IMPROVING STUDENT LEARNING THROUGH INTEGRATED PROJECT EXPERIENCES

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1 ABSTRACT

Design projects draw on a broad range of knowledge and skill areas for successful completion. However, in most landscape architecture curricula the rigid structure of faculty assignments and course descriptions prevent learning outcomes that allow students to experience the impact of multiple skill areas in shaping solutions. Rather, students operate within "silos" of information without adequately drawing the connections between subject areas that are necessary to achieve a systematic design solution. Furthermore, because students don't consider the ways in which one knowledge area influences the others, and the refinements that result, student design solutions can be one-dimensional.

Realizing an opportunity, the faculty of Purdue University's junior-level courses in design, grading and drainage, plant materials, and construction documents began seeking a single project that would allow the students to integrate material from all of these courses in a single project. This paper describes a project process created by the authors to combat these inherent drawbacks of the traditional curricular structure. Rather than simply using a common site to achieve individual course outcomes, the authors sought a fully integrated experience that would emulate a professional's process and enrich the end product.

The paper will explore the process created and propose opportunities for programs with like curricula structures to implement similar integrated project experiences, and will include preliminary data gathered. Further data and analysis on the results of this particular methodology to follow once a reasonable sample size is collected.

1.1 Keywords

studio pedagogy, curriculum, systems approach

2 INTRODUCTION

Due to their complexity, design problems must draw on a broad range of knowledge and skill areas—design theory, sociology, earthworks and drainage, plant materials, detailing, client interaction, and untold others—for a successful and creative solution. Some knowledge areas are essential to most projects; other knowledge areas will only be necessary in some instances. In all projects, however, design professionals must be able to identify the knowledge and skills necessary, be able to bring together knowledge from all the disparate areas, and be able to combine it into the most successful solution to a problem.

This information synthesis—the ability to explore several aspects of a problem simultaneously and allow each area to inform and magnify the work of the others—is the basis of divergent thinking and its complementary process, convergent thinking. As defined by Guilford in the 1950's, divergent thinking allows for the creation of a number of unique design ideas. As part of this process, divergent thinkers also simultaneously consider a variety of approaches to a problem. Convergent thinking brings the disparate elements into a cohesive whole.

> "Convergent thinking has two elements: judgment, the evaluation of concepts to determine the ideas or components of ideas that contain the most potential; and amalgamation, the ability to combine the convergent ideas into a design solution that becomes more than simply the sum of its parts." (Rotar and Deeg, 2012)

Convergent thinking, then, is the foundation of design thinking. While intuitive solutions may successfully be developed by highly experienced and skilled designers, a clear, deliberate design process that incorporates multiple knowledge areas offers the best opportunity for students to develop successful, creative solutions.

3 PROBLEM DEFINITION

Unfortunately, many students find it extremely difficult to achieve this synthesis of information that forms the foundation of this kind of project approach. Instead, the projects that students produce in the design studio are too often one-dimensional—students rely on too few inputs to solve the problem, reducing the breadth of their design thinking and, ultimately, the value of their design solutions.

The authors have observed three key student attitudes that restrict students' ability to integrate multiple knowledge areas into a design problem. The roots of these attitudes are readily understandable, coming as they often do through in the structure of the academic curriculum or in the attitudes and culture of the faculty.

First, integrating knowledge areas in a design solution is difficult when students envision separate bodies of knowledge as "silos." Students do not draw the connections between knowledge areas that are necessary to achieve a systematic design solution because too often they don't realize the concrete interrelation between the knowledge areas. Students either actively compartmentalize knowledge into manageable pieces (commission) or, often, haven't thought deeply enough or thought at all of how the different knowledge areas impact one another and the whole (omission).

The typical structure of courses at many universities reinforces students' compartmentalization of knowledge. At Purdue University the standard curriculum in a given course of study defines many topics and knowledge areas and each knowledge area (or portion of a knowledge area digestible in a proscribed academic term) becomes the subject for a course. The course description rigidly defines the topic; the assigned faculty is responsible for setting the expected outcomes and evaluating student learning in the specific subject area and deviation from the catalog description of the course can become problematic.

Faculty may also play a role in exacerbating this structural problem. Because faculty may simply assume that students are aware of the expectation for knowledge integration, a professor may not explicitly require knowledge integration and students may therefore be unaware of its necessity.

