://nccte.org/publications/index.asp>
- 11) Chodikoff, I. (2004) Viewpoint. *Canadian Architect*, April 2004. p.6
- 12) Cowan, H., George, J., and Pinheiro-Torres, A. (2004) Alignment of developments in higher education. *Higher Education*, 48(4), pp.439-459
- 13) Davidson, J. (2003) A New Role in Facilitating School Reform: The Case of the Educational Technologist. *Teachers College Record*, 105(5), 729-752.
- 14) Dirckinck-Holmfeld, L. and Lorentsen, A. (2003) Transforming university practice through ICT – integrated perspectives on organizational, technological, and pedagogical change. *Interactive Learning Environments*, 11(2), 91-110.
- 15) Doherty, P., Huxtable, J., and Murray, J. (1991) Planning for capability and progression for design and technology in the National Curriculum. *Design and Technology Teaching*, 23(2), 70-76.
- 16) Erman, T., Altay, B., and Altay, C. (2004) Architects and the Architectural Profession in the Turkish Context. *Journal of Architectural Education*, 58(2), pp. 46-53.
- 17) Ezulike, E. and Hoare, D. J. (1998) The need for education in alternative dispute resolution (ADR) in the construction industry. *Engineering, Construction and Architectural Management*, 5(2), 144-149.
- 18) Finn, C., Jr. (2002) Making School Reform Work. *Public Interest*, 148, 85-95.
- 19) Galligan, A. (2001) *Creative, culture, education, and the workforce*. Center for Arts and Culture, Arts, Culture & the National Agenda Issue Paper, Washington, DC.
- 20) Glasser, D. (2000) Reflections on architectural education. *Journal of Architectural Education*, 53(4), pp. 250-252.
- 21) Gettinger, M. (2003) Promoting Social Competence in an Era of School Reform: A Commentary on Gifford-Smith and Brownell. *Journal of School Psychology*, 41(4), 299-304.
- 22) Gurel, M. O. and Basa, I. (2004) The status of graphical presentation in interior/architectural design education. *International Journal of Art Design Education*, 23(2), 192-206.
- 23) Guy, S. and Farmer, G. (2001) Reinterpreting sustainable architecture: the place of technology. *Journal of Architectural Education*, 54(3), pp. 140-148.
- 24) Hindle, R. and Rwelamila, P. (1998) Resistance to change: architectural education in a turbulent environment. *Engineering, Construction and Architectural Management*, 5(2), 150-158.
- 25) Kaufman, P., Bradby, D., and Teitelbaum, P. (2000) *High Schools That Work and whole school reform: Raising academic achievement of vocational completers through the reform of school practice*. Berkeley, CA: University of California at Berkeley, National Center for Research in Vocational Education. (ED 438 418)
- 26) MacDonald, S. (1998) Post-it culture: post-modernism and art and design education. *International Journal of Art & Design Education*, 17(3), pp. 227-235(9).
- 27) Maira, S. (2003) *Desis in the House: Indian American Youth Culture in New York City Philadelphia*: Temple University Press.
- 28) McCormick, R. (2004) Collaboration: The Challenge of ICT. *International Journal of Technology and Design Education*, 14, 159-176.
- 29) McCormick, R. and Scrimshaw, P. (2001) Information and communications technology, knowledge and pedagogy. *Education, Communication & Information*, 1(1), 39-57.
- 30) Ministry of Education. (1998) *Building up a life-learning society*. Taipei, Taiwan: MOE.
- 31) National Science Council. (2003) *White paper on science and technology: visions and strategies for the development of science and technology, 2003-2006*. Taipei, Taiwan: NSC.
- 32) Vaira, M. (2004) Globalization and higher education organizational change: A framework for analysis, *Higher Education*, 48(4), pp.483-510.
- 33) Wang, T. (2004) *Curricular planning of upgrading the practical and professional competence of students in Technological Colleges*. Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition, Salt Lake City, UT.
- 34) Willinsky, J. (2002) Education and Democracy: The Missing Link May Be Ours. *Harvard Educational Review*, 72(3), 367-392. <http://www.edreview.org/harvard02/2002/fa02/f02will.htm>

Brief Biography:

Dr. Wang has over twenty years of experience as an architectural designer, engineer, and educator. Currently, he is an Associate Professor of Architecture at the College of Design and Graduate Institute of Vocational & Technological Education at the National Taipei University of Technology, Taiwan - a multi-disciplinary teaching and research engaged in the educational technologies and the development of learning environments which are sensitive to diversity, culture and ethics issues. His research integrates aspects of architectural education, sustainable environment, and the learning, knowledge, & technology. Currently, he is doing research and study based on inquiry-oriented action research and how technology and project-based strategies can support teachers' learning and technology-mediated learning environments support students' and teachers' inquiry learning. Dr. Wang has also actively served committees member of jury for government and private sectors in architecture and information technology.