Curriculum Reform and the Impact of ICT on Architectural Education: Case Study at King Saud University

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Abstract:

Schools of Architecture all over are repeatedly required to find new strategies for integrating Information and Communication Technology (ICT) into architectural education. Developments in ICT are so dynamic that in many cases the implementation gap becomes overwhelming. Bridging such a gap requires systematic efforts and cannot be achieved in one giant step. A way of organizing such effort is to setout intermediate goals and long-term objectives.

This paper considers the case of King Saud University College of Architecture and Planning, whereby a major reform of the curricula is underway, and proposes a number of specific 'critical' areas of implementation of ICT to focus on as intermediate goals towards the long-term aim of joining the IT age. Since only intermediate goals are aimed for the strategy should combine the benefits of the new technology with the established traditional methods and tools and view the technology not as an end in itself, rather as means of overcoming difficulties with the educational process.

Keywords: Architectural design studio, Information Technology, Education.

تطوير المناهج وأثر تقنية المعلومات والاتصالات على التعليم المعماري:
حالة دراسية كلية العمارة والتخطيط بجامعة الملك سعود

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كلية العمارة والتخطيط, جامعة الملك سعود

تواجه كليات العمارة بشكل مستمر الحاجة إلى إيجاد استراتيجيات جديدة لمواكبة تطورات تقنية المعلومات والاتصالات وإدراجها ضمن مناهجها وطرق التعليم المعماري. النمو السريع لهذه التقنيات جعل هذه "الفجوة التطبيقية" دائما قائمة, بل تتسع أحيانا لتصبح هوة تكاد تعجز الكليات عن مواكبة عصر المعلوماتية. يتطلب سد هذه الفجوة جهدا منظما ولا يمكن تحقيقه من خلال قفزة واحدة جبارة. من الوسائل الفعالة لتنظيم هذه الجهود تحديد أهداف وسيطة وغايات بعيدة المدى. يتناول هذا البحث حالة كلية العمارة والتخطيط بجامعة الملك سعود, حيث يجري حاليا برنامج مكثف لتطوير المناهج الدراسية. يهدف البحث ضمن هذا الإطار للوصول إلى عدد محدد من مجالات التطبيق "الحرجة" ذات التأثير الإيجابي الواضح بحيث يمكن اعتبارها أهداف تطبيقية متوسطة المدى تؤدي في النهاية للغاية المنشودة. هذا التوجه الذي يركز أولا على الأهداف الوسيطة يعني أيضا أن الاستراتيجية المطلوبة يجب أن تجمع بين فوائد التقنيات الحديثة وإيجابيات الطرق والوسائل التعليمية التقليدية القائمة حاليا, وتعامل هذه التقنيات ليس كهدف في حد ذاته, بل كوسيلة للتغلب على الصعوبات التي تواجه العملية التعليمية.

1. Introduction:

During the last decade, computer-aided design (CAD) education was integrated, to various extents, into the curricula of virtually all schools of architecture worldwide. The conversion from drawing board to desktop environment has taken place, particularly in the third world and middle-eastern region, to a scale unprecedented before. CAD software has become sufficiently user friendly, and computer hardware remarkably affordable, to prompt this transition and enable schools of architecture to include compulsory CAD courses in their curricula.

In the literature, a fair number of studies has been undertaken to propose strategies for integrating CAD into the schools' curricula. Some of this research is specifically directed towards assessing the impact of such technology within the local context of application, as for example in the middle-eastern context of Jordan:

"Students are trained to adapt design thinking into the new innovation of CAD … to enable the transition without creating a chaotic thinking atmosphere". (Agabani, F. and Qaqish, R., 1995: PP 47-50).

Other studies stressed the relation to local experience and expertise, like in Bratislava:

"Slovak architects, urbanists, engineers and constructors must find their own way in the different social, economical and even technical environment. ... This process is strongly supported and influenced by architectural education" (kosco, I. and Furdik, J. 1994: PP 47-51).

