Architectural learning: evaluating the work environment and the style of teaching and management in design studio

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Three variables play a key role in architectural design education: the studio environment, style of teaching and studio management, and the type of interaction between the instructor and his/her student. As a contribution towards improving the quality of design education, this study aims at evaluating these three variables as well as identifying the most influential factors on the design grading system. The study adopts a descriptive and analytical approach, including a large scale survey questionnaire of 36 instructors and 380 students of various studio levels in the Department of Architecture at King Saud University, in Saudi Arabia, as well as observations of studio behavior and interviews with some of the participants. Recommendations call for the importance of reviewing the style of teaching and management in design studio to meet the objectives of architectural education. Several suggestions for improvement are presented. The most prominent ones are differentiating between studio levels in terms of teaching style, splitting the large studios into more than one section to increase the interaction time, providing intensive lectures, introducing elective design workshops dealing with similar design cases, and providing a qualified teaching assistant in addition to the design instructor.

هناك ثلاثة متغيرات تلعب دورًا مهمًا في عملية التعليم المعماري، هي: بيئة الأستوديو، وأسلوب التدريس وإدراة الأستوديو، ونوع التفاعل بين أستاذ التصميم وطلبته. تهدف هذه الدراسة إلى تقويم هذه المتغيرات الثلاثة، بالإضافة إلى تحديد العوامل الأكثر تأثيرًا في كيفية تقويم مشروعات الطلبة في قسم العمارة وعلوم البناء ونظام وضع الدرجات. اتبعت هذه الدراسة المنهج الوصفي التحليلي للمعلومات المستخلصة من خلال إجراء مسح ميداني اعتمد على مقابلات شخصية واستبانة ذاتية التعبئة استهدفت جميع أعضاء هيئة التدريس وطلبة التصميم المعماري في قسم العمارة وعلوم البناء في جامعة الملك سعود. أظهرت نتائج هذه الدراسة جملة من الاقتراحات والتوصيات التي يمكن أن تساهم في الارتقاء بأسلوب التدريس والإدارة في أستوديو التصميم المعماري. من أهم تلك التوصيات، تغيير أسلوب التدريس والإدارة في الاستوديو حسب مستوى التصميم، تقليص حجم الأستوديو (عدد الطلاب) إلى شعب أصغر لزيادة وقت التفاعل والاتصال بين الأستاذ والطالب، زيادة الوقت المخصص لإلقاء المحاضرات ذات العلاقة أثناء الأستوديو، زيادة عدد المعيدين ومساعدي التدريس المؤهلين لكل شعبة تصميم.

Keywords: Architectural learning, Design education, Design studio, Teaching style, Studio management

1. Introduction

1.1. Historical background

The department of architecture started in 1967, as the first architecture department in the Arabian Peninsula, within the College of Engineering at King Saud University (KSU). In 1983, a specialized committee consisting of several faculty members holding PhD degrees from top American and European universities (e.g. Harvard, MIT, and Michigan) worked out a program for an independent college of architecture and planning with two departments: the department of architecture and building sciences and the department of urban planning. Currently, the college has almost 900 enrolled students with an approximate annual intake of 180 new students selected from around 500 candidates. Three quarters of them enroll in the department of architecture and building sciences after the completion of the first common year. The College study program is five years, and a student is required to complete successfully 175 credit hours as well as undertake three months field training. Basic skills, basic design and design studios are the core of the curriculum, covering almost 43% of the study program. The

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department of architecture also offers postgraduate studies (MArch and PhD) in architecture and related professional disciplines supported by an extensive range of facilities, including a library, image library, workshop, model shop, electronic media lab and well equipped computer labs (see figs. 1 and 2).

Recently, the Department of Architecture has formed special committees for performance evaluation, conducted each semester involving students and faculty to identify all the possible ways and means that can be used to improve the quality of studio teaching and learning. The most recent evaluation (2003) revealed that the faculty is somewhat dissatisfied with students' performance in design studios as compared to the time and efforts given by the college and faculty. Such feeling is also shared worldwide [1-8]. This paper attempts to address this issue and discover the bases of such dissatisfaction.

1.2. Literature review

A review of recent literature reveals the massive efforts that concerned researchers have devoted toward improving the quality of design education as well as increasing our understanding of the cognitive properties of design. Recent studies stress the need for a major change in current design education since architectural practice is changing and transforming rapidly [9-12]. Other studies imply that the problems of the profession have their roots in the current educational system of architecture [13, 1, 2, 8] [4] added that the education and the practice of architecture in recent times faces severe challenges and crucial issues caused by the current approach to teaching architectural design which follows principles and rules developed in the past, and not equipped to confront the environmental needs of contemporary societies. An analysis of such criticism and its influences on design education indicates that design education is greatly dependent on many variables that may belong to three main factors: the style of teaching, the studio environment, and the design instructor.

In terms of teaching style [14, 15] argue that the studio design teaching has a unique characteristic that distinguishes it from other types of technical design education. While the latter generally relies on a systematic approach, which mainly focuses on the problem in order to reach the correct solution, architectural design education, in contrast, focuses mainly on proposing a series of possible solutions and, through a process of elimination, selects the most acceptable ones. [9] Add that since design decisions are subjective and the design requirements are controversial, the process of argumentation helps the designer understand the given design situation, locate the source of controversy, and select the appropriate course of action.

[2], in his study of design studio, argues that design education is a complex process since it is generally based on the imitation of professional task performance where the measure of learning is associated with the evaluation of the product of designing rather than on a learning increment. On top of that, most design education deals with guiding students to discover their own ways of designing rather than teaching them how to design. [3] Also argues that students are not only expected to grasp many new concepts, but they are also required to perform at least two tasks simultaneously: 'to design and to learn to design'. Another study reveals that the students must learn how to present and defend their design concept verbally and graphically as well as learn how to establish a relationship based on trust and commitment with their studio instructors [16].

The design studio, which has been widely adopted for architectural design education, is in itself, a complex experience. Although it is considered as the essence of design learning, interaction and creativity, there is a variety of design teaching methods adopted at studios all over the world and, even, within the same college [17-19]. For students, the studio is more than a place to study, it is as [20] notes: 'the culture of the architectural profession'. She defines the source for patterns of studio design education as derived from the famous French design institute, the Ecole des Beaux Arts. A design studio is also described as a

social place for mutual interaction among students themselves and with their instructors [6]. [1] Defines the studio as a place for making designs under the periodic guidance of the design instructor who intervenes in the student's designing, generally in reaction to the student's explicit design. Another definition considered the studio as a 'melting pot' where many disciplines related to architecture are integrated [21]. The underlying idea is that the design studio is the place where students are expected to grasp, present, and defend design concepts, as well as acquire new techniques and skills. Other researchers, however, have commented on the studio and its role in the current design education; while some researchers are in favor of a reform of the design studio and the architecture curriculum [22-25], others go so far as to suggest canceling the design studio in design education [26-28].

Other important factors that make design education a complex, and perhaps a unique, process are the type of interaction between the instructor and his/her students and the need to complete the studio requirements in a limited period. In this regard, [9] state that "the mishap in design studio teaching is that the instructor, consciously or not, tries to impose his/her design ideas instead of helping the students develop their own." [3] Also argues that the student in the studio must take into consideration not only the design project and the nature of the design process but also the other demands of the studio, namely, the instructors' preferences. Hence, each instructor teaches according to his/her own set of ideologies and beliefs, which gives a tremendous diversity of contents, methods of teaching, and design requirements. In some studios, the instructor may dismiss a project if the student's idea contradicts with his/her own values, even if it is successfully implemented in a design plan [9].

Concerning the students' ability to complete the studio requirements, [3] remarks that only a few students can complete them without encountering difficulties. He thinks that there are many causes for the incompletion of work, the most apparent one being that students do not know how to begin, or are not sure how to proceed, or simply, 'being frozen or stuck' [3, 29]. This behavior can be perceived as an obstruction to progress in the studio. Since the studio requirements are many and varied, producing a good design solution to the given problem within the given time period is considered an achievement. Therefore, progress is expected to be visible in the architectural production by means of drawings and models, whereas in some studios progress is measured in terms of the production of more drawings whatever their content [3].

Other studies, on the other hand, manifest the importance of knowing how to teach students to generate a design concept and to improve their skills in graphic presentation. Many architects and some architectural students feel that a design concept is the essence of architectural design and a building is mostly appreciated because of its concept, its meaning and its underlying and integrating ideas [30]. [31] Also argues that learning the required skills in graphic representations is the most effective tool for students to express their design concept, since design primarily deals with the creation of form, and relies on visual imagery. Freehand sketching and model making are also useful tools, not only as memory aids to record ideas to be recollected but also as inseparable tools of the design process for crystallizing design ideas and for generating further thought [32].

This literature review clearly highlights the uniqueness of architectural design education as well as the complexity of the studio environment and its major effect on students' learning and, thereby, on architectural practice. It also reflects the need for more research in the field of architectural education and design teaching. Since architectural education is the backbone of the profession of architecture and since the design studio is the main concern of architectural educators, it is important to investigate the problems and difficulties encountered the design studio. What is significant about this study, however, is that it attempts to evaluate the studio environment and the style of teaching and studio management from the point of view of the users themselves, and hence may be considered as a further contribution towards

improving the quality of architectural design education.

1.3. Objectives of the study

This study attempts to achieve the following objectives:
1. Evaluating the work environment of the design studio from the perspective of its users, the students and faculty members.
2. Assessing the style of teaching and management in the design studio.
3. Identifying the most difficult issues facing students when pursuing their design problem.
4. Identifying the type of interaction that exists between the instructor and the student in the design studio.
5. Identifying the main factors influencing instructors in design grading.

1.4. Methodology

The methodology adopted for this study is based on descriptive and analytical approaches, including a large-scale survey questionnaire addressed to all students and faculty teaching staff in the Department of Architecture at King Saud University, in Saudi Arabia. Since the population to be surveyed differed in status and background, the questionnaire was produced in two separate forms to fit fluently with each type of population: the faculty and students, yet keeping the perception data and related questions in parallel formats. The questionnaire was divided into three parts: background information, factual data such as students' grades on design courses, and perceptual data regarding studio environment and teaching style. The two forms of the questionnaires were pre-tested and 36 instruments were administered to instructors and 380 to students of all studio levels on the same day with the help of studio teaching assistants.

A total of 287 student forms were returned, giving a response rate of 76%, along with 32 forms from the faculty, consisting a response rate of 89%. The responses were then coded and analyzed using the Statistical Package for Social Sciences (SPSS). Key variables such as student's Grade Point Average (GPA), design studio level and faculty position were isolated and further analyzed.

This questionnaire approach was supported by observation sessions of behavior as well as interviews that were undertaken prior to and after the finalization of the format of the questionnaire. The researcher's long experience in teaching design studio was also useful in ensuring that important issues were covered in the study.

1.5. Results and analysis

This part describes and analyzes the findings of the main variables of the survey that are thought to be significant to architectural design education. Statistical techniques, such as cross tabulations and univariate-analysis (ANOVA), were employed to test the degree of association among key variables. The discussion will be organized in the following order:
1. Description of Study Population
2. Evaluation of Studio Environment.
3. Style of Teaching and Studio Management.
4. Factors Influencing Design Grading.

2. Study population

2.1. Professors

The data shows that the current faculty body in the Department of Architecture at KSU is dominated by Assistant Professors with 69%, whereas the remaining 31% is distributed evenly between Full and Associate Professors. The data also shows that their academic teaching experience ranged from 2 to 33 years, with a mean of 13 years, while their professional practice experience ranged from none to 32 years, with a mean of 10 years. Further analysis of the data indicates that the majority of the faculty have completed their graduate studies in the USA, 72% for Masters' degree and 52% for PhD. Europe came second with 16% for Masters' degree and 42% for PhD. The remainder of the faculty obtained their higher degrees in Canada, Australia, and Egypt.

2.2. Students

The current students-per-instructor ratio is 12, the instructor-per-studio ratio is 4, and the students-per-studio ratio is 47. The data shows that the students' grade point average (GPA) out of 5 ranged from 1.93 to 4.85, with a mean of 3.13, whereas the students' average grade for design studios ranged from 1.0 to 4.85, with a mean of 3.41. Since the student's average grade on design is part of their overall GPA, a paired-sample t-test between these two variables was computed to see whether the variation between their mean values is statistically significant or not. The result of the test shows a very significant variation between the students' average grades on design and their GPA (*t-value=-6.8, a =0.000*). This result clearly indicates that in general students are inclined to get better grades in their design studios than in other courses, or that there are some courses, probably the technical ones like structures and mathematics, that are responsible for pulling down the overall GPA.

Table 1 shows a comparison of students' overall GPA and their average grades in design studio broken down by design level. The table indicates that the students' average grade in every design studio is also higher than their overall GPA. The table also indicates that the students' average grade in design studio 3 (third year) is the highest (3.57), while it is the lowest (3.17) in studio 6 (fourth year).

In addition, correlation analysis revealed that these two variables (student's GPA and design grades) are strongly correlated to each other (r = *.55*), meaning that students who have high GPA are more likely to have high grades in their design studios, and vice versa. Though this study has the limitation of being based on obtaining factual data of design grades, it suggests the importance of further investigation of the effect of other courses (theoretical and technical) on students' GPA and design grades to reach a better distribution of course work. Further, fine points of the data show that less than half of the students (47%) have a GPA above 3.0 (out of 5), while 81% have an average above 3.0 in their design studios grades. The data also show that 30% of the students have failed at least once in one of the design studios, about one third of the failures are in studio 1, and only 4% have failed twice or more. This high percentage of failed students in design studio 1 is perhaps partly due to the new policy of the Department in its attempt to improve the quality of design education. This kind of "filtering process" would disallow second-rate students to continue and give a chance only to the qualified students.

3. Evaluation of studio environment

In order to learn about the quality of the studio environment in the Department of Architecture see figs. 1 and 2, students and faculty were asked to evaluate 9 attributes considered to be very important for the work environment on a 4-level scale of adequacy. Table 2 shows the values of favorable responses of the participants' evaluation (very adequate and adequate) and the mean value to clarify the variations in the evaluation. The mean values presented in table 2 correspond to the following scale: (1 = not adequate to 4 = very adequate).

As can be seen from the table, the majority of the faculty and students perceived most of the attributes as inadequate, whereas illumination, air-conditioning, and studio capacity were evaluated as most adequate. It can be noted that the faculty were slightly more pleased with studio environment in general than students, but this difference was not statistically significant. By examining the F-value, which reflects the differences of mean values between the evaluation of the faculty members and the students to each attribute, it appears that there is no significant difference on their evaluation of the studio environment, except for the furniture arrangement and the illumination ($a \leq .05$).

To further see whether the key independent variables: teaching experience, academic status, and studio level have an effect on faculty evaluation of outcomes, a univariate-analysis test (ANOVA) was carried out. The results of the test reveal no significant association between any of the nine attributes and the two variables: faculty members teaching experience and their academic status. Meanwhile, the test provides

Table 1
The distribution of students' overall GPA and their average grades in design studio according to their design levels

	Over all GPA		Students' average grade in design	
Design level	No. of cases	Mean	No. of cases	Mean
Studio 1	22	3.25	247	3.47
Studio 2	51	3.28	192	3.46
Studio 3	31	2.95	164	3.57
Studio 4	25	3.01	140	3.35
Studio 5	19	3.04	116	3.49
Studio 6	51	3.13	63	3.17
Studio 7	15	2.99	14	3.43
Studio 8	42	3.23	--	--
Grand mean	256	3.13	249	3.41

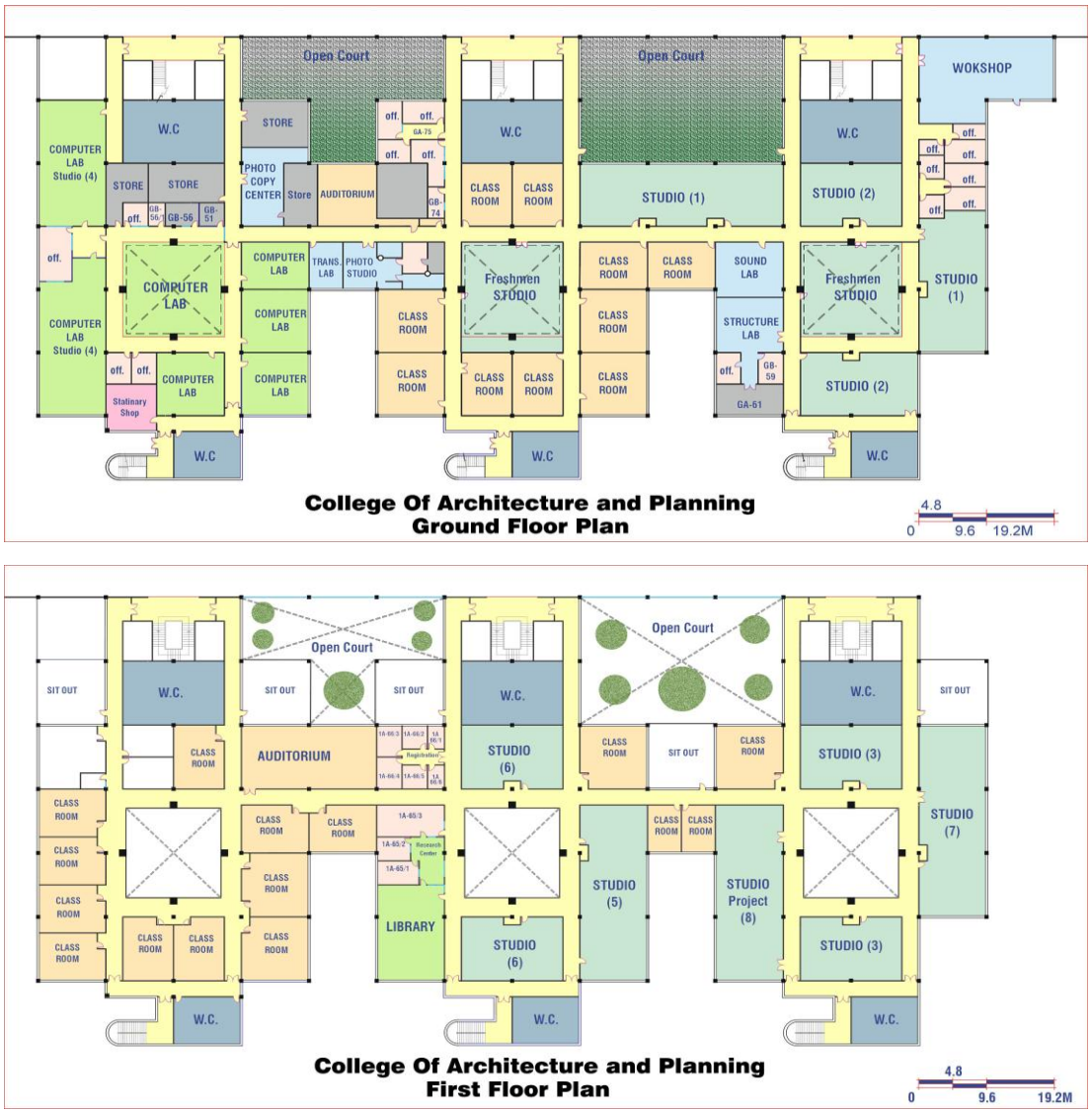
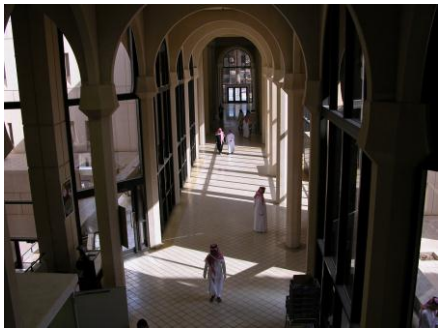


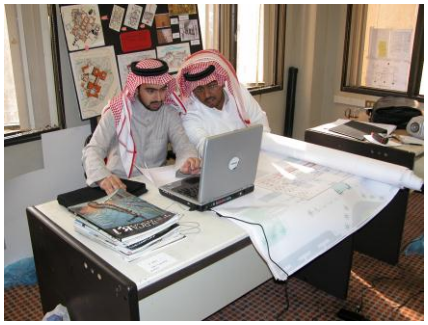
Fig. 1. Floor plans for the college of architecture and planning.

Studio (1)

Computer Lab Studio (4)



Main Corridor



Final Project Studio (8)

Fig. 2. Examples of studio environment.

Table 2
Participants' evaluation of the adequacy of the Studio environment

	Faculty		Students		Significance	
Attributes	%* (32)	Mean	%* (284)	Mean	F-value	α ≤ .05
1) Studio capacity	59.3	2.66	64.4	2.65	--	--
2) Furniture arrangement	25.0	2.00	41.2	2.34	6.28	0.013
3) Quality of tables	28.1	2.09	22.1	1.98	--	--
4) Quality of chairs	28.1	2.00	26.0	1.96	--	--
5) Day lighting	46.9	2.25	45.6	2.30	--	--
6) Illumination	87.5	3.25	79.5	2.95	5.03	0.025
7) Air-conditioning	84.4	3.19	78.8	3.03	--	--
8) Teaching aids	43.8	2.41	54.8	2.54	--	--
9) Studio appearance	53.1	2.50	38.6	2.25	2.8	0.09
All attributes	54.5%	2.48	50.1%	2.45	--	--

* % = (adequate + very adequate).

a very significant association between studio level and two of the attributes: the quality of the chairs and the day lighting, indicating that some studios are much better than others in terms of these two attributes.

A similar test was also performed to compare students' evaluation of the nine attributes and their GPA and studio level. While the test shows no indication of influence with reference to their GPA, it reveals a strong association between the studio level and their evaluation of all attributes, except for the furniture arrangement, the quality of tables, and the studio appearance. This would mean that the students' judgment on these three attributes remains the same regardless of the variation of studio level or its location.

The significant association between the studio level and its environment quality raises the question of its effect on students' design

work and grades. However, since there is inconsistency in assigning the same studio level to a regular location every term, a definite judgment would not be viable in this study, which, thereby, calls for further investigation.

4. Style of teaching and studio management

Based on the experience of the faculty in teaching and students in learning, two sets of questions were posed. One set aimed at investigating the ongoing teaching style and management in design studios and the type of interaction between instructor and student and how it could be improved. The other set of questions were designed to look into the difficulties facing students in pursuing the design problem and how it could be simplified.

4.1. Teaching style and type of interaction

Faculty members of the department of architecture usually prepare project statements for every design studio including information about building type, site context, the client, users, and other design constraints such as city codes and market demands. Depending on studio level, students are often required to develop case study analyses covering critical issues concerning the design problem such as concept, spatial relationship, circulation patterns, etc. before beginning their own design activity. The teaching style is generally based on a weekly rotation of the studio instructors to supervise groups of students. In some studios, two instructors or more comment on a student's work together, whereas in other studios each of them may see the student's work separately during the 5-hour twice weekly studio session.

This survey aimed at understanding the attitude of the faculty members and students toward the current teaching style. First they were asked whether or not they preferred having more than one instructor in a design studio, following up and critiquing the student work. Only 58% of the faculty and 53% of the students answered yes. A two-way tabulation of the latter value against the design level revealed that 76% of those who favored more than one instructor following up students' work, were students from the upper design levels (studio 4 and higher), whereas 35% were from lower levels (studios 1 to 3).

Interviews conducted with students of design 2, confirm this finding and uncovered the frustration they faced when two instructors or more criticize their design work, especially when those instructors use a different approach that disorients the students. This finding is in agreement with a study already cited earlier which suggests that the instructor's actions and his/her opinions can be seen by students as a cause of being frustrated if the comments are not understood or they do not tally with the students' perception [3].

A further question concerned the amount of time students actually use in developing their design work during the 5-hour studio session. It was found that the average actual time used was 2.2 hours. While one out of four students (26 %) reported that they work one hour or less during the studio meeting times, about one out of ten (11%) said that they used most of the studio time developing their design work. The remaining students (63%) revealed that they were able to use about 2 to 3 hours. When these results were viewed according to studio level, a great variation in the mean values of time used in the studio session was noticed in favor of students in lower studios, (a=.04). However, to understand the reasons preventing students from working in studio, they were given 7 factors elicited from interviewing students as part of the interviewing process and were asked to rank order them as shown on table 3.

It appears that "fatigue" caused by staying up all night working on design project ranked as the top cause preventing students from working full time in studio, with 49.6%. Next, comes the "waiting for the design instructor" to see student's work for comments, voted for by almost 47%. These findings are logical, since students who completed their design requirements before the studio session will tend not to put in extra work in their design sheets unless they take comments on their work from their instructors. The last three factors (5, 6, and 7) are shown to be the least significant impediments since only few

students have reported them. Interestingly, students in all studio levels (lower and upper) have shared the same feelings toward ranking the seven factors, except for "the lack of concentration" and "noise and interruption" in studio. The most likely interpretation for this phenomenon is that students in lower levels tend to be more quiet and disciplined in their studios than students in upper levels, and partly, due to the complexity of the given design problems at higher studio levels.

In terms of the type of interaction between the design instructors and their students, it was found that 35% of the faculty members could not see or discuss the assigned project with all of their students during studio session. On top of that, they reported that when they could see their students, they spent less time than they felt they should (on average, 14 minutes spent versus 25 minutes needed as revealed by the faculty). When asked about the reasons for not being able to see all of their students or spend with them the time they felt sufficient, instructors pointed out the "too large number of students to be seen in one day" as the most outstanding reason (39%). "Fatigue and exhaustion" came second with 13%. Other reasons were also suggested but their effect was only margined.

Students were also unhappy with the time their instructors spent with them discussing their design work. While 90% reported that their instructors spent 10 minutes or less, 88% thought that the discussion time should be doubled to 20 minutes. This contrasted with the faculty perception. The faculty felt that they were giving the students more time, an obvious case of mixed perceptions, with the faculty pushing the case of having too much work whereas students seek more attention. This result clearly assures the importance of increasing the discussion time, to give the instructor a chance to help students thoroughly understand the design problem, have them explore alternative design solutions, develop their own ideas, and receive objective evaluation of their design outcome.

The last question in this regard was addressed to the faculty members seeking their opinion about the ideal number of students to be assigned per instructor. It was found that 39% of the faculty go for 8 students or less, 42% for 9 or10 students, and 19% for 12 to 15 students. A cross-tabulation against design level was also obtained to identify the ideal number of students per instructor for each studio level. Table 4 shows the results.

As can be seen from the table, while some instructors suggest as low as 5 students per instructor, some others go as high as 15 students. However, the grand mean of the ideal number is 10 students. A univariate-analysis test (ANOVA) was also carried out and reveals no significant variation between the faculty's answers.

4.2. Difficulties faced in the design task

Five issues that are thought to represent the type of difficulties that students face in solving design problems were listed and students and faculty members were asked to select the most important issue from among them. Table 5 shows the resulting output. It seems that faculty and students have strongly agreed that "generating the design concept"

Table 3
Reasons preventing students from working full time in studios

Reasons	Lower levels		Upper levels		Total		Signif.
	% (114)	Rank	% (170)	Rank	% (284)	Rank	$\alpha \leq .05$
1) Fatigue	50.0	1	49.4	2	49.6	1	--
2) Waiting for instructor	47.4	2	46.5	3	46.8	2	--
3) Lack of concentration	40.4	3	50.6	1	46.5	3	0.05
4) Work under pressure	38.6	4	37.1	4	37.7	4	--
5) Lack of equipment	23.7	5	24.7	6	24.3	5	--
6) Noise and interruption	14.9	6	28.2	5	22.9	6	0.006
7) Working in front of others	14.3	7	14.7	7	14.5	7	--

was the biggest obstacle facing students, with over 81% and 53%, respectively.

However, students and faculty gave different rankings of the other difficulties. While students think that "determining the needed areas of spaces for project functions" is the second most important obstacle facing them (with 18%), none of the faculty voted for it. Meanwhile, "site analysis" ranked as the second most important issue pointed out by the faculty, but was ranked as fourth by students.

When these results were viewed by studio level, they did not show any significant variation in faculty responses, except for "site analysis" which was selected only by two instructors of upper level studios. On the other hand, there was a significant variation in students' responses to most to the 5 issues, except for "identifying project function" and "site analysis", as can be seen in table 6. The most important observation indicated in the table is that the majority of students at upper level (60.6%) do feel that "generating the design concept" is the most difficult issue facing them when compared with students of lower level studios (41.9%). This might be attributed to the complexity of the given design problem for the upper levels and probably their higher expectations as well.

As for reducing the difficulties facing students in solving design problems, it was suggested that the most effective way would be providing intensive lectures on the design problem at hand, which was selected by 84% of students. The next more popular suggestion (with 73%) was introducing 'elective' design workshops dealing with similar design problems. Another suggestion (with 64%) was to provide a qualified teaching assistant in the company of the design instructor whose task would be to follow up students' work rather than doing administrative tasks, such as taking student attendance. The latter suggestion, though useful for students to better understand the design problem, is out of the department's control, because of the scarcity in quantity and quality of teaching assistants. This is perhaps due to the fact that

Table 4
The ideal number of students to be assigned per instructor according to design levels

Design level	Minimum	Maximum	Mean
Studio 1	8	12	9
Studio 2	10	12	10
Studio 3	7	15	12
Studio 4	10	10	10
Studio 5	5	10	8
Studio 6	7	15	11
Studio 7	8	8	8
Studio 8	8	10	8
Grand mean	5	15	10

Table 5
The most difficult issues facing students in solving design problem

Issues	Faculty (32)		Students (287)	
	%	Rank	%	Rank
1) Identifying project function	3.1	3	9.2	3
2) Determining needed areas	0.0	5	17.9	2
3) Determining functional relationship	3.1	3	6.0	4
4) Generating design concept	81.4	1	53.5	1
5) Site analysis	6.3	2	6.0	4
6) Other issues	6.3	--	7.4	--

Table 6
The most difficult issues facing students according to studio level

Issues	Lower levels		Upper levels		Signif.
	%	Rank	%	Rank	$\alpha \leq .05$
1) Identifying project function	6.3	4	11.2	2	0.16
2) Determining needed areas	28.7	2	11.2	2	0.000
3) Determining functional relationship	10.7	3	2.9	5	0.007
4) Generating design concept	41.9	1	60.6	1	0.003
5) Site analysis	4.5	5	7.1	4	0.26

the university treats the College of Architecture just like any other college in this respect, and does not recognize its particular need for teaching assistance and his/her important role on design education.

Another suggestion mentioned by 56% of students was to lighten the requirements of other courses prior to and after the design day, to give them enough time to absorb the design problem, and hence, provide in-depth sketches. Although this suggestion is a typical student complaint in demanding a reduction in college homework, it does draw attention to the need for more co-ordination and cooperation with other instructors and the necessity of making a pre-approved agenda regarding mid-term exams and design submittals and presentations under the supervision of the department.

Faculty, on the other hand, think that the best way of reducing the difficulties facing students in design problem-solving is to break down the design problem into parts verbally, give some practical solutions, and present partial sketches to one of the proposed solutions in the student's design sheet. This suggestion was made by 66% of the faculty. However, as was found earlier, the too large number of students per instructor in the design studio (1 to 12 students) makes it difficult for instructors to spend sufficient time with every student to discuss, listen or make sketches on his design sheet. Fatigue and exhaustion also prevail in this respect.

5. Factors influencing design grading

The final finding of the survey reveals the very great differences that exist between the faculty's and the students' perception of what influences the grading of a student's final design product. Faculty and students were given seven factors and asked to rank order them according of their perceived effect on design grading. Table 7 shows the results.

While the faculty consider the "design concept" as the most influential issue in grading design projects, the students think it comes as third. However, the most outstanding observation in these results is the great variation between students and faculty in perceiving the influence of "graphic presentation" and "student's standing" on design grading. While these two factors were ranked by students as the top factors influencing design grading, the faculty think they are the least important ones to be taken into consideration.

It is suspected that the students' perceptions are quite right in this regard, since the faculty probably express how grading system should be, and not what the actual situation is like. In fact, in most final juries, for lack of time and sometimes concentration, many faculty are influenced by presentation standards and students' reputation. Based on the researcher's teaching experience, it becomes apparent that the students almost always can predict the grade for their classmates because of their preceding knowledge about every student in the studio [16].

Table 7
The most influential factors in grading student's final design projects

Factors	Faculty		Students	
	Mean	Rank	Mean	Rank
1) Design concept	6.8	1	4.1	3
2) Verbal presentation	3.1	5	2.6	7
3) Form of the building units	4.9	3	2.9	5
4) The completion of design requirements	4.2	4	2.9	5
5) Graphic presentation	2.9	6	6.7	1
6) Function relationship	5.1	2	3.7	4
7) Student's standing and reputation	2.8	7	5.8	2

Finally, these ranking results were further analyzed according to design level to see whether this had an influence on the responses of the faculty or the students. While the test results show no significant association between the design level and the faculty's responses; they indicate a strong influence on students' responses ($a \leq .05$) to all of the factors, except for the "verbal presentation" and "functional relationship", which were accepted by students at all levels.

6. Conclusions and recommendations

The findings of this study show that the students' average grades in all design studios are significantly higher than their overall GPA, indicating that on average students perform well and get better grades in their studios than in other theoretical courses. Though this result calls for admiration indeed, because more than 80% of students have an average grade of more than 3.0 in their design studios, when compared to their GPA, some dissatisfaction with the studio environment and its style of teaching and management was exposed. In fact, the study provides strong evidence that the studio itself influences the perception of its environment regarding its capacity, quality of the chairs, illumination, day lighting, air-conditioning, and teaching aids. Students' dissatisfaction with their studio environment was also found to be a strong influence on students' productivity in studio time. This observation calls for the responsibility of the studio instructor who should be more active and enthusiastic to create all means and channels that would encourage students to develop their work in studio session.

Several ideas were suggested to improve the quality of design education. The most prominent ones are as follows:

1. Giving intensive lectures on related design problem.
2. Introducing 'elective' design workshops dealing with similar design problems to encourage students improving their way of thinking and approach to the design problem.
3. Splitting the large studio into more than one section with self-governing instructors, to increase the interaction time between the instructor and his/her students, as well as to reduce the noise and disturbance caused by the large number of students.
4. Increasing the number of faculty to reduce the ratio of students-per-instructor to 10 or less.
5. Providing a larger number of qualified teaching assistants to help students develop their design work.
6. Differentiating between studio levels in terms of teaching style and methods of problem solving to meet the specific requirements of design studio.
7. Assign only one instructor per group of students at lower levels for one design problem to assure good relationship and understanding of design requirements, as well as avoid conflict of faculty approach.

Meanwhile, the design instructor should contribute to the studio not only by critique of student's work or giving brief comments, but rather, by providing the needed knowledge for the given problem and assisting the students to employ the ideal approach of dealing with the design problem. The instructor should also teach students how to generate concepts, develop their own ideas, create forms, cope with the site, as well as have them explore alternative design solutions and provide the right image for the right project. As for the Department's role, it should annually evaluate the performance of each studio in terms of such variables as design progress, design quality versus grades, design requirements versus students' productivity, studio needs and students attendance, among other factors.

Although this study is limited to the evaluation of work environment and the style of teaching in design studio, it suggests the importance of further investigation of the effect of theoretical and technical courses on students' performance in design as well as on their GPA and design grades. Such investigation would help in attaining a deeper interactive analysis and understanding of problems that could direct future decision-making regarding the amount, distribution, and contents of other subjects to meet students' interest and support design studio.

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Received June 12, 2006
Accepted September 16, 2006