



ENHANCING CRITICAL THINKING THROUGH "INDEPENDENT DESIGN DECISION MAKING" IN THE STUDIO¹

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Abstract

A group of faculty at Penn State's Department of Landscape Architecture observed that the traditional master/apprentice model of studio instruction fosters greater student dependence on faculty for decision-making guidance than the faculty considers desirable. They contend that this traditional model promotes a studio dynamic that encourages students to look to the professor for design ideas and wait for faculty approval before making design decisions. The faculty considered this decision-making dependency to be in conflict with the need for students to develop the critical-thinking skills required to address the complex and ill-structured problems that are common in architecture and landscape architecture. In response to their concern this faculty team developed a studio teaching method they termed "independent design decision-making." They speculated that by transferring the responsibility for design decisions from professor to the student, students could improve their critical thinking and gain confidence in design decision-making. The faculty conceived a set of strategies to implement in a 3rd year team-taught site planning and design studio that presents a range of complex design issues and scales. In collaboration with Penn State's Schreyer Institute for Teaching Excellence, the faculty researchers developed a 2-year comparative study to test this new teaching method in the same design studio with two consecutive student groups-evaluating the strategies implemented in the first year, refining methods, then applying and re-evaluating the results in the next year's class. These new strategies included ways students receive information to inspire their designs ("input strategies") and ways to receive critique on their design ideas ("feedback strategies"). Two evaluation instruments were chosen to assess this method of studio teaching: 1) the Group Embedded Figures Test (GEFT), and 2) Student Assessment of Learning Gains (SALG). This paper presents this teaching/learning method and reports on the results of the comparative study.

Keywords: Critical Thinking, Studio Pedagogy, Evaluation Of Student Learning, Case Study

INTRODUCTION AND BACKGROUND

As is traditional in many programs, studio teaching at Penn State's department of Landscape Architecture is characterized by the Beaux Arts/Bauhaus-inspired master/apprentice model of education. In this model, described eloquently by Schön (1985, 1987), individual faculty members work one-on-one with students for the duration of a studio project, leading to the student's solution of the design problem. However, a group of faculty at Penn State's department of Landscape Architecture observed that the Beaux Arts/Bauhaus-inspired teaching/learning model employed in their department led to student design solutions exhibiting more design influence from the professor than may be desirable. Too often, students simply wait for the

professor's visit, expecting the professor either to provide design ideas or to sanctify their work on paper. The unfortunate resulting dynamic is that the student believes s/he will succeed by "doing what the professor wants." The final design, typically filled with ideas generated by the professor, often "belongs" as much to the teacher as to the student. Not only is the work difficult for the professor to assess, but also the central pedagogical question remains unanswered: *what did the student actually learn?*

Design problems represent ill-structured problems (SIMON, 1984: 152) and, in the case of architecture/landscape architecture, a special type of ill-structured problem termed "wicked problems" (ROWE, 1987: 41). As the name suggests, ill-structured problems lack well-structured goals, and

¹ The research team would like to acknowledge assistance received from the Schreyer Institute of Teaching Excellence in planning this study, and with help in statistical analysis.

consequently there is no single "correct" answer to such problems; this situation is further complicated in the case of wicked problems because there are no explicit yardsticks for deciding when the solution is achieved (ROWE, 1987: 41). In the case of wicked design problems, the solution depends on how individual designers utilize information/knowledge and judgment to develop goals and objectives to structure the problem, and develop personal yardsticks to assess when the problem goals are sufficiently achieved to warrant termination of the process. Thus, the solution is as much driven by personal judgment-derived problem definition/resolution as by the solution process itself. The best way to approach such ill-structured problems is to specify multiple goals, and in response develop and evaluate several solutions to the goals (HALPERN, 2003: 356). Defined in this way, the process of design is almost identical to critical thinking-defined as "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based" (American Philosophical Association, 1990 cited in BLATTNER and FRAZIER: 2002, 47-48). Thus the pedagogical question articulated above (what did the students actually learn) can be more specifically expressed as: ***do students learn critical thinking skills needed for effective design through the studio teaching/learning process?***

In the last decade, the design studio educational approach has been acclaimed as close to ideal for virtually all disciplines (BOYER and METGANG, 1996): in current pedagogical parlance its strengths include active, problem-based critical inquiry with teacher as "guide on the side." Given this current popularity of the studio method of

instruction, it becomes even more significant to examine student learning within the studio environment.²

So the researchers began with the following concern: in design studios at Penn State, the traditional master/apprentice model seemed to inculcate a "design decision-making dependency" (of student upon professor) at odds with the critical thinking necessary to address the wicked problem of design. They consequently posed a pedagogical question: Could faculty give students more ownership of their design process in such a way as to instill effective critical thinking skills? These faculty were motivated by the belief that, by transferring the responsibility for design decisions from the professor to the student, students could gain confidence in their critical thinking about design decision-making; and that, if successful, this teaching/learning technique could provide a strategy for design studio that may ultimately serve as a useful pedagogical alternative to the traditional apprenticeship approach. With these intentions in mind, the researchers set out to design a studio emphasizing what they named "independent design decision-making."³

APPROACH

The quest to develop a credible method to foster "independent design decision-making" led the researchers to collaborate with Penn State's Schreyer Institute for Teaching Excellence in a 2-year comparative study (2004 and 2005) testing this new teaching method in the same design studio with two consecutive student groups-evaluating strategies implemented the first year, refining methods, then applying and re-evaluating the results in the next year's class. This paper reports on the

² The researchers acknowledge that they are not the first to question the traditional method of studio instruction. It has been criticized on grounds of social, gender, racial, and pedagogical concerns (AHRENTZEN & ANTHONY, 1993; ANTHONY, 1991; DUTTON, 1987, 1991; DUTTON & MANN, 1996; MITGANG, 1997; and WARD, 1991). Some researchers have proposed alternative methods of studio instruction (ANGUS, 2003; FRANCIS, 2001; FORSYTH, HENRY, & MCGIRR, 1999; GELERTNER, 1988; PARNELL, 2001; SANOFF, 2000; SYMES & MARMOT, 1983), others have focused on the relationship between design and other aspects of the curriculum (FILOR, 1994; GAZVODA, 2002), and few studies have categorized different methods of studio instruction (BOSE, 1997; LEDEWITZ, 1985; SALAMA, 1995: 131-143). The authors acknowledge that there is a long-standing debate regarding studio teaching methods occurring in design conferences (like those orga-

nized by the Association of Collegiate Schools of Architecture in the US, the Center for Education in the Built Environment in the UK, and the European Association for Architectural Education); however, these debates are largely based on anecdotal observation of alternative methods of studio instruction rather than objective evaluation of the impact of those methods on student learning. A thorough literature review of published journals over the past 15 years did not identify any study that systematically and rigorously assessed student learning in the studio.

³ It is important to note that this approach is distinct from a study by Stoltz and Brown (1994) that explored fostering "independence of learning" through a pedagogical model combining Bloom's taxonomy of educational objectives with Kowitz and Smith's (1987) framework of forms of instruction.

results of this comparative endeavor.

Larch 427, the studio chosen for this experiment, is a 3rd year team-taught site planning and design studio, the first studio in the 5-year undergraduate program that presents a range of complex design issues and scales. The researchers felt that the complexity of issues made this studio a good candidate for testing teaching methods to foster independent design decision-making. Also important was the fact that this studio is team-taught by three faculty, presenting opportunities to alter the traditional master/apprentice studio dynamic. Two major sets of strategies were instituted in the studio: 1) the way students receive information to inspire their designs ("input strategies") and 2) the way they receive critique on their design work ("feedback strategies"). Additionally the faculty focused the corollary theory seminar on exploration of design processes to engage students in critical thinking about how they design.⁴

INPUT STRATEGIES

To counteract the habit of waiting for a desk critique for guidance and to foster independence in design decision-making, several strategies were implemented in the way students received information throughout the 2004 studio semester:

- Theory seminar topics on design process closely linked to studio work were developed to provide students with a broader conceptual framework for their design process;
- A precedent analysis project was included to provide students an overview of issues inherent in the project type as well as design inspiration;
- Group brainstorming sessions facilitated by the faculty actively engaged students in exploration of studio issues and ensured the creation of a shared knowledge base;
- Individual library research was encouraged, with numerous books placed on reserve or recommended to encourage students to independently seek outside input when generating design ideas;
- Detailed drawings and models of project buildings were made available to enhance stu-

dents' ability to visualize relationships between architecture and the landscape;

- Program information was presented to the students through a "client scenario process" which provided students direct access to a fictitious client (role-played by the faculty). This enabled a dialog to take place between the students and the "client" so that the program could evolve through student initiative.

Based on student response to the 2004 studio, faculty maintained these input strategies in the 2005 iteration; also based on student response, the faculty made extra effort in 2005 to ensure transparency of the method through studio discussions explaining both the teaching/learning strategies and their intent.

