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Donald Schon's Philosophy of Design and Design Education

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Donald A. Schon is among our generation's most influential philosophers of design and design education, yet remains uncelebrated in both philosophy *and* design education. This paradox dissolves when we consider Schon's specific contribution. He was, by his own account, a *displaced* philosopher working in (among other places) a management consulting firm, a governmental agency, a non-profit center for social development, and finally a university department of urban planning. He used his marginal position in the design professions to reframe professional practice generally. Schon spoke *from* philosophy and design *to* professional practice, conceiving design to be its unifying core. From his philosophy of design he projected a new model for teaching and learning in the professions, and a new conception of the research university. The former has been taken up and elaborated by educators in the professions – in schools of medicine, law, business, public administration, education, engineering, architecture, among others. The latter has entered the mainstream of discussion among higher education reformers. Philosophers and design educators have not paid the same measure of attention to Schon's ideas.

My purpose in this article is to re-introduce Schon as philosopher and design educator, to provide a simple exposition of his basic ideas – his conception of design, his notion that all professional practice is 'designlike,' his ideas about how design is taught and learned, and his conception of the university as a collection of schools of design.

I. THE DISPLACED PHILOSOPHER

Schon compared himself to the giraffe: tall, curious, aloof. The comparison is insightful. Physically tall, he also looked down upon the world of practice – learning its ways and assisting its denizens to make life a little better – from the inquisitive but distanced perspective of the philosopher. He 'spoke a hundred languages of expert communities' (Walsh 1997) but philosophy was his first professional tongue.

Schon studied philosophy at Yale and the Sorbonne, and earned his Ph.D. in philosophy from Harvard in 1955. While at the Sorbonne he also studied performance music (clarinet and piano) at the Paris Conservatory, and was awarded the Premier Prix in clarinet. He continued throughout his life to

perform both jazz and composed music and as we shall see, he used his intimate knowledge of musical performance to great philosophical advantage.

From the first the major influence on his thought was John Dewey's theory of inquiry. But he warned that we should 'beware of accepting it precisely as he left it to us' (Schon 1992, p. 122). From his Ph.D. dissertation on, he accepted Dewey's concept of thinking in 'problematic situations' as a starting point, but sought to 'rethink and reconnect' Dewey (Schon 1983, p. 357). He aspired to illuminate the process of practical inquiry by combining conceptual analyses with empirical studies of expert practitioners. He was briefly a professor of philosophy at the University of California, but realizing that his experimentalist approach was out of favor in philosophy he embarked upon an astonishing career as a displaced philosopher in the world of design.

Despite lack of formal qualifications Schon was offered a job at the Arthur D. Little consulting firm in Cambridge Massachusetts. At ADL Schon formed the New Products Group and consulted with more than 30 industrial firms on product design and technical innovation. In 1963 he joined the department of commerce in the Kennedy administration and directed a new Institute for Applied Technology in the Bureau of Standards. In 1966 he left government service to return again to Cambridge where he founded the Organization for Social and Technological Innovation, which engaged in research and practical interventions in the fields of housing, health, education and other social services. In 1972 he became the Ford Professor of Urban Planning and Education at MIT, a position he held until his retirement in 1992. Schon died of leukemia at age 66 on September 13, 1997.

What did he learn from his long excursion into technological innovation, design, and applied research? First, long before Alvin Toffler's *Future Shock*, he discovered that the increased rate of technological change had thrown us into a constantly changing and destabilized world that threatened our individual and social identities, against which we mounted identity-conserving reactions on the whole dysfunctional for ourselves and our institutions. He explored this insight in *Technology and Change: The New Heraclitus* (1967) and his Reiff lectures, published as *Beyond the Stable State* (1971).

Second, he discovered that generative metaphors permitted us to 'construct meaning' in our perpetually changing circumstances, providing continuity between our older experiences and our new situations by pointing at similarities or family resemblances between them. We constantly find ourselves in disorienting situations which must be conceptually 're-framed', and until we discover through 'frame-experiments' a conceptual framework for the new situation we cannot even begin to determine what the relevant facts are, or what evaluative criteria apply. Metaphors permit us to bring 'the familiar to bear in the unfamiliar in such a way as to yield new concepts while at the same time retaining as much as possible of the

old' (Schon 1963, p. ix). He explored this idea in his first book, the *Displacement of Concepts* (1963) and amplified it in 'Generative Metaphor: A Perspective on Problem Solving in Social Policy' (1979). While humanists might accept such a description of their practice, Schon argued that technological innovators, social planners, and other professional practitioners – also engaged primarily in such 'frame-reflections.' Third, he saw that in our era of mass tertiary education professional practice has increasingly become the primary institutional channel whereby all significant problems are addressed, and hence has become society's central arena for such 'frame-experiments'. Schools of engineering, management, forestry, and other fields had entered the research university, leading (in Wilensky's phrase) to a 'professionalization of everyone' (Schon 1995, p. 29). The university had become the epistemological center of practice and training ground for all practitioners.