Student designers often develop habits that prevent fully realized design solutions from developing. Often students attempt to reach a program and a set of forms as quickly as possible. This habit may simply form out a desire to be "done" with the design solution (or may be necessary due to the sheer volume of work their coursework requires) or the haste may come as a byproduct of procrastination or distraction. Whatever the source, the result is the same: students jump to design conclusions without working systematically to investigate the impact of individual knowledge areas upon the others, without fully considering their criteria for making judgments, and without fully exploring design alternatives.

Finally, this rush to design completion also limits the time students take to review their design solution, to reflect and self-criticize, and to revise and refine the solution. This lack of revision and refinement, and the lack of time to allow each of the various knowledge areas to individually come to the fore and influence the overall design, is widespread among students. Again, too often the structure of LA courses reinforces this problem: projects are routinely critiqued following the deadline, but, unlike in a professional setting, there is seldom time given to revision of the solution as a structured part of the assignment. Students look forward to project due dates as the point at which they are "done" and can put a particular problem behind them without having to intellectually engage it again.

Certainly, each of these attitudes may be present in greater or lesser degrees in any given student. While the sources of student attitudes are understandable, faculty should seek ways to improve student outcomes while overcoming the students' ability to self-impose limits to their creative responses.

Since the authors identified integrated thinking as essential to successful student design projects, and because the authors observed the difficulty that students have in engaging that kind of thinking as part of their design approach, the authors hoped to design a methodology in which we could help students discover this kind of thinking within their own design processes.

4 LITERATURE REVIEW

In recent years there have been multiple studies that seek an improved pedagogy for design. Rotar and Deeg outline a pedagogical process for integrating a divergent thinking process into the studio environment. (Rotar and Deeg, 2012) Others have designed in-class structures and exercises that make visible for students the role that a focus on different content areas within a design process will yield different final project results. (Dahl et. al., 2013; Steinitz, 2011)

The integrated studio (similarly defined in Levy's descriptions of his "Total Studio") best simulates architectural design in a real office, reinforcing the iterative multi-modal skillsets inherent in the design process. It is difficult if not impossible to separate technical, historical, or theoretical content from the act of designing, yet many traditional AEC programs teach in this manner, with coursework covering the parts of a system ("silos" of knowledge) but not the whole. As Teal describes, "...history, theory, and design are not separate subjects but instead are fundamentally interconnected realms that can be engaged and activated through both intellect and activity." and that "Approaching design foundations from this integrated perspective introduces students to a necessary interplay between society, culture, place, people, and time; and initiates practices for activating their knowledge of these factors to engage complexity, nonlinearity, and the a-rational, ways of thinking that are frequently excluded in more rigid educational frameworks." (Teal, 2011, p.37-38) The design process is not an isolated linear exercise and often one bounces between separate and unfinished works to refine a single idea, revealing insight into disparate areas of a project. The same can be said for the inclusion of materials presented in non-studio courses.

No design professor is so much of a specialist that they are not capable of contributing to the generalist approach often presented in a design studio yet all too often faculty teach specific skills without being able to connect them to the larger systems inherent in the design process. This approach does the faculty and especially the students a disservice by avoiding the interrelations between aesthetic design and technical skills and knowledge. The argument that technical content is too complex and unwieldy to present to students new to the major has been shown to be false; numerous studies have demonstrated the rich work presented by students in collaborative, integrated, or interdisciplinary courses (Bender, 2005; Goldberg, Holland, and Wing, 2012; Levy, 1980; O'Brian, Soibelman, and Elvin, 2003; Ozimek and Ozimek, 2011; Steinitz, 1990, 2011; Teal, 2011).