Soon afterwards, during the last 'half-decade' so to speak, the spread of information and communication technology (ICT) has been quite dynamic, and in fact much more aggressive than the "innovation of CAD". As a result, the emphasis has shifted towards not only bringing CAD into the studio to enhance design thinking and creativity, but also to support interactive processes through communication and databases. Once again, new strategies are required by schools of architecture to maximize the benefits of the already existing CAD systems and, in some cases, enable a more efficient management of course delivery system through the potentials of ICT. Garba (2002) has demonstrated the utility of computer aided

instruction in teaching history of architecture at KFUPM University in Saudi Arabia. At the same college, Siddiqi (2003) argues that architectural schools were among the latecomers in the domain of IT application in education, but the gap is narrowing. IT has addressed most tangible issues of human life but many challenges still haunt architectural educators.

The College of Architecture and Planning at King Saud University (KSU) is actively seeking a strategy for integrating information technology (IT) into the set curricula. Computer facilities, which were limited to computer 'labs', are now gradually being provided in the design studio halls. Various incremental plans for better utilization of computer support facilities are also contemplated. A more comprehensive strategy, however, is required in order to end a crisis situation at KSU whereby a dramatic expansion in computer facilities is met by diminishing returns in terms of design quality in the studios. Although students use CAD animation more frequently now, this remains limited exclusively to the later stages of the design process – merely as a presentation tool. A great deal more effort is required before CAD and IT can become positive media for design at the college.

The college, however, is in some sort of a transitional stage whereby a program has been set in motion to restructure and expand on the existing two streams of study for the Bachelor degrees in Architecture and in Planning offered by the college. The Department of Architecture intends to introduce more options of "specialization block courses", constituting the last three semesters in the study plan, in fields such as interior architecture and building technology. All this entails that the existing course structure will have to be radically remodeled, and its contents rewritten. Since a serious course review is anyway overdue, to take care of the recent developments in educational trends, the set task has become quite complex. This curriculum reform plan, however, is being actively worked out and is likely to materialize soon. Hence, the present research becomes timely and may be considered as a contribution in this direction. This will be limited to the design studio part of the curriculum, the backbone of all architectural education systems, and will explore the potential applications of CAD and ICT as media for upgrading architectural education at KSU.

2. Computer support for Design Studio Courses:

Within the Department of Architecture, there is a mood for seeking out new ideas to improve students' performance in design studio. Present attempts include frequent 'one-day' design exercises (quiz) aimed at training on design process and graphic presentation skills. As part of these efforts, and as a response to an assignment by the Head of Architecture, the author presented a review and display of the set studio design courses in such a way as to highlight the links between the successive courses. Part of this work is presented in the charts shown in Figure (1) (as well as Figure (4) to be discussed later). The objective was to make explicit the required skills the student should attain at each design course level, as well as propose the operational means of achieving such skills. It became apparent through this exercise that CAD/IT skills are not well related to studio design courses as set in the curricula. It was further pointed out that the students are not effectively using computer support for studio design. Many spend long hours trying to excel by exploiting computer support as a source of design skill and knowledge, but face difficulties due to limitations in the existing setup in the college and the university in general.

One particular example may suffice for the moment to expose the nature of such limitations: The analysis of 'case studies', or design precedents, is extensively used at the early stages of studio design projects as a means of exploring the components and constraints of the set problem. Omer Akin (2002) holds that case-based instruction (CBI), which takes the form of precedent analysis, continues to be a widely used instruction technique in the studio setting. This technique is also typical of many colleges in the Middle-eastern region whereby three "cases" are usually required, one each as local, regional, and international precedent. This of course is a recognized technique that combines the added advantage of allowing the student, while tackling the set design problem, to pick up along the way more knowledge about theories of architecture. The students usually sift through books and journals to locate relevant precedents. Many, however, resort to the Internet without much success, and typically end up back in the library, or the Department's reading room – which may not be up-to-date. The college has no digital library of architectural precedents as part of its computer support setup.

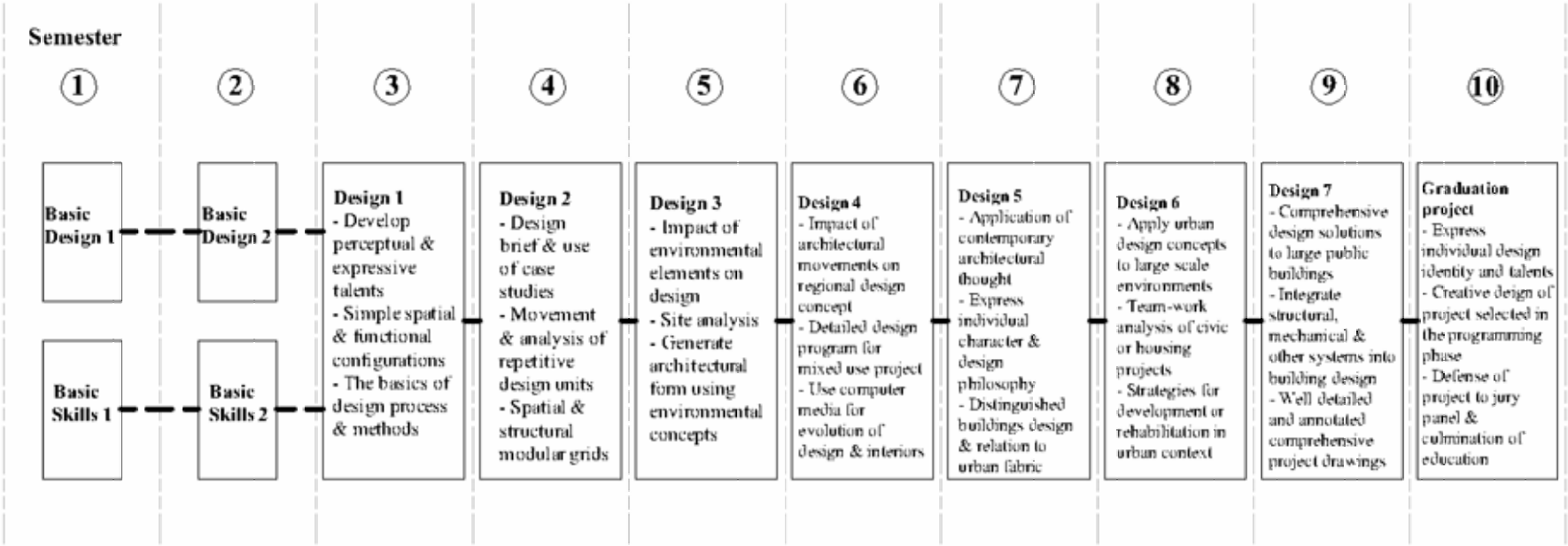

Figure (1) : A simplified chart of the contents of the set studio design courses. The object is to make explicit, and in a nutshell, the design skills required to be attained by the student at each level, and the means of developing such skills.

3. Areas for Implementing Information Technology:

The above is only one example of the need for the college to seek out a strategy for implementing CAD/IT as a medium for upgrading architectural education. This is particularly urgent considering the current substantial provision of computer hardware facilities at the college. The critical areas for implementation with maximum impact, which the College can deal with in the short and long terms, are as follows:

1. Integrating CAD/ICT into studio design courses.
2. Integrating theoretical courses into studio design.
3. Utilization of computer assisted learning (CAL).
4. Building a database of architectural precedents.

With this in mind, this work sets out to systematically explore these areas of application as relevant to the context of the college at KSU and its intended curriculum reform plan. The ideas illustrated here may be viewed as a step towards establishing a more comprehensive theoretical framework and operational strategy for integrating information and communication technology into architectural education at the college.

4. Intermediate Goals for Bridging the Implementation Gap:

To bridge the implementation gap outlined above requires systematic efforts and cannot be achieved in a single step. In such a situation, one should perhaps focus on ‘intermediate goals’ as a step forward towards long-term aims. Since only intermediate goals are aimed for, such a strategy should combine the benefits of the new technology with the established traditional methods and tools, such as sketchpads, drawing boards, and jury sessions.

Recently the main theme in the literature dealing with the implementation of CAD/ICT in architectural education has shifted from focusing on the computer as a tool, which facilitates development of design drawings, towards considering CAD and ICT as media for overall design process, and in some cases “the only design

medium" (Hanna 2001). Another emerging area of implementation of ICT is the management of course delivery system. Hanna (1998) provides a good account of how computers are currently having a new role in exploring design and in teaching design. He holds that "CAD is not a tool; CAD is a medium. It provides an environment to explore and test design ideas by means of interactive three-dimensional solid modeling and visualization".

Unfortunately, however, Hanna underestimates the role of freehand sketching in design. He considers "the uniqueness of sketching as a design tool" to be an outdated concept, soon to be replaced by developments in CAD systems. Mitchell (2000) reported that the MIT faculty members encourage their students to continue using traditional methods of representation. Although at the MIT they have added a computer terminal at each student's desk, Mitchell emphasizes that the aim is to supplement the capacities of the traditional studio space rather than to substitute them. Other institutions may take a different approach, such as Colombia University whereby in recent years they have developed a "paperless studio". Students carry out their work exclusively in computer medium. Mitchell does not advocate this approach and believes that the traditional design media and techniques remain valuable. In particular, he believes that "freehand sketching remains an enormously important activity in the design process…. It is a technique that involves numerous cognitive cycles that significantly help the designer develop his or her design".

The four critical areas, identified above, for implementing CAD and ICT and integrating that into architectural education will now be considered in turn. To fully understand the context of this study, however, it is necessary first to give a very brief description of the existing situation of computer support at KSU.

5. The Existing Setup of Computer Support at KSU:

The College has already in operation a local area network (LAN) and all students are assigned accounts to access the network. The network covers the 'computer halls' and the two 'Graduation Project studios' for Architecture and Planning, as well as the

teaching staff rooms. Expansion of the network to cover all studio halls (numbering 14 in total) has been halted, probably because the college is due to move premises into a new building, now under construction. In total about 280 computers (PCs) are provided in six computer halls of various capacities. Adequate numbers of scanners, printers, and plotters are provided, and studio projectors and screens installed. The hardware setup is in fact quite impressive. However, it is not matched by similarly robust software and technical staff support to assist the studio tutors.

The computer halls are used primarily for teaching CAD courses and for undertaking two studio design courses, one for Architecture (Arch. Design-4) and the other for Planning, in which the use of computer medium is a major requirement. This is in addition to delivering a few taught courses where the tutors make a point of training the students on relevant computer application programs. Otherwise, the students use the computer halls when available, mainly for scanning, printing and plotting, and sometimes storing their project drawings in the network server. Presently a few application programs, such as MS Office, AutoCAD and ArchiCad are available over the LAN, but no database or digital archive is provided.

The college has recently established a digital archive unit that has commenced building up a digital library for architecture and planning. This archive is stored in the unit's own computers and is not available over the LAN, yet. So far, the unit is scanning the existing slides library accumulated over the years. This digital archive is in no way adequate or comprehensive, but represents a step in the right direction. It is, however, a far cry from a well thought out and structured relational data base of architectural precedents badly needed by our students to support their design studio projects.

The college does not provide the students with access to the Internet, yet. The college is in the process of installing 30 PCs in an 'Internet Hall' for use by students, and is presently awaiting Internet access to be given by the university computer center. The university, in general, is expanding its Internet service and this is now gradually reaching the students.

6. Integrating CAD/ICT into Studio Design Courses:

The poor integration of CAD/ICT into studio design courses at KSU has already been pointed out. It may be witnessed, rather dramatically, in the complete separation of studio halls and computer rooms, both physically and by program. Figure (2) illustrates this situation. This may be compared to the situation, shown in Figure (3), whereby a design studio was specially set up during the summer of 2001 for work on a major design competition in which some of the Faculty members and students took part. Computers were extensively used side by side with drawing boards and block models. The space itself was re-arranged to allow for this and computer data cables from the LAN were dropped through the ceiling. This brief exercise was valued positively in the College. It made a convincing argument for changing the design studio environment to work perhaps more like many office settings whereby there is a blend of traditional design methods along with new technologies.

It is interesting to note that the leader of this same design team was able in the following academic year to provide rather extensive computer support within his design studio hall (Arch. Design-6: Urban Design). The students were required at the end of the program to present their work for the jury panel solely through digital presentations. In fact, the students were instructed to organize the urban design problem itself as a database but this did not really happen, probably because the students lacked the required expertise. This exercise in using computer support in the studio, though limited in scope, is still a significant start and one-step forward towards computer/drawing board interchangeability. Such an integration of CAD/IT into design courses was a pioneering effort, and will probably be the norm in all studios in the near future, as part of the college reform plan currently underway for better utilization of computer support. However, it was not without some negative aspects. One drawback was that the final presentations given by the students using “Power Point” and desktop projectors tended to be a ‘one-way’ affair with little interaction with the jury panel. It was quite different from traditional jury settings where the tutors participated more actively while being presented with the whole set of project drawings together, as hard copies.

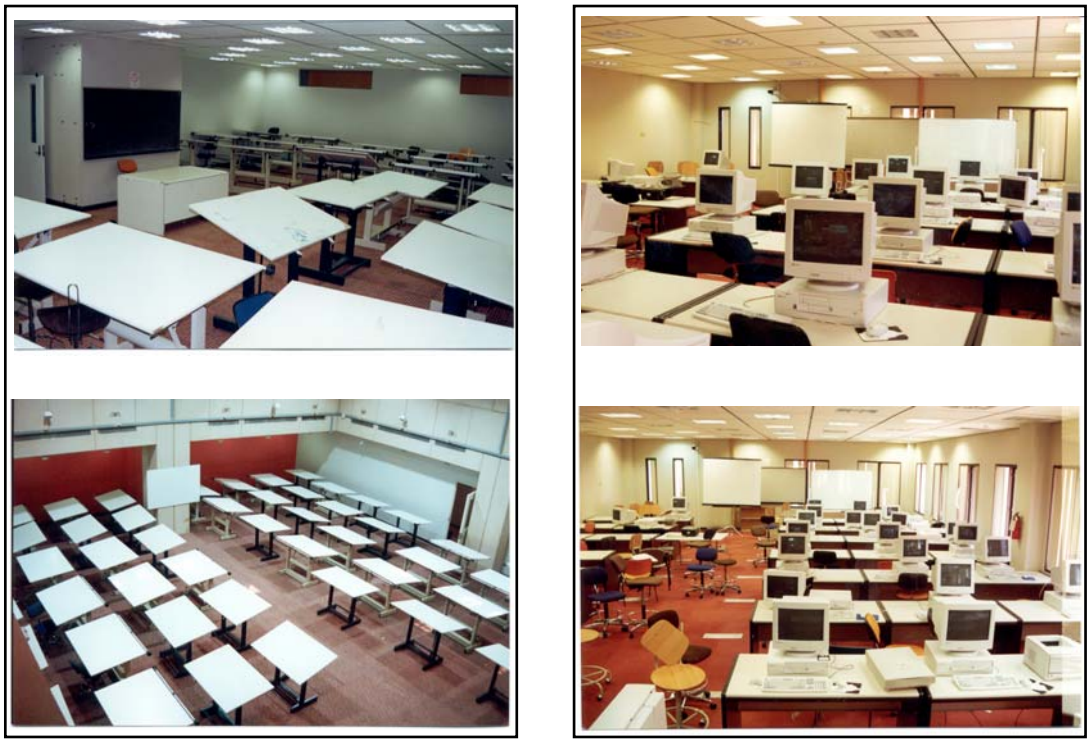

Figure (2): The complete separation of studio halls (on the left) and computer rooms (on the right). This contributes to the poor integration of CAD/ICT into studio design courses.

Figure (3): A design studio specially set up for work on a major competition. Computers are used side by side with drawing boards and block models.

Our students generally use computers more intensively in the studio following completion of Arch. Design-4 in which they are required to use CAD as the main medium for design. Some of the faculty members have pointed out that use of computer skills in the set courses should in fact start at the early stage of "Architectural Graphics" and "Basic Design" which precedes studio design courses. This was turned down; probably because of an undercurrent among the Faculty in our Department that resists the "too early" utilization of computer medium.

7. Integrating Theoretical Courses into Studio Design:

The integration of architectural science or theory of architecture disciplines into design courses is only occasionally discussed in the literature. In particular, the ability of IT to bridge this gap is not sufficiently explored. At KSU, the rigid demarcation of courses is a negative aspect of the course structure, as well as the course delivery system. The student's knowledge/skills continue to develop separately in each field and are poorly related to design studio courses. It is left to the student's own initiative to integrate the knowledge gained in various courses as they progress, and implement that knowledge in studio design. Although this may seem easy for tutors, who are experienced designers, it is not obvious for the student whose aim is usually to pass each course separately. The links between all architectural courses should be made visible to the student, and ideally should be 'built-in' in the study plan.

This state of affairs is in part fostered by a sequential arrangement of the successive courses as set in the study plan, whereby the 'theoretical' taught courses are not well linked to the studio design courses. This may be seen in the chart shown in Figure (4), which is intended to expose the links between all the courses in the set curricula. It was prepared to test the situation in the event that a proposed study plan is implemented by the College whereby students of Architecture and Planning do two, rather than one, common years (presently a hot issue in the College). One can see from the chart that many taught courses in theory of architecture and building

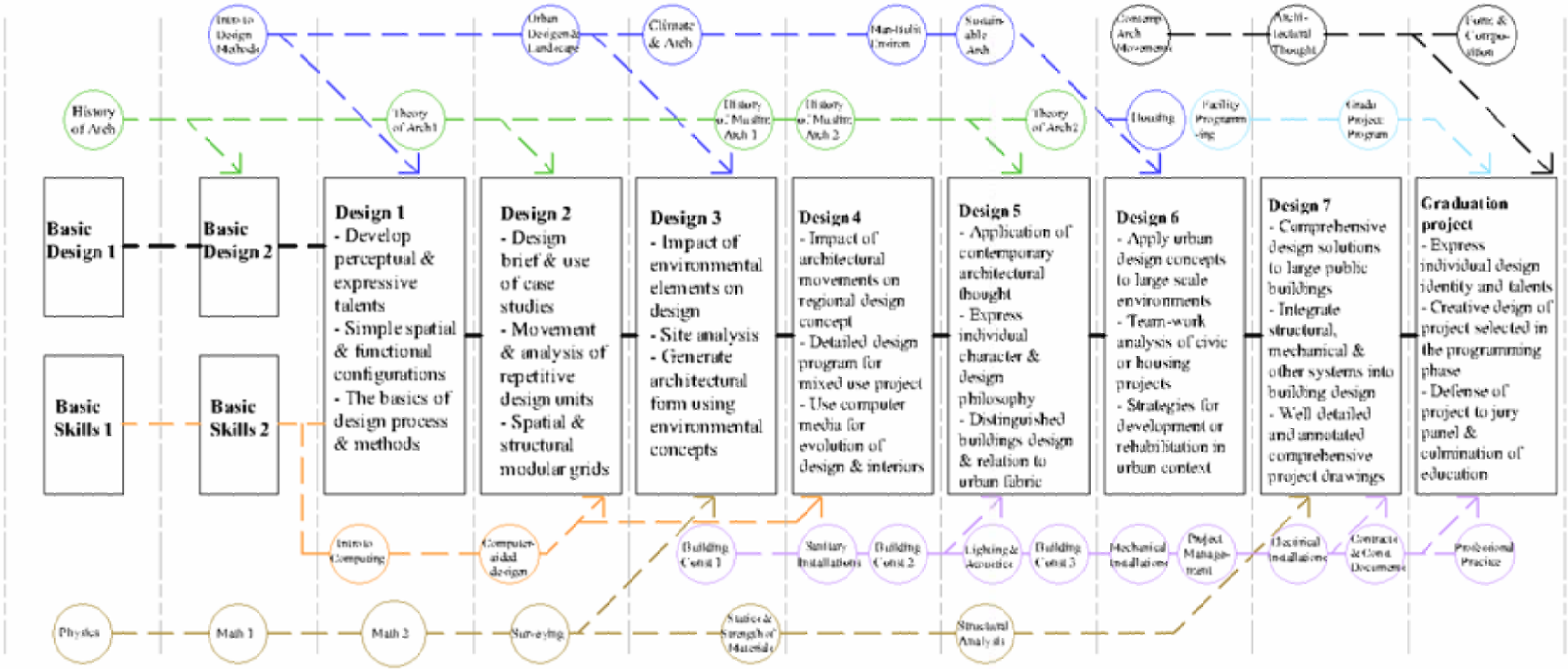

Figure (4): As an extension of fig. (1), this chart exposes the links between all courses in the curriculum. Taught courses are arranged into 'strings' of fields of study and the arrows indicate where the courses usefully feed into studio design.

construction, as well as computer skills, are set rather late in the study plan to feed usefully into studio design courses taken at earlier levels. One way out for resolving this situation and bringing theoretical disciplines into studio design could be through the utilization of computer assisted learning, to be discussed in the next section.

In most schools of architecture worldwide, theory is an integral part of the design studio learning. The best way to train students on a particular issue is perhaps by 'dropping it' right in the middle of a studio project. The mere memorization of theory courses does not constitute an effective knowledge base for designing. Learning about design methods or architectural precedents, for example, remain ineffective until that knowledge is put-into practice. Learning by doing is the proven method in profession-oriented programs like architecture. Just like in the Medical disciplines, the student work should be assessed by the tutors not only on the bases of how much is learned from theory but also how well it is applied in the studio, and treating the design situation, as a 'design case' perhaps. As Brady (1996) argues, the medium itself and making use of information directly affect the end-result and the students learning experience. Medical students spend more time in teaching hospitals training on actual cases, following their pre-medical studies. Similarly, training in Architecture should ideally be built-into the set courses and not merely undertaken for a brief period towards the end of the study program.

8. Utilization of CAL and Multimedia Resources:

Courses on areas such as design process and theory of architecture should ideally be taught as part of design studio at each level, though this may be difficult to achieve. If that was possible however, then the tutors could have identified the abilities and skills needed by the students and dealt with them in parallel with the development of students' design process. In all cases, however, computer assisted learning (CAL) methods may be used to achieve such an integration of theory and design in a step-wise fashion, by filling-in gaps in the student's knowledge. The value of CAL in supporting taught courses is undisputable, primarily because of the

advantage of immediate feedback and interactive learning. The question here is how to utilize this fact in studio design.

Students learn best by example and by practical application. Practical exercises are not always sufficiently covered in taught courses. Hence, the theoretical concepts should always be applied in the studio. One can even go further and allow the students to explore concepts practically first, as applied in studio design, and later on the theory, as in taught courses, will illuminate the practical application. This could very well be a sound teaching method considering that some important courses are set rather late in the study plan, or that the students did not receive sufficient practical training through the taught courses. Either way, what is of special significance is that tutors should adopt a problem-solving approach in studio design whereby students learn from their own efforts, as well as from documented precedents. Students may then be assigned 'mini projects', focusing on specific skills or gaps in their design knowledge, which they can do at their own pace through CAL if it becomes available. Examples that easily come to mind for areas in which the students would willingly seek CAL at KSU are perhaps the application of structures, acoustic treatment and air conditioning systems to advanced studio design projects.

9. Building a Database of Architectural Precedents:

Perhaps the most effective way to enhance students' performance in design studio would be through establishing a database of architectural precedents. This will probably have to be provided in-house or through university links. Library databases available over the Internet, even when accessible, are not particularly helpful in architectural design. In most cases, such sites refer the user to published literature, largely not available locally, or provide only a brief documentation. A number of web sites, such as 'ArchNet' for instance, have digital archives of important buildings and award winning projects in the Muslim World (http://archnet.org/library). Usually such documentation is quite valuable for studies in theory of architecture but not comprehensive enough for detailed case studies of architectural design.

This situation is further compounded by another factor, the language barrier. Despite the fact that our students are supposed to be proficient in English, they typically make little use of material in English. The majority of case studies selected by students are ones reported in Arabic text journals, which is an unnecessary limitation. This lends further support to the need for an in-house digital library, which should be in both Arabic and English texts. Presently, students who 'surf' the net tend to wander rather aimlessly without getting anywhere near to a well-documented case study to report on.

10. Conclusions and Recommendations:

To bridge the gap, now ever widening, towards joining the IT age is a massive task that requires systematic efforts and cannot be achieved via one giant leap. This goes beyond the deployment of capital resources and requires serious assessment of where we stand today and where we should be heading. The main idea presented in this paper is to establish intermediate goals and focus on specific areas of implementation of IT with maximum impact on upgrading the educational process. Ultimately, a more detailed strategy is required, based on a clear theoretical framework of set objectives and operational means.

The current plans now underway by the college to restructure itself and review the curricula should focus on bringing CAD and ICT into the design studio to enhance creative thinking, particularly at the early stages of the design process. The reform plan should adopt a strategy that combines the benefits of the new technology with the established methods and tools, and view the technology, not as an end in itself, rather as means of overcoming difficulties with the educational process. The present outstanding difficulties include integrating theoretical disciplines with design studio courses and the practical application of concepts and knowledge in design. Finally, exploiting the potentials of computer assisted learning, and establishing a digital library of architectural precedents seem to be two projects which would maximize the benefits of IT at KSU.

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References:

Agabani, F. and Qaqish, R., "A Strategy for Teaching CAAD: A Case Study at Applied Science University", Open House International Vol. 20 No. 2, (1995), PP. 47-50.

Akin, O., "Case-based Instruction Strategies in Architecture", Design Studies, Vol. 23 No. 4, July (2002), PP. 407-431.

Brady, D., "Education of an Architect: Community and Change", Journal of Architectural Education, September (1996).

Garba, S. B., "Computer Aided Instruction in the Teaching of Architectural History in KFUPM: A Review of Current Experience and Future Challenges", Paper at the Symposium on Architectural Education in the Kingdom of Saudi Arabia, King Faisal University, Dammam, April (2002).

Hanna, R. and Barber, T., "An Inquiry into Computers in Design: Attitudes before – Attitudes After", Design Studies Vol. 22 No. 3, May (2001), PP. 225-281.

Hanna, R., "Can IT Bridge the Gulf between Science and Architecture?", Proceedings of the 16th European Conference on Education in CAAD, (ECAADE), Paris, France (1998).

Http://archnet/library/ Web site of project developed at MIT School of Architecture and Planning with support of Aga Khan Trust for Culture, November (2002).

Kosco, I. and Furdik, J., "CAD in Slovak Architectural Education and Practice", in the Virtual Studio, Proceedings of the 12th European Conference on Education in CAAD, (ECAADE), Glasgow, UK, (1994), PP 47-51.

Mitchell, W. J., "The Future of the Design Studio", In an essay by M. Al-Asad and M. Musa on a presentation given by William Mitchell to Diwan al-Manar, February (2000). http://www.csbe.org/lec-1.htm

Prospectus of the Department of Architecture and Building Science, College of Architecture and Planning, King Saud University, Riyadh, KSA, (1999).

Siddiqi, Anis, "Challenges of Writing Curriculum in the Age of Information Technology", International Conference on Building Education and Research (BEAR), University of Salford, UK, April (2003).