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21st National Conference
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Stephen Temple, editor

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Primary Contexts
Informing Beginnings
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Cultural Pluralities
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Problem-Based Learning in Architecture and Medicine: Comparing Pedagogical Models in Beginning Professional Education

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Introduction

> *"If future-oriented curricula are to prepare students for effective living, they must emphasize critical-thinking skills, continuous learning, and creativity or fluency of ideas."*[1]

Throughout the past thirty-five years, Problem-Based Learning (PBL) has gained international popularity in primary-, secondary-, and higher-education, and has gained esteem in diverse disciplines, including medicine, the social sciences, engineering and chemistry, and the design disciplines. Formalized PBL began in 1969 at McMaster University in the education of health sciences students. Subsequently, in numerous universities throughout the world, traditional health sciences curricula were converted to the PBL model. The rapid growth in problem-based pedagogy in the medical profession resulted from two conjoined issues. First, in a tradition that found its roots in educational scholars such as Dewey and Kilpatrick,[2] an increased focus and value had been placed on "active learning"; the lecture-based approach to teaching and learning had fallen out of favor. Educators in secondary- and higher-education were exploring new teaching methods that placed students rather than instructors at the center of classroom activities. Case-studies, group projects, and project-based activities became more prevalent. Second, the medical profession, its knowledge base, and the technologies of medical practice were changing rapidly. Students and practitioners were expected to engage in continued education and sustain a working knowledge of the newest advancements. The pre-1960 model of health education did not readily prepare students or practitioners for continued learning. The pre-1960 model focused primarily on rote memorization not on *processes* of learning, information gathering, or problem solving. Problem-based learning approaches offered solutions for both addressing the critiques of the previous educational model and preparing professionals for the changing knowledge-base and practice of medicine.

In contrast, architectural education, at least that of the design studio, had remained (has remained) largely unchanged. Three and a half to six years of college-level study followed by three (or more) years of internship: architectural education is currently a two part linkage born from the Beaux Arts tradition and the model of apprenticeship that preceded it. The preparation of medical students is an analogous two-part study. Although the delineation of problem-based learning methods was formed much later than the traditions of the architectural design studio, and although established in a divergent discipline, the basic components of problem-based learning are synonymous with the pedagogical traditions of the design studio. "Problem-based learning (PBL) is an approach to professional education that stresses the use of real-life problems as a stimulus for learning."[3] Critical thinking, self-reflection, interdisciplinary and self-directed learning, and ill-structured problems are central to both PBL and design education. In addition, PBL has been formally adopted by architecture schools in Australia, Asia, the UK, and northern Europe. Hundreds of other architecture schools employ this instructional model, but do so in an implicit rather than explicit, and an anecdotal rather empirical manner. There is great danger in this.

Problem-based learning has significant implications for the beginning years of professional education—the years in which students are socialized to a) various teaching/learning

approaches, b) discipline-specific methodologies and terminology, and c) the demands of a professional education. In addition, formations of learning habits and significant cognitive developments occur in the beginning years. Though variations of problem- (or project-) based learning methods are used in hundreds of design schools around the world, there is little research or literature on problem-based learning in architectural education, especially beginning design education in the United States. PBL in beginning design education requires further study.

On the contrary, educational literature on the use of PBL in the health professions is abundant. For this paper, the author is suggesting that this literature may provide an analogue to PBL in professional architectural education, as numerous similarities between the educational and professional *mechanisms* of architecture and medicine exist. This paper, therefore, examines the implications of problem-based learning in beginning design education through a comparison to PBL in medical education. The paper includes a discussion of three basic issues: 1) a comparison of "pure" problem-based learning to the traditional architectural studio education, 2) a comparison of the professional educations of architecture and medicine regarding PBL, and 3) an articulation of the need for and areas of further research on PBL in beginning design education. The primary goal is to provoke further research on PBL in architectural education.

Comparing PBL and the Traditional Design Studio Education

There have been increasing debates throughout the past ten years over curricular integration and roles of the (so-called) 'sub'disciplines of architectural education—history, technology, theory, and practice, as well as a general, liberal arts education—in relation to the design studio. "Making the connections, both *within* the architecture curriculum and *between* architecture and other disciplines on campus, is…the single most important challenge confronting architecture programs."[4] The use of PBL in some European and Australian schools results from this drive toward *curricular reintegration*, a desire to recombine the autonomous design studio with the allied subjects of architectural education. Faculty members at the University of Newcastle in Australia, for example, have published several pieces on this subject.[5] The faculty asserts that the "integration of subjects is somewhat handicapped in a 'design'-dominated curriculum like architecture." They propose PBL as a solution, as integrative learning is central to PBL.[6]

The five basic objectives of problem-based learning are to facilitate a student's development of: 1) extensive, growing, and flexible knowledge, 2) effective problem solving skills, 3) self-directed, life-long learning skills, 4) effective collaboration skills, and 5) an intrinsic motivation to learn.[7] The two overriding goals of PBL are to foster self-directed learning and self-regulated learning. These ambitions are pursued through the use of ill-structured, open-ended problems, which often elicit multiple viable solutions and often require integrative, interdisciplinary learning. Critical thinking, self- and group-criticism, a combination of analysis and synthesis, and a preference of the *application* of knowledge over rote memorization are central to problem-based methodologies. These characteristics are also fundamental to the studio environment. In both situations—the architectural design studio and the PBL environment—the instructor is a facilitator or "coach" rather than a lecturer, and his/her daily activities tend to be reactive rather than preemptive. In a lecture-based setting the instructor is the "channel" for learning and students maintain a passive role, while, on the contrary, the studio environment employs the design problem as the conduit for learning and requires active student involvement. Advantages and disadvantages of each method—including learning outcomes, instructor preparation time, student motivation, etc—have been well established and discussed. One dilemma that remains unstudied in both PBL and the design studio is the role and application of "the problem."

The nexus of the students' activities is the ill-structured problem; it is the mechanism for learning. Students move through various stages of problem-solving[8]—clarifying unknown terms, brainstorming, testing hypotheses, etc—throughout the learning process and partake in various roles—information gatherer, critic, etc. The tenuous issue is that the problem exceeds the

student's current knowledge foundation. "In a PBL classroom, students confront a problem before they receive all of the relevant information necessary to solve it."[9] In other words, learning occurs through the struggle of solving the problem(s); the problem is not a means to evaluate or apply prior knowledge. This is a common oversight in the daily interaction of studio instructors and students. Students often become frustrated in their inability to solve the given design problem and their lack of knowledge, experience, and expertise at doing so, and fear how their unfamiliarity with the issues of the problem will affect their grade in the course, while studio faculty often profess that students are under-prepared (by previous studios, by secondary-education, etc) for the content of the current course.

"Pure" problem-based learning is intended to be adopted throughout the curriculum, from year one through graduation, in both studio courses and non-studio courses. The architecture faculties at Newcastle in Australia and Delft in the Netherlands, as two examples, made the transition to a formalized PBL curriculum in the 1990s. The mid-90s was also a time when many U.S. medical schools shifted to a PBL program. Most institutions, including professional schools of medicine and architecture, however, are not structured to make the full transition to "pure" problem-based learning, nor is there consensus among most faculties to do so. This may result from a number of causes: escalating number of adjunct and visiting faculty members, discontinuity in administrative structures and teaching assignments, lack of teaching experience or knowledge, and/or lack of broad (school-wide) curricular discussion or awareness, among other reasons. As well, the traditions of professional education (whether architectural or health sciences education) have maintained a strong foothold, and even pedagogical siblings such as PBL are skeptically viewed. Some architecture curricula are built around the view that first-year courses are broad, shallow introductions to the various topics of the discipline. In this curricular structure upper-level courses move deeper into the subjects revealed in beginning courses and require increased sophistication. An alternate curricular structure views each course, regardless of year-level, as a primary source of a specific content area; each course is specialized. And, of course, other models exist; though it is currently unclear which model is most successful for student learning and which is the best match for the PBL system. Further research needs to be conducted on the value and success of the aforementioned and other curricular structures regarding a) student learning, b) cognitive development, c) student motivation and satisfaction, and d) preparation of students for licensure and practice.

Another aspect of "pure" PBL that has been dismissed in the project-based structure of the design studio is group learning. Problem-based learning is intended to be collaborative. Because the problem precedes the student's learning/knowledge, shared knowledge is crucial. When part of a formally structured group, students are able to learn from the knowledge and experiences of others, gauge others' views against their own, share their own unique experiences, and "pool" their knowledge in the problem-solving process. In addition, the PBL environment provides students the experience of working in groups and helps to prepare them for an increasingly collaborative working environment. This is a significant reason why PBL is valued in medical education. The medical profession is becoming increasingly specialized, requiring specialists and general practitioners to work in conjunction to solve patient problems. In parallel, the architectural profession is immensely collaborative both within the architecture firm and in association with the various specialists that provide consultation to the architect. So, why are so few curricula (why are so few studio projects) structured as group or collaborative problems? Why are so many projects built on an antiquated model that views the architect as a self-sufficient authoritarian? Admittedly, the assessment of group work may be more cumbersome, less precise, and less easily controlled; organizing group activities can be time-consuming; sustaining desirable group interactions can be unpredictable; and institutions with highly competitive entrance or touch-stone requirements may not be conducive to group structures. However, there is abundant literature on the group learning activities of PBL that may be useful: group structure and

interaction,[10] structure of effective problems,[11] formative and summative assessment strategies,[12] student and faculty perceptions of working in a PBL environment,[13] and curriculum structure.[14] Group activities and assessments can be as easily managed in the PBL and studio environments as the parallel activities seen in typical lecture settings, given that the instructor is properly trained and practiced and utilizes the appropriate educational literature.

Comparing PBL in Medicine and Architecture

> *"Problem solving is an important aspect of professional practice. Professionals must be able to 'make new sense of uncertain, unique or conflicted situations' that they regularly face in their work…Increasingly, professional education programs are recognizing the need for professionals to be able to solve ill-structured problems and are incorporating instructional experiences into their curriculum to help students develop problem-solving skill. One such instructional method is problem-based learning (PBL)."*[15]

Formalized PBL began in the late 1960s at McMaster University (Canada) and rapidly flourished as an educational technique in the health sciences. With a widespread increase in the perceived value of 'active learning' methods, PBL has gained interest among educators across multiple disciplines. As a result, literature on the use and effectiveness of PBL has promulgated in various higher education publications during the last two decades in virtually all disciplines—health sciences among the most common. Though variations of project- or problem-based learning methods are used in hundreds of design schools around the world, little educational literature has been written on the use of PBL in professional design education, especially beginning design education. Professional medical education, presumably, is a viable analogue to professional architectural education because the pedagogical and professional *mechanisms* that underlie each discipline possess a reasonable degree of similitude. Each is a two-part education composed of academic instruction and practical (e.g. clinical) training; each requires licensure through national examinations; each requires an internship under the supervision of a licensed practitioner; both professions are governed by local and national bodies; and each discipline—architecture and medicine—requires lifelong learning.

Like medicine, the knowledge-base, technologies, and everyday practices within the architectural profession are continually changing. Medical practitioners and design practitioners achieve licensure later in life (than many other professions), but can often anticipate long careers. Philip Johnson, for example, practiced architecture for 60 years. Over such lengthy careers, professionals must expect and be prepared to cope with changes: technological, political, social, or otherwise. Moreover, in both medicine and architecture each project ("case") is unique, with its own physical, social, and fiscal contexts; though there are transferable characteristics between cases (i.e. the use of case-studies). Adaptability, on the part of the practitioner, is crucial. The practitioner must be able to incorporate previous knowledge and be skilled in the search for new wisdom when solving each problem. Therefore, the education of the practicing architect or health professional does not merely reside in obtaining factual knowledge. The preparation of each aspiring professional comprises a) obtaining technical knowledge, b) honing critical thinking skills, c) refining research and investigative skills, and d) cultivating skills for solving open-ended problems. As students and licensed professionals must understand the fundamental knowledge of their discipline, they must also know the appropriate (and multiple) resources for obtaining knowledge that they do not already possess, enabling the resolution of unique problems. The two-part goal "is to build disciplinary knowledge bases as well as to develop metacognitive skills…to become lifelong learners."[16] Again, the interest in problem-based methods has grown due to PBL's ability to do just that. In addition, "a critical aspect of problem solving in ill-structured situations is that people hold multiple, and sometimes conflicting, perspectives of the nature of the problem, procedures for solving it, and appropriate solutions."[17]

In both medicine and architecture, professional preparation is two-part: academic instruction (the setting of the academy) and practical training (the setting of the internship). It is expected that specific knowledge and skills are obtained in each setting. In architectural education, however, the instructional roles of the academy and the profession are unclear. According to Oppenheimer, "Confusion and ambiguity surround architectural education, what it is and what it should be."[18] Oppenheimer goes on to state that there is a clearly outlined track of study for medical and dental students, but architecture students have a less defined path, partly because the academy-internship schism is poorly defined. Furthermore, there is debate surrounding the roles of beginning design education vs. upper-level courses of study. Similar debates have emerged regarding the use of PBL in medical education. Is PBL appropriate in 1st year study? And oppositely, is it beneficial in the "clinical years?"

As stated by Knowlton, some educators believe that "foundational knowledge" must be established prior to problem-based learning. Knowlton refutes this claim and argues that problem-solving is relevant throughout the curriculum and that rote memorization is not a prerequisite to problem solving. "When faculty members point to a need for students to have foundational knowledge, they really are advocating that students memorize information as a precursor to…problem solving. Rarely, though, does memorizing a database of knowledge assist students in solving problems."[19] Other research suggests that students exposed to problem-based methods early in their medical education expressed higher levels of satisfaction and greater perceived learning than did traditional curriculum students.[20] In addition, McClean reported that students who had previously failed year two of a traditional medical curriculum, largely overcame this setback once enrolled in a PBL curriculum.[21] It still remains unclear, however, how and when PBL is best introduced, while the disjunction between secondary-education methods and PBL methods in entry-level higher-education remains a predicament, especially in architectural education.

Conclusion: An Outline for Further Research

The advantages of PBL are numerous. First, the problem-based method gives students the experience of working in groups and prepares them for an increasingly collaborative working environment. PBL allows students to share their own unique knowledge, while, in complement, students become aware of what they do not understand and learn from the know-how of others. Second, PBL requires that students recognize and evaluate disparate (often conflicting) ideas and construct relationships between previous and new knowledge. This parallels constructive views of adult education (andragogy) and the work of educational theorists such as Mezirow's *transformative learning theory*.[22] Third, problem-based learning builds confidence and knowledge of where to go to "find answers"; i.e. students become familiar with multiple resources for learning and become adept at gauging which resource is most appropriate for their specific problem-driven needs. Forth, PBL helps to bridge the gap between academia and practice. The disjunctions between practice and academe can be vast and troublesome to aspiring professionals. Complex problem-solving develops students that are familiar with and prepared for 'real-world' problems, in part because the learning issues in the academic environment are viewed by the students as relevant to their professional training. Finally, most of the literature and research suggests that students in a PBL curriculum declare higher levels of empowerment, responsibility, and perceptions of learning, are more motivated, and are more likely to continue (life-long) learning than traditional curriculum students. Problem-based methods, however, are not free from scrutiny; and there are numerous areas in which further empirical study is required.

Foremost, a clarification of the role of PBL in architectural education is needed. Future research might include: 1) the typological differences between problems, 2) the effectiveness of these various "problem types," 3) curricular organization (i.e. the role, structure, and function of problems at different levels in the curriculum), 4) formative and summative assessment techniques, 5) PBL-student vs. traditional-student long term success (in the profession), 6)

outcomes of group learning vs. individual learning scenarios, 7) PBL and cognitive development (especially traditional vs. non-traditional students), 8) instructor/student interactions in the PBL environment, 9) perceived and actual learning outcomes, and 10) student transitions from non-PBL settings to problem-based environments.

It may be argued that too much of the architectural design curriculum is implicit, hidden; pedagogic strategies are often kept from the students rather than described to them. From this author's experiences, not enough time is spent in the studio discussing the facts of architectural education (specifically) and the characteristics of learning (more generally): teaching methods, learning styles, cognitive development, etc. It is often expected that students will either "get this knowledge elsewhere" (e.g. PSYCH 101) or will come to understand architectural learning intuitively through experience. But it is not sufficient for students to operate in the project-based method with merely an implicit understanding of the learning objectives, processes, and assessment techniques employed. PBL (or any other instructional strategy, for that matter) should not be utilized by the instructor without a thorough tutorial session for the students on the differences between PBL and other methods, what students can expect in the PBL setting, and why the PBL method is being used. Research suggests that learning outcomes, positive student attitudes, and student motivation increase in the problem-based environment when courses/curricula begin with a comprehensive tutorial session which contextualizes the PBL environment. It is in the opinion of the author that studio instructors must develop more numerous and more formalized group learning activities. It is important to teach students not only about architectural history, technology, etc, but also about the educational methods that are at work.

Traditional first-year students, for example, enter the architecture studio with few prior educational experiences that are structured like the design studio. The educational and social environment of the design studio differs greatly from that of secondary-education. It is important to research how beginning students, especially traditional students (i.e. entering 1st year college students) react to, cope with, and adapt to an unfamiliar pedagogical model. For instance, what are students' perceptions of the high level of one-to-one interaction with their instructors? Early studies suggest that student reactions to various types of instructors are not easily predicted. Webster states that "there has been surprisingly little research focused on the tutor-student relationship…in one-to-one design tutorials."[23] More broadly stated, very little research has been conducted on the role of problem-based learning in architectural education, especially beginning design education in the United States. Part of the dilemma resides in the fact that there are few discipline-specific venues in the U.S. for the publication of empirical studies in architectural education. In conjunction, most scholarly activity in architectural education is anecdotal. There are, however, extensive similarities between problem-based learning in medicine and the structure of the architectural design studio. These parallels should not be readily dismissed. The project-based environment—whether termed "PBL" or "design studio"—is being sought after for its core values: fostering critical thinking, cultivating collaborative skills, and inciting life-long learning. Despite recent critiques of the long-standing traditions of the architectural design studio,[24] it is difficult to imagine an alternative system of learning. The project-based environment is all too synonymous with the profession and practice of architecture. The design projects faced in architectural studios—whether in firms or in schools—are complex "problems" that require creativity, speculation, and self-criticism. Problem-based learning *is* the design process; "we cannot design without inherently thinking and working in a problem-solving mode."[25]

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