Students are more likely to retain specific skills and techniques if they are integrated into a larger framework of a project the student finds interesting. This way they are working towards a visible creative goal and not just "adding another tool to their toolbox". Projects presented through integrated coursework force students to use knowledge in direct practice and design; reinforcing the value and purpose of the skills and concepts they have been taught. Students in the digital age often feel "bombarded with facts... …Thus, they do not pay attention to knowledge we try to deliver them, unless they find it useful." (Ozimek and Ozimek, 2011, p.54-55) While their research dealt with integrating CAD tools into studio courses, Ozimek and Ozimek's findings are applicable to any technical or theoretical content. They found that undergraduate students had difficulties applying the skills learned in non-studio courses to their studio design work in a traditional educational system but that an integrated approach "…seems to help in shortening of this (application and transition) period and in better understanding of dependencies between different aspects of their creation."(Ozimek and Ozimek, 2011, p.56)

In a multi-course integrated approach to architectural education, the design studio should serve as the catalyst or "master course" as it "…is the only environment in which all aspects of architectural ideas and skills - formal aesthetics, building technology, theory, history, and drawing - can be learned", (Levy, 1980, p.29) though it is important that the non-studio courses are not seen as being secondary or "lesser" by students. All learning goals, methods, and outcomes should be structured around and focused through a studio design project that forces a creative endeavor to be influenced by technical skills and theory presented in supporting courses. This material can also be presented in the studio course itself as redundancy, with studio related content discussed in the technical courses in order to keep project goals in mind throughout the student learning process while reinforcing the interrelated nature of different course materials.

To accomplish the truly integrated studio, technical course assignments should coordinate work whenever possible with studio design problems that can take advantage of the use of knowledge of that particular topic or skillset. Teaching basic materiality and construction methods during a small scale site design would reinforce the technical knowledge through use in studio, and should result in a more robust and "complete" design as noted by Teal in his study on non-architectural course influences on design. "When such thinking provides a foundation for a designer's specific skills, the process of making architecture shifts from the creation of particular objects toward cultivating practices that open up territories, like 'ecological urbanism,' where all the relevant elements and information can react with one another. When this occurs, design becomes more effective." (Teal, 2011, p.38) This clearly creates some scheduling and material continuity issues in some classes, but over the course of a semester the bigger topics and concepts can be planned around (this especially includes assignment due dates). This methodology also allows multiple professors to fit seamlessly into formal critique sessions as project constraints and opportunities are already known to the involved faculty.

This methodology requires the availability of professors from each of the non-studio technical or theory classes during formal studio hours so that there isn't a break in "voice" or vocabulary, which can cause difficulties for faculty, though e-mail, video conferencing, and other technologies have made this less of an issue in recent years. (Bender, 2005, p.1) It should be noted: the idea "…that a holistic view of architecture leads directly to support for a holistic approach to architectural education may be simplistic." (Levy, 1980, p.30) and that careful consideration should be taken to be sure that all included faculty fully understand the overall project and are able to contribute to the system without bias towards their specific course material. At Purdue University, all tenure track professors teach a mix of studio and non-studio courses, easing difficulties that may arise in approach between technical course and design studio teaching methods.

5 PROJECT DESIGN

Perhaps the most common vision of landscape architecture education sees the design studio as the vital component of the curricular system. In the studio, students are presented with the opportunity to integrate all the knowledge and skills acquired in their broader studies—especially the technical and theoretical knowledge of other parts of the landscape architecture curriculum—into creative solutions to complex problems. Any experienced educator knows, however, that this ideal situation is seldom easily realized. The authors sought to use the studio as the basis for crafting an integrated project process approach while incorporating several other content areas that should impact design thinking.

The authors designed a pedagogical approach with three goals: first, to integrate the various knowledge areas (in this case design theory, earthworks and drainage, planting design, and landscape architecture engineering–construction documentation) in a single project; second, to break the typical structure of student projects in which a master plan is seen as a project's final product by including an iterative design process, in which many revisions are required; and third, to make visible the impact of each knowledge area upon the others and the whole.

For the project site, the instructors chose a vacant piece of land in the middle of the Ellsworth-Romig neighborhood in Lafayette, IN. A local neighborhood advocacy group, the Ellsworth-Romig Neighborhood Association, was seeking a vision for the site that would enhance it as a potential open space for the city. The site, a sloping parcel bounded by several streets (including an abandoned dead-end), offered great potential for the problem: it was neither too large nor too complex to allow students to apply several knowledge areas to its design. Rather than simply using a common site to achieve individual course outcomes, the authors sought a fully integrated experience that would emulate a professional's iterative and cross-informative/cyclical/revisionist process and enrich the end product.

Students began their design exploration with a quick "charrette" day of intense activity involving the faculty of their design studio course and their courses in earthworks and stormwater, planting design, and landscape engineering–construction documentation. This charrette introduced the design problem and reinforced the nature of the collaboration between the courses. Subsequent design development occurred using critique from the four faculty members both individually in their own class time, and collaboratively in a series of group pin-ups and interim juries. The initial product requirements included an illustrative plan and support drawings to communicate a vision for this site, a conceptual planting scheme that described the characteristics of plant materials and massings, and a conceptual grading scheme that addressed the relative vertical location of elements, slopes, and water runoff.

Following the initial submittal, students were then asked to review their design work with a critical eye and, following a round of client input, to revise their site designs in accord with peer, faculty, and client critique. The critique included input related to program, site forms, grading, and plant material use. As a part of this step, students were required to create a precision drafted digital line drawing of the plan, as the original illustrative plan and support drawings could be produced by hand or digitally; while they conveyed vision, they were not of the quality to allow for more accurate representation necessary for construction drawings.

In the next step, students were asked to revise their design solutions a second time, paying particular attention to the changes mandated by a more focused and refined approach to earthworks, stormwater design and planting. Students used their digital drawings (produced through CAD) as the base for the creation of a construction-document quality grading plan. A final revision and refinement of the project is currently taking place as students prepare final site plans, layout plans, and planting plans.

In all of these multiple steps, instructors reinforced the need for students to self-assess as part of the process of revision. Faculty expected each subsequent layer of thinking to influence the overall design, even though changes, especially in the later stages of the process, would be subtle.

In summary, the project process pushed students to experience the project as a professional typically would: integrating many types of information into the project process, using an iterative process of revision and assessment, allowing each type of information or process to demand particular responses, and then incorporating each piece into a new cohesive whole.

6 ASSESSING PROJECT EFFECTIVENESS

Surveys are the primary method for assessing the project's effectiveness. However, the variability of the survey method is minimized by the use of multiple surveys to different audiences. Three surveys have been designed: one to assess student skills by questioning their internship employers (see table 1 and table 2); a second to quantify student perceptions by asking questions of those involved in the project (see table 3), and a third to quantify student perceptions of effectiveness after a longer period by questioning graduating seniors (see table 4). The overlapping results begin to reliably assess effectiveness. Secondarily, the study uses a metric developed in which faculty assessment can be quantified.

This study has used our current junior class (20 students) as a model to test this collaborative integrated system; these students will soon be venturing out to work in their co-op firms where we will receive evaluations from their professional mentors. Measuring the success of an integrated course approach requires a control group that is difficult to create in architectural education due to instructional equity and faculty/student scheduling. This can especially be the case if a study attempts to split a typical design studio into two separate groups since students are accustomed to collaboration and shared learning styles in a studio environment. We will compare this data to previous class years that were taught the material in the more traditional segregated manner and determine if there are any significant differences between class abilities in the topic areas covered in the four integrated courses involved in this study.

Table 1. Co-op survey question measuring general design knowledge

	Far short of expectations	Short of expectations	Equals expectations	Exceeds expectations	Far exceeds expectations	N/A
Concept development	❍	❍	❍	❍	❍	❍
Problem solving	❍	❍	❍	❍	❍	❍
Creativity & process	❍	❍	❍	❍	❍	❍
Research (finding surveys, aerial photos, demographic data, etc.)	❍	❍	❍	❍	❍	❍
Site inventory	❍	❍	❍	❍	❍	❍
Site analysis	❍	❍	❍	❍	❍	❍

Because these undergraduate students at Purdue spend their fourth year on a paid cooperative internship (referred to as the co-op) before they return for their fifth and final year we can survey their mentors and direct bosses or project managers at their design firms as to the students design skills, production effectiveness, and general knowledge. We can then use this data to measure not only our teaching effectiveness but also our student's comprehension and retention of material learned to date. There are factors that are likely influencing the professional abilities of our students, expressly maturity, personal drive, and talent, but we believe the independent assessment by active practitioners is the best way to determine the ultimate effectiveness of our courses and abilities of our students.

Table 2. Co-op survey question measuring technical skill aptitude

	Far short of expectations	Short of expectations	Equals expectations	Exceeds expectations	Far exceeds expectations	N/A
Grading	❍	❍	❍	❍	❍	❍
Hydrology	❍	❍	❍	❍	❍	❍
Understanding of materials	❍	❍	❍	❍	❍	❍
Plant knowledge	❍	❍	❍	❍	❍	❍
Cost estimating & takeoffs	❍	❍	❍	❍	❍	❍
Time management	❍	❍	❍	❍	❍	❍
Punch lists & evaluation	❍	❍	❍	❍	❍	❍

Table 3. Excerpt from the participant student perception survey

The integrated course approach has allowed you to:	Hindered a lot	Hindered a little	Neither helped nor hindered	Helped a little	Helped a lot
Create a deeper more robust design solution	❍	❍	❍	❍	❍
Understand the coordinated systems approach to design	❍	❍	❍	❍	❍
Understand the iterative and adaptive process of design	❍	❍	❍	❍	❍
Better manage time due to shared deadlines and expectations	❍	❍	❍	❍	❍
Become competent in the individual skills necessary to create a complete project (grading, drainage, planting, etc.)	❍	❍	❍	❍	❍

Table 4. Excerpt from the graduating senior survey measuring perceived knowledge and abilities

	Not at All	Name & Describe	Understand & Apply	Create & Integrate
Develop design programs based on user needs and client goals/resources	❍	❍	❍	❍
Analyze relationships among design elements by determining opportunities and constraints	❍	❍	❍	❍
Develop conceptual design, planning, & management solutions	❍	❍	❍	❍
Evaluate design alternatives to determine appropriate solutions	❍	❍	❍	❍
Designing complete places (strong sense of identity, enclosure, wayfinding, etc)	❍	❍	❍	❍

This study understands that due to relatively small sample sizes, variations between class years, and placement availabilities of student internships, the confidence interval possible in drawing valid inferences from the data is lower than the ideal. It is the hope of the professors involved that over time a large enough sample can be gathered, along with the opinions of the faculty (based on independent assessment of student work), to measure the hypothesized increase in quality and depth of student projects. Informal responses from students gathered as the project progressed show an unintended effect. As part of project critiques, students often expressed confusion about faculty expectations for the project. Broader than students simply lacking understanding, the students expressed dismay that they were receiving different kinds of comments from their four instructors. While unintended, this perception both demonstrates the inability of students to adequately assimilate multiple points of view (searching for "the" answer) into a project, and offers the opportunity to again replicate a professional project experience, as the situation replicates the multiple viewpoints found in several clients, stakeholders, or firm principals and project managers.

It is the authors' belief that an collaborative course structure will allow students to see, understand, and integrate knowledge gained in various non-studio courses, thereby creating more robust, deeper, and more "complete" design solutions in studio. This methodology should serve landscape architecture's students by reinforcing the iterative multi-modal nature of design before they venture out to their co-op internships.

7 OBSTACLES TO AN INTEGRATED APPROACH

Perhaps the largest obstacle to integrated student learning experiences is simply that university and curricular structures often do not envision them nor easily allow them to occur. The difficulties of course content, course description, and the structure of curriculum have already been discussed. In addition, while faculty may expect students to apply knowledge from previous semesters or concurrently running courses, the students too often expect that only the content laid out in the course description be covered. These disconnects between faculty and student expectations may become a source of misunderstanding, frustration, and disappointment on both sides.

Further complicating the issue, the standard practice in many universities is to establish an “instructor of record” responsible for administering a specific course to an individual group of students. Although collaborative teaching with colleagues may offer benefits to student learning, student expectations of a single instructor to whom they are responsible, and who ultimately evaluates and issues the grades, is a reality of administration that is not easily discounted.

Finally, the reality of faculty course assignments is also problematic. In some landscape architecture programs, faculty members are routinely assigned the same courses year after year. While most instructors are aware of each course’s role in the overall curriculum and seek student outcomes that reinforce that role to the benefit of all students, the danger of faculty focused solely on their subject with little regard or overview of the entire curriculum still exists.

8 SUMMARY

At present, this course approach has not gathered a large enough sample size to measure significant results from the study. However, the authors expect that the repetition of an integrated course approach will yield valid data as to the effectiveness of this methodology in the future. While previous studies have described integrated approaches to design pedagogy in the past, these methods have not yet been widely adopted in landscape architectural education. The authors hope that this study will reinvigorate a conversation about an integrated approach to design so that students will be better prepared for the complex realities of professional design practice.

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