FEEDBACK STRATEGIES

The primary goal of changing the studio feedback structure was to foster greater independence in critical thinking and design decision-making. To force students to prioritize information and make critical design decisions on their own, students received critiques from all three professors and classmates—a significant departure from the departmental norm. In the 2004 iteration this approach entailed three components:

- One-on-one desk critiques rotated among the three studio faculty to ensure a variety of feedback;
- Group critiques (three to five students and one professor), designed as small-group pin-ups, were instituted to foster critical thinking skills by challenging students to discover strengths and weaknesses in peers' designs and to apply criticism of others' work to their own designs;
- Group peer critiques (three to five students, no faculty), guided by written questions to focus discussion, were intended as a means to further develop students' critical thinking skills through providing relevant feedback to others.

Again, based on student response to the 2004 studio, faculty introduced one feedback change:

⁴ In this school's curriculum, each design studio is paired with a 1-credit theory seminar to provide opportunity for reading and discussion about the concurrent studio content.

because the group peer reviews were negatively perceived in 2004, faculty eliminated group peer critiques from the feedback strategies.

In addition, the researchers added some tools in the 2005 studio to help assess effectiveness of this model, one of which is germane to this paper: a "Design Confidence Survey" was designed and administered in the 1st and 15th weeks of the course. The eighteen questions in this survey used a 5-point Likert scale (1 = strongly agree to 5 = strongly disagree) to measure baseline and end-of-semester student confidence in the critical thinking and design decision-making skills that this studio was attempting to inculcate.

EVALUATION INSTRUMENTS

Two evaluation instruments were chosen to assess this method of studio teaching: 1) the Group Embedded Figures Test (GEFT), and 2) Student Assessment of Learning Gains (SALG). The GEFT is a recognized and validated tool used to explore analytical abilities and problem-solving styles (HAYES & ALLINSON, 1997; WILLIAMS, 1985: 480). Designed as an adaptation of the individually administered Embedded Figures Test, the GEFT is used to test groups of subjects to determine perceptual field-dependence-independence (WITKIN, MOORE, GOODENOUGH, and COX, 1977). In the GEFT, students are asked to identify common geometric shapes embedded in a series of larger complex figures.

Since the focus of the new studio model was to enhance students' independent design decision-making skills, it was hypothesized that students would demonstrate greater field-independence in their second GEFT—that is, they would begin to critically look at the individual parts of their designs and be better able to analyze how they fit within the larger design context. In 2004, the GEFT was administered during the 8th (middle) and 15th (final) week of class. The delay in administering the first GEFT was a result of preliminary time working with the Schreyer Institute to identify an effective

evaluation instrument to assess students' critical thinking/independent design decision-making skills. This delay was rectified in 2005, when the GEFT was administered during the 1st and final weeks of class.

The SALG is a web-based instrument designed to reveal student perception and evaluation of different course elements, so that faculty can use student feedback to modify course structure to enhance student learning. The SALG used for the 2004 studio consisted of 6 major questions, each with several components, for a total of 57 questions.⁵ For the 2005 studio, the SALG questions were streamlined, and six additional questions on critical thinking were added. The 2005 SALG consisted of 3 major questions, each with subparts for a total of 40 questions. In both cases, the questions used a 5-point Likert scale (1 = no help to 5 = very much help) to probe a variety of issues ranging from usefulness of resources and feedback types to skills gained.⁶ The SALG also invited students to comment on their ratings. The SALG website was made available to each class during the last (15th) week of the semester, and students were given an extra credit point for completing it.

FINDINGS

Because this article focuses on comparing two iterations of this teaching/learning experiment, it omits some experiments exclusive to one studio or the other, and instead reports only on those strategies repeated both years. Thus this paper emphasizes results of the GEFT, and student responses to input/feedback strategies and critical thinking skills as assessed via the SALG.

GEFT

The GEFT was analyzed each year as a paired T-test.⁷ Results for students on the 2004 GEFT ($n = 18$, 62% of the class) indicated no significant differences in critical problem-solving abilities between the two tests administered during the 8th week and the 15th week of class. The researchers

⁵ <http://www.wcer.wisc.edu/salgains/instructor/default.asp>, Student Assessment of Learning Gains website, accessed March 7, 2005.

⁶ Readers interested in the two survey instruments are invited to contact the researchers.

⁷ The paired T-test is used to compare the means of a depen-

dent variable (critical problem solving ability measured by GEFT) of two related samples—in this case, students in a 3rd year landscape architecture studio, before and after an intervention (a particular studio instruction method). A significant difference between the two means would suggest that the intervention made a difference in the dependent variable.

How much did each of the following aspects of class help your learning?	NA	No help	A little help	Moderate help	Much help	Very much help	Mean
2004: Detailed drawings of business and residential buildings	0%	0%	0%	9%	30%	61%	4.52
2005: Detailed drawings and models of project buildings	0%	3.8%	3.8%	15.4%	23.1%	53.8%	4.19
2004: The client scenarios process	0%	0%	9%	30%	43%	17%	3.70
2005: Directions/ideas from "client"	0%	0%	30.8%	42.3%	23.1%	3.8%	3.0
2004: Seminar readings	0%	0%	9%	39%	22%	30%	3.74
2005: Seminar readings on design process, theory, approach	0%	3.8%	19.2%	19.2%	42.3%	15.4%	3.46
2004: Reserved books in the library for residential design project	9%	0%	13%	26%	39%	13%	3.57
2005: Resources on reserve in the library	15.4%	7.7%	19.2%	23.1%	15.4%	15.4%	2.64
2004: Precedent study	0%	4%	13%	30%	43%	9%	3.39
2005: Precedent analysis for business campus project	0%	0%	23.1%	30.8%	34.6%	11.5%	3.35
2004: The use of class-wide group brainstorming sessions	0%	9%	17%	30%	35%	9%	3.17
2005: Class-wide group brainstorming/decision-making sessions	0%	3.8%	30.8%	34.6%	19.2%	11.5%	3.04

Table 1. Comparison of students' perceived utility of information input strategies in 2004 and 2005.

conjectured that this was at least partly due to the fact that the first GEFT was administered half-way through the semester, and did not represent a true baseline of field independence-dependence of students. They hypothesized that the GEFT score would improve during the 2005 semester. This hypothesis was supported by the 2005 GEFT data: the paired t-test results for students on the 2005 GEFT (n = 33, 92% of the class) indicated a significant difference (p = .046) in field independence between the first (1st week) and second (15th week) administrations of the test.

SALG

Input Strategies

SALG responses in 2004 (n = 23, 79% of the class) and 2005 (n = 26, 72% of the class) indicated that the information input strategies were quite positive-

ly perceived by students both years (Table 1). In 2004, student appreciation for these information sources ranked as follows (in descending order):

1. Detailed drawings of buildings
 2. Client scenario process
 3. Seminar readings
 4. Books on reserve in the library
 5. Precedent study
 6. Class-wide brainstorming sessions
- In 2005, the ranking was slightly different:
1. Detailed drawings of buildings
 2. Seminar readings
 3. Precedent study
 4. Class-wide brainstorming sessions
 5. Client scenario process
 6. Books on reserve in the library

The chi-square test of independence⁸ (Table 2) illustrates that student responses to the input strategies

How much did each of the following aspects of class help your learning?	Chi-square value	Probability
2004: Detailed drawings of business and residential buildings	2.5168	0.2841
2005: Detailed drawings and models of project buildings		
2004: The client scenarios process	6.6635	0.0357*
2005: Directions/ideas from "client"		
2004: Seminar readings	3.3049	0.1916
2005: Seminar readings on design process, theory, approach		
2004: Reserved books in the library for residential design project	2.4000	0.3012
2005: Resources on reserve in the library		
2004: Precedent study	0.2841	0.8676
2005: Precedent analysis for business campus project		
2004: The use of class-wide group brainstorming sessions	0.8919	0.6402
2005: Class-wide group brainstorming/decision-making sessions		

Note: * = significant probability.

Table 2. Chi square test of independence between 2004 and 2005 student response to input strategies

⁸ The chi-square test of independence is used to determine the pattern of similarity/differences of two data sets.

How much did each of the following aspects of class help your learning?	NA	No help	A little help	Moderate help	Much help	Very much help	Mean
2004: Critiques with three instructors instead of one instructor through the duration of each project	0%	4%	22%	39%	22%	13%	3.17
2005: Critique with variety of instructors instead of one	0%	0%	7.7%	30.8%	38.5%	19.2%	3.72
2004: The use of group critiques	0%	4%	26%	43%	26%	0%	2.91
2005: Group critique with one professor and peers	0%	0%	19.2%	15.4%	38.5%	23.1%	3.68
2004: The use of peer critiques	0%	35%	35%	17%	13%	0%	2.09
2005: Peer critiques eliminated	No results						

Table 3. Comparison of students' perceived utility of feedback strategies in 2004 and 2005.

reflected a similar pattern in both years-i.e. showing little variance in appreciation between 2004 and 2005-with the exception of the client scenario process. Indeed, review of Table 1 shows that, in 2004, 60% of students found the client scenario to be of "much help" or "very much help," while only 27% of students in 2005 felt the same. The following student comment sums up the five negative student statements about the client on the 2005 SALG: "The clients' directions were difficult to understand. When we thought we had an idea of what they wanted, their wishes changed." The researchers surmise that the difference in student appreciation for working with "clients" was the result of a change in the teaching team and dynamic between 2004 and 2005: in 2004, the three researchers comprised the teaching team and took great pains to ensure that, when they role-played as clients, they portrayed the different characters of the individual clients but presented a generally unified vision of what the client group sought. This entailed daily pre-class meetings to strategize the most useful client stance on relevant issues. In 2005 the teaching team comprised two of the researchers plus one new faculty member. This new team had trouble meeting regularly before class to unify their "client" positions-resulting in sometimes conflicting client directives to the students.

Feedback Strategies

Feedback (critique) strategies were largely negatively evaluated by students in the 2004 studio (Table 3). Peer critiques were deemed least valuable, group critiques were seen as somewhat more valuable, and critiques with three instructors instead of one during a project were rated slightly higher-though only as high as the lowest rating for input strategies. Many 2004 students reported that the format of critiques with three professors instead of one was challenging and stressful. One student summed up the general reaction: "I feel that in jumping around from prof to prof I had gotten conflicting answers to my questions which made me very frustrated with the design process." Even more negative 2004 student reaction to the other two feedback strategies was summed up in the following: "Group crits and peer crits didn't really work because we didn't want to do them."

As previously noted, the research team eliminated peer critiques from the 2005 studio based on the overwhelmingly negative response by the 2004 students. Thus we can only compare two feedback items between 2004 and 2005: critiques with more than one instructor, and group critiques. Student response to the 2005 feedback strategies was more positive than the 2004 response, with over half of respondents deeming both feedback strategies to be of "much help" or "very much help." (Table 3) This

How much did each of the following aspects of class help your learning?	Chi-square value	Probability
2004: Critiques with three instructors instead of one instructor through the duration of each project	4.1131	0.1279
2005: Critique with variety of instructors instead of one		
2004: The use of group critiques	7.3797	0.0250*
2005: Group critique with one professor and peers		

Note: * = significant probability.

Table 4. Chi square test of independence between 2004 and 2005 student response to feedback strategies

Table 5.
Comparison
of students'
assessment
of critical
thinking in
class in
2004 and
2005.

	NA	Not at all	A little	Somewhat	A lot	A great deal	Mean
How much has this class added to your skills in each of the following?							
2004: Independent design decision making	0%	0%	9%	13%	48%	30%	4.00
2005: Ability to absorb a variety of information and feedback, then critically evaluate and prioritize it to effectively develop my design (a.k.a. "independent design decision-making")	0%	0%	3.8%	46.2%	30.8%	19.2%	3.65
To what extent did you make gains in any of the following as a result of what you did in this class?							
2004: Ability to think through complex site design and planning problems	0%	0%	0%	13%	57%	30%	4.17
2005: Ability to think through complex site planning and design problems	0%	0%	0%	34.6%	46.2%	15.4%	3.8
How much of the following do you think you will remember and carry with you into other classes or aspects of your life?							
2004: Understanding of how to critically analyze and critique site designs	0%	0%	0%	5%	68%	27%	4.23
2005: Ability to critically analyze and effectively critique design	0%	0%	3.8%	26.9%	61.5%	7.7%	3.73

was supported by student comments on the 2005 SALG: "It was helpful to get as much feedback as possible and then sort out the info and apply it to the design," and "Group critiques were very useful as you could find things in other people's critiques that applies to your design." Moreover, the chi-square test of independence (Table 4) was significant for the group critiques ($p = 0.025$) indicating a notable positive variation relative to 2004 responses; and, though not statistically significant, the chi-square result was encouraging in the case of critiques with three instead of one instructor ($p = 0.1279$).

The researchers surmise that the difference in student response to feedback strategies can be attributed to one or both of the following: The first is prior experience—the 2004 group had exclusively experienced the traditional master/apprentice model of teaching/learning in their three previous design studios; so it should not be surprising that they found a new model, requiring filtering and prioritization of varied feedback, to be challenging. In contrast, the 2005 group already had been introduced to these feedback strategies in a limited, unstructured test during their first design studio (though not in their second or third), and may thus have felt more comfortable with this model. A second reason for the more positive response to feedback strategies in 2005 could be the transparency of intent that the faculty worked hard to establish in that iteration: students were frequently reminded of

the reason for varied feedback sources, and the expected enhancement of critical thinking skills to be derived from this approach.

Critical Thinking

Response to the SALG questions regarding critical thinking (Table 5) indicates that 2004 students perceived significant gains in critical thinking skills in this studio. Student comments suggest that they realized that independent reasoning and evaluation leading to directed problem-solving are important design skills: "I learned a lot by even working things out on my own." "I think I have made great gains in how to break down complex site design issues into smaller ones that I can more effectively solve."

In 2005, students again responded positively to critical thinking questions (Table 5), but the gains they reported were lower than those of their 2004 counterparts. The chi-square test of independence (Table 6) was statistically significant for the question on added skills in independent design decision-making ($p = 0.0412$) and close to significant on the other two questions: gains in ability to think through complex site planning and design problems ($p = 0.0665$) and probability of carrying forward gains in ability to critically analyze and effectively critique design ($p = 0.0660$).

The researchers were initially disappointed by the 2005 SALG results on critical thinking. They had tried hard to raise student perception of gains above 2004 levels through frequent discussions of

	Chi-square value	Probability
How much has this class added to your skills in each of the following?		
Independent design decision making	6.3800	0.0412*
Ability to absorb a variety of information and feedback, then critically evaluate and prioritize it to effectively develop my design (a.k.a. "independent design decision-making")		
To what extent did you make gains in any of the following as a result of what you did in this class?		
Ability to think through complex site design and planning problems	3.3670	0.0665
Ability to think through complex site planning and design problems		
How much of the following do you think you will remember and carry with you into other classes or aspects of your life?		
Understanding of how to critically analyze and critique site designs	5.4352	0.0660
Ability to critically analyze and effectively critique design		

Note: * = significant probability.

Table 6.
Chi square test of independence between 2004 and 2005 student response to critical thinking questions

intent; and the GEFT scores objectively indicated significant gains in field independence. Why didn't the students see their own advancement in critical thinking skills? But further consideration of 2005 evaluation tools and responses revealed the following:

1. The "Design Confidence Survey" devised for 2005, intended to compare student confidence in their design decision-making skills at the beginning and end of the course, revealed that student confidence was high at the beginning and did not change over the semester;⁹
2. The SALG questions specifically asked students whether they had made gains in these skills through this course.

Thus the researchers surmise that the 2005 group began the semester confident in their design decision-making, and may not have perceived gains in these skills brought about by this studio. So they may have responded accordingly to the SALG questions-even though the GEFT suggests that they did indeed make significant gains in the field independence normally associated with critical thinking.

SUMMARY AND CONCLUSIONS

It may be helpful to preface the study conclusions with a brief summary of findings:

GEFT: While the GEFT tests administered in weeks 8 and 15 of 2004 did not show significant variation, the pair of GEFTS in 2005, establishing a true

first-week baseline and final-week endpoint, showed significant improvement in students' field independence, thus suggesting enhanced critical thinking skills.

SALG/Input Strategies: Students largely appreciated the varied forms of input provided to inform their designs. The divergence in appreciation for the client scenario between 2004 and 2005 raises an important issue regarding faculty commitment required for this studio model, discussed in the conclusions that follow.

SALG/Feedback Strategies: Student appreciation for multiple feedback sources on their designs varied from 2004 to 2005, and seems to be linked to prior experience and/or understanding of the benefits of this strategy.

SALG/Critical Thinking: A surprising disconnect occurred between student perception of their gains in critical thinking (as reported in the SALG) and the results of the GEFT paired T-test: students perceived less gain in this skill set in 2005 than 2004, while the 2004 GEFT revealed no gain and the 2005 GEFT revealed significant gain.

What can we conclude from this two-year study of a design studio strategy attempting to foster "independent design decision-making"? At least one major lesson emerges, along with three worthy corollaries:

First and foremost, the study demonstrates that a studio structure providing students a variety of infor-

⁹ A variety of statistical tests (paired-T test, chi-square, Pearson Rho) were conducted to determine if there were differences between the two data sets (collected at the beginning and end of the semester). The results were inconclusive due to little variation in the two data sets, as well as problems arising from small data sets.

mation to inspire designs, plus a variety of feedback to critique designs-both of which demand that students filter and prioritize varied and sometimes conflicting information to make design decisions-results in significant gains in field independence as objectively measured by the GEFT.

The first noteworthy corollary to this discovery is that student perception of their own gains in critical thinking does not necessarily jive with GEFT results. This raises two opposing but equally interesting questions for future study:

- Is the SALG a faulty instrument to assess learning gains? In other words, does student perception of their own learning in a course present an unreliable assessment tool? This would raise significant doubts about the end-of-semester student questionnaires used by most universities to assess teaching, and may suggest that students are not equipped to measure the extent of their learning in a given studio until some time has elapsed-perhaps not even until they are practicing professionals.
- Is the GEFT an imperfect tool to measure critical thinking skills? The researchers and staff of Penn State's Schreyer Institute equated field independence with characteristics exhibited by effective critical thinkers-is this correlation misleading?

The second corollary is a caveat for anyone interested in testing the "feedback strategies" introduced in this study. Simply put: if students have had experience with the traditional master/apprentice model, do not expect them to immediately enjoy receiving criticism from a variety of sources. Appreciation for the benefits of varied and/or conflicting feedback seems to come from practice, and requires ongoing reminders of the intent and the expected outcome of this critique approach.

Finally, the negative student response to the client scenario in 2005 stands as a reminder of the intense faculty commitment required in this studio model. Perhaps ironically, it takes incredible facul-

ty effort to create a context in which students can succeed at independence-from determining and providing the array and type of information students need, to ensuring that all members of a faculty team are at least reasonably consistent on such issues as critique criteria¹⁰ and general "client priorities and values" (the problem in 2005)¹¹.

In sum, while this study did not attempt to compare this studio model with the traditional master/apprentice model, both the SALG and the GEFT appear to indicate that the "independent design decision-making" strategy is at least as effective as the traditional model, offering a useful studio alternative. Additional support for this method comes from anecdotal, though more typical, subjective faculty observations of student design projects. Faculty who used this studio approach observed a dramatic change relative to more traditional site design studios, both in quality of design work and in student confidence and awareness of skills. Additionally, faculty throughout the department commented on the high quality of design produced in this course. In sum, there is a perception among faculty, regardless of the results reported in this paper, that this studio strategy is worthy of further consideration.

This project is still in-process. Next steps include refinement and testing of additional changes for the 2006 studio-including possible changes in evaluation methods,¹² and exploration of alternative tools to assess critical thinking. Meanwhile, the Penn State researchers remain optimistic about the potential of the "independent design decision-making" studio model to inculcate useful critical thinking skills in design students.

¹⁰ For example: because the researchers gave critiques to different students each day, they met before class to determine the day's "crit issues" so that students would experience some class-wide consistency in progress.

¹¹ This is not to suggest that a client scenario should present a group of "clients" in lock-step, as some "client" variation and changes of opinion can serve to reflect "real world" experience; but fictitious clients who provide ever-changing

and ever-conflicting viewpoints will at some point be deemed deleterious rather than informative by students.

¹² In the 2005 iteration of this studio, the researchers introduced assessment rubrics to enhance grading clarity, as well as evaluation of design process to give weight to students' efforts at independent design decision-making; but they acknowledge that further consideration of evaluation methods are warranted for this studio model.

REFERENCES

- AHRENTZEN, S., & ANTHONY, K.H. 1993, "Sex, Stars, and Studios: A Look at Gendered Educational Practices in Architecture," *Journal of Architectural Education*, 47(1), pp.11-29.
- ANGUS, M. 2003, "Trigger Paper: The Crit," Paper presented at Studio Culture - Who Needs it? A Conference for Teachers in Schools of Architecture and Landscape, 17-18 December, St. Catherine's College, Oxford, UK. Available: http://www.cebe.ltsn.ac.uk/news/events/concrete/triggers/angus_crit.pdf
- ANTHONY, K.H. 1991, *Design Juries on Trial: The Renaissance of the Design Studio*, Van Nostrand Reinhold, New York, NY, USA
- BLATTNER, N. H., & FRAZIER, C. L. 2002, "Developing a Performance-based Assessment of Students' Critical Thinking Skills," *Assessing Writing*, 8, pp.47-64.
- BOSE, M. 1997. "Methods of Studio Instruction: Hidden Agendas and Implicit Assumptions," *ARCC-Proceedings of the 1997 Spring Research Conference*, Architectural Research Centers Consortium, pp.25-34.
- BOYER, E.L. & MITGANG, L.D. 1996, *Building Community: A New Future for Architecture Education and Practice*, The Carnegie Foundation for the Advancement of Teaching, Princeton, New Jersey, USA.
- DUTTON, T.A. (Ed.). 1991, *Voices in Architectural Education: Cultural Politics and Pedagogy*, Bergin & Garvey, New York, NY, USA.
- DUTTON, T.A. 1987, "Design and Studio Pedagogy," *Journal of Architectural Education*, 41(1), pp.16-25.
- DUTTON, T.A., & MANN, L.H. (Ed.), 1996. *Reconstructing Architecture: Critical Discourses and Social Practices*, University of Minnesota Press, Minneapolis, MN, USA.
- FILOR, S.W. 1994, "The Nature of Landscape Design and Design Process," *Landscape and Urban Planning*, 30(3), pp.121-129.
- FORSYTH, A., LU, H., & MCGIRR, P. 1999, "Inside the Service Learning Studio in Urban Design," *Landscape Journal*, 18(2), pp.166-178.
- FRANCIS, M. 2001, "A Case Study Method for Landscape Architecture," *Landscape Journal*, 20(1), pp.15-29.
- GAZVODA, D. 2002, "Characteristics of Modern Landscape Architecture and its Education," *Landscape and Urban Planning*, 60(2), pp.117-133.
- GELERNTER, M. 1988, "Reconciling Lectures and Studios," *Journal of Architectural Education*. 41(2), pp.46-52.
- HALPERN, D.E. 2003, *Thought and Knowledge: An Introduction to Critical Thinking*, Lawrence Erlbaum Associates, Mahwah, NJ, USA.
- HAYES, J. & ALLINSON, C.W. 1997, "Learning Styles and Training and Development in Work," *Educational Psychology*, 17(1/2), pp.185-194.
- KOWITZ, J. T. & SMITH, J. C. 1987. Three Forms of Instruction. *Journal of Educational Technology Systems*, 15(4), pp.419-229.
- LEDEWITZ, S. 1985, "Models of Design in Studio Teaching," *Journal of Architectural Education*, 38(1), pp.2-7.
- MITGANG, L.D. 1997, "Saving the Soul of Architectural Education," *Architectural Record*, 85(5), pp.24-128.
- PARNELL, R. 2001, *Its Good to Talk: Managing Disjunction Through Peer Discussion*. Paper presented at the AEE2001 Conference, Cardiff, September 2001. Available: <http://www.cebe.heacademy.ac.uk/learning/studio/conf.php>
- ROWE, P. G. 1987, *Design Thinking*, MIT Press, Cambridge, MA, USA.
- SALAMA, A. 1995, *New Trends in Architectural Education: Designing the Design Studio*, Tailored Text and Unlimited Potentials, Raleigh, NC, USA.
- SANOFF, H. 2000, *Community Participation Methods in Design and Planning*, John Wiley and Sons, Chichester, NY, USA.
- SCHÖN, D.A. 1985, *The Design Studio: An Exploration of its Traditions and Potentials*, RIBA Publications for RIBA Building Industry Trust, London, UK.
- SCHÖN, D.A. 1987, *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in The Professions*, Jossey-Bass, San Francisco, CA, USA.
- SIMON, H. A. 1984, "The Structure of Ill-Structured Problems," In N. Cross (Ed.), *Developments in Design Methodology*, John Wiley and Sons, Chichester, NY, USA. pp. 143-166.
- STOLTZ, R.R., & BROWN, R.D. 1994, "The Application of a Pedagogical Framework to the Design of University Courses," *Landscape and Urban Planning*, 30, pp.159-168.
- SYMES, M., & MARMOT, A. 1983, "Introducing the Architectural Case Problem," *Journal of Architectural Education*, (34) 3, pp. 99-107.
- WARD, A. 1991, "Biculturalism and Community: A Transformative Model for Design Education," *Journal of Architectural Education*, 44(2), pp.90-109.
- WILLIAMS, J. D. 1985, "Coherence and Cognitive Style," *Written Communication*, 2(4), pp.473-491.
- WITKIN, H.A., MOORE, C. A., GOODENOUGH, D.R., & COX, P.W. 1977, "Field Dependent and Field Independent Cognitive Styles and their Implications," *Review of Educational Research*, Winter 1977, 47, pp.1-64.

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