But fourth and finally he recognized that in an era of rapid change there was an emerging crisis of professional practice. Society was questioning the legitimacy of professional autonomy, and professionals themselves could not give a persuasive account of its rational or moral basis.

This last insight, in particular, lay behind the work for which Schon is best known, his books *The Reflective Practitioner* (1983) and *Educating the Reflective Practitioner* (1987). The philosophy of the research university, its 'epistemology of practice', was formed in the 1870s as American scholars imported from Germany the idea of the university as a place in which to do 'pure' or 'scientific' research to provide a *rational foundation* for practice. The adoption of this epistemology led to a normative professional education curriculum, in which students first study basic science, then the relevant applied science. Practical work enters only at the last stage in the curriculum, in the practicum where students are expected to apply the science learned earlier in the curriculum to real-life problems.

The crisis of the professions arises because real-life problems do not present themselves neatly as cases to which scientific generalizations apply. So this epistemology of technical rationality eventually leads to a dilemma of *rigor vs. relevance*. Professional practitioners find themselves pursuing either arcane technical studies more or less inapplicable to the 'swamps' of real-life practice, or significant real-life problems which call for approaches not deemed 'rational' or 'scientific' when judged by the standards of university professional schools. Practicum instructors are caught in the dilemma of having to teach real-life practice when they are supposed to be teaching something else, applied science.

Schon set out to develop an epistemological alternative in which the actual practices of professionals, acquired from tradition and experience, rather than from science, constituted the core of professional *knowledge*. As we shall see, this move problematized the privileged place of science in professional education and practice, and led Schon to a new model for higher education.

II. DEWEY'S EXPERIMENTALISM AND SCHON'S DESIGN-CONSTRUCTIVISM

Schon's new epistemology of practice can best be explained by understanding how he 'rethought and reconnected' Dewey. Dewey and Schon both offer their theories of reflective practice as alternatives to the model of technical rationality. But while Dewey and Schon both address the same questions, and both reject the same *wrong* answers, they offer different, and competing, *right* ones.[1]

Dewey (1902, 1904, 1938) shares with the technical rationalists a commitment to science as the method of reflection, but rejects technical rationalism because it provides no independent check in the primary (non-scientific) experiences of practitioners and clients for the validity of scientific laws as recipies for problem-solutions. He posits that scientific inquiry is merely an intermediate stage in a process which begins when practice becomes unsettled or problematic. This leads to a 'time-out' from practice for reflection, during which inquiry guided by the methods and spirit of the sciences yields causal connections to apply in practice. But for Dewey, unlike advocates of the technical model, the process ends only when the results of inquiry have been carried back to practice and are confirmed in the experiences of practitioners and clients as solutions to their problems. For Dewey practice itself is not primarily a 'knowledge affair.' Knowledge comes into play only during periods of reflective delay.

Schon, however, rejects the idea of reflection as a 'time out' from practice for scientific inquiry. For Schon, practitioners (such as architects, engineers, and industrial designers) have their own 'esoteric' knowledge codes woven right into their practices. Practice *is* a knowledge affair. Practitioners apply tacit knowledge-in-action, and when their messy problems do not yield to it, they do *not* take 'time out' to reflect, and they do not disengage from the languages of practice in order to use any more general methods of scientific inquiry (Schon 1992, p. 125). Instead, they 'reflect-in-action,' and in the languages specific to their practices. Even when they do stop to reflect *on* action, they think in the language of practice, not the language of science.

This implies a fundamental difference between Schon and Dewey on what reflective practice is and how it is learned. For Dewey, it remains akin to scientific thinking, and it is learned by doing – by engaging in scientific inquiries at one remove from the practical problems generating them. For Schon it is the forms of thinking specific to e.g. professional practices, and it is learned in the thick of the professional activity, not at one remove. For Dewey the paradigm site of education is the scientific laboratory; for Schon it is the design studio. This difference generated sharply different views of the university and its place in society.

III. DESIGN AND THE REFLECTIVE PRACTICUM

The institutional goal of Schon's epistemological project is indicated clearly in his (1987) subtitle: 'toward a new design for teaching and learning in the professions.' Like Dewey, Schon sees the role of the philosopher as providing a useful plan for education. This is a conceptual hypothesis to be tested for its consequences and implications, hence, a 'design' for education. And Schon's proposed 'design' for professional education is design itself. His hypothesis is that *all* professions are 'designlike' in some relevant respects. Thus we can organize *all* professional education on the template of educating designers: this is Schon's 'new design for professional education,' and points towards his new design for the university and for education as a whole.

In his best known books (Schon 1983, 1987) he procedes by analyzing design education on-site, providing and studying audio-taped protocols from teaching-learning sessions in the design studio. His first objective is to understand these protocols, to grasp the central features of education in design. He then extends his analysis to other professions, testing his hypothesis that *all* professions are 'designlike' and that *eo ipso* education in the professions simply *is* education in design. After interpreting the protocols from the design studio, Schon explores protocols from other professional education situations and applies his interpretive terms – his vocabulary – to determine whether it provides an interesting and useful frame for them.

In *Educating the Reflective Practitioner* (Schon 1987) he provides three 'test cases.' The first is education in the performance of composed music. The other two are from education in two 'interpersonal' professions: psychoanalysis and management consulting.

The choice of performance of composed music is a very good strategic one for Schon. As he notes, music performance is an artistic and creative profession and thus one might expect that an analysis of education in the design studio would cast *some* light on it. On the other hand, the performance of composed music *tests* Schon's theory because in this profession the professional performs from a score composed by *another* musician and thus executes another professional's design. What Schon's brilliant analysis demonstrates is that this prior design is only one element in the total situation. The performer must interpret it – must impose upon it an overall coherence of new musical meaning – in short, provide a *new design* expressed in and through the technical operations of performance (e.g. bowings selected by a violinist). The choice of performance music also gives us a good platform for testing the application of Schon's conception of design to school and college teaching, because the teacher also characteristically executes a design provided by others (e.g. curriculum developers, text book writers).

IV. THE PROFESSIONAL PRACTICUM AND REFLECTION-IN-ACTION

Schon notes that the practice of any profession involves the use of special esoteric 'knowledge in action.' This knowledge is not merely verbal, but does, of course, have a verbal or discursive dimension. And though the professional can employ the knowledge 'in action,' he or she generally cannot give a very full meta-description of his or her practical knowledge. In Polanyi's terms, this is 'tacit' knowledge learned not in the abstract but in use.

There are three ways of acquiring such knowledge, Schon states. The first, very unusual, way is via self-instruction. The second is via apprenticeship – learning 'on line' in 'real world' contexts. But because this is both inefficient and can have serious negative real world effects, the standard site of learning is the 'practicum.' The practicum is an 'off-line' situation that *approximates* the world of practice. In this 'virtual world' the novice learner undergoes a series of graduated problems under the close supervision of a master practitioner serving as a 'coach.' The novice learns the vocabularies of the professional practice in the course of learning its 'operational moves.'

ln the more advanced problems the novice learns to confront the messy unanticipated problems that arise in professional practice. This is not merely *knowledge* in action, but 'reflection-in-action,' in that new moves have to be tried out and assessed, and thus thought about and talked about. The practicum as a training program aims at proficiency in this sort of 'reflection-in-action.' It takes the form of 'reciprocal reflection in action' – the coach and novice engaged in conjoint problem solving – talking and working through the problems side by side. In making the moves, talking about them and even talking about their talk about them ('meta-reflection'), the novice and master 'negotiate the ladder of reflection.' In these two ways, in its aims and methods, such experiences are *reflective* practica.

V. THE CONCEPT OF DESIGN AND THE DESIGN PROFESSIONS

Although the term 'design' is central to his work, Schon does not unpack it in any one convenient place. But he does have a specific *conception* of design and the activity of designing at the heart of his program. It will be useful to begin with a few general remarks on the general concept of design and then review Schon's more specific analysis or conception.

The term design is used as both a noun ('a design') and a verb ('to design'). As a noun, a design is a form, arrangement, pattern, blueprint, template, model, outline, plan, plot, scheme, or sketch. These more specific design synonyms show that a design may be either (a) a pattern *inherent within* an event or object or (b) a conceptual *template* – a pattern coming *before* something else that is then executed or made according to its form.

This template may be merely 'mental' or 'in the head' of the person whose action is guided by it. But a design may also be a *physical product*, something itself made and expressed in physical space, which contains a form or pattern after which something else will be made, such as a blueprint or a mold.

The verb 'to design' may also be analyzed along these lines. To design may be (a) to draw, to impose a pattern, or (b) to produce a template for subsequent iteration. To design in this second sense is to conceive, plan, form, model, originate, outline or sketch. The activity of designing is thus one of conceiving, planning, dreaming up something that will subsequently be brought into existence following its guidelines. The general contrast term for the verb 'to design' in this sense is 'to execute.' To execute is to complete, to carry out, deliver, finish, fulfil, or implement.[2] The *two step* model (Design Model I) suggested is:

(Design Model I): Design > Execute.

The design professions in general are those engaged in designing in this second sense – those whose products are designs as templates. The products of the paradigmatic design professionals (architects, composers, city planners, engineers, industrial designers) are of course not 'in the head' but on paper as sketches, scores, blueprints, plans, or programs. Schon recognizes the 'two-step' implication of the term 'design' when he contrasts the training of design professionals with e.g. machinists. The design professions are the professions of pre-conceptualization for subsequent execution. To say that all professions are 'designlike' is to imply that in all of them this conceptualizing feature predominates. This presupposes a broad distinction between conceptualizing and executing, and between professionals (engaged in conceptualizing occupations) and operatives. Operatives are, of course, not mere slaves. They execute the plans of others, but as Schon would be the first to insist, these are not self-applying. The builder, for example, has to be able to 'read' the blueprints drawn by the architect; they do not contain within themselves the rules about what to attend to and what to make of it. Sometimes Schon goes so far as to say that, for these reasons *all* occupations are designlike. This appears to stretch the concept of 'design' beyond recognition, however, robbing it of meaning by making it apply to everything and thus losing the distinction between design and execution that Design Model I depends upon. We are on safer ground in saying that for Schon all occupational activities have conceptual and operational dimensions, but in the professions the conceptual aspect predominates. Hence professions are all 'designlike' in that they all consist in conceptualizing, planning, patterning, or otherwise establishing cognitive order.

VI. DESIGN AS FRAME EXPERIMENTATION

Schon adds to the basic concept of design a specific *conception of design as frame experimentation*. He develops this in his analysis of the protocol of 'Judith,' an indocile novice, and 'Northover,' an inexperienced design teacher (who is a stand in for Schon). Judith thinks of designing buildings in terms of imposing shapes on materials, while attending to technical considerations such as acoustics and energy conservation. She thinks that she can merely 'choose' a basic design idea once for all 'in her head,' and impose it on the materials of the situation and make it work. But for Northover (as for Schon) designing is a process of trying out *meaning-establishing moves*. For Judith the design experience consists of exercising conceptual *control over* the situation. For Northover (Schon) it is an uncertain and indeterminate matter of experimentation to *discover* an over-all coherence *in* it. On this conception of design an initial idea, a 'frame' of meaning, is posited and put into play in the design *process*. But then the designer enters into a 'frame experiment,' a 'dialogue' with the materials of the situation. In the process the designer makes tentative operational moves and the materials 'talk back' to the designer, constraining and shaping subsequent moves. They can even *negate* the initial frame of meaning. Finally a new order of coherence, a new world, emerges through the co-creation by designer and materials in the frame experiment.

For Schon, then, to design is to discover a framework of meaning *in* an indeterminate situation through practical operations in the situation. This conception of design has three implications for Schon:

(1) design is learnable but not didactically or discursively teachable: it can be learned only in and through the practical operations of frame experimentation;

(2) design is holistic: its parts cannot be learned in isolation. Rather, it must be learned as a whole, in a molecular way, because to design is to work toward a pattern, a coherent order, a world of meaning comprising all components of a situation;

(3) designing depends upon the ability to recognize desirable and undesirable qualities of the discovered world. But novice students do not possess this ability, and it cannot be conveyed to them by verbal descriptions. This is because the quality-designating words in the design situation obtain a specific meaning *only* in the operational context of designing: their immediate meaning emerges from operational moves and material back-talk in the context. Hence, as Schon frequently insists, word-meanings in design contexts depend on the design moves to which they are attached. By the same token the significance of the design moves depends upon the words used to describe and explain them. Thus the 'language of design' is an inseparable part of a practical word-action complex, a Wittgensteinian 'form of life'.[3]

VII. DESIGN EDUCATION: TEACHING AND LEARNING TO DESIGN

Schon's ideas about teaching and learning to design follow closely from this conception of the design process. Design teachers are coaches who are initiates (in the best case, master practitioners) in this form of life. They are *insiders* who know the practice – both the operational moves and the associated ways of thinking and talking. By contrast design students are novice learners who want to learn the process, but are at the start on the *outside* of the form of life. They do not know either the operational moves or the specific meanings of the esoteric terms of the associated design vocabularies. This faces design teachers with the *three tasks of coaching*:

(1) dealing (alongside the novices) with the substantive problems of design, via combinations of moves/words, demonstrations/descriptions, in order to convey to novices the ability to deal with similar situations;
(2) particularizing the demonstrations/descriptions to specific learners – that is, fitting esoteric moves and words into a dialogue with the novices' uncertain moves and words;
(3) maintaining relationships with the novices. These teaching-learning relationships are fraught with problems because the novices can only learn by doing – but as novices they cannot yet actually *do*. The novices thus can be expected to experience feelings of loss of control, vulnerability, and enforced dependence. So coaches must cope with the predictable negative feelings arising in this predicament.

VIII. EXECUTION AS DESIGN: MUSICAL PERFORMANCE AND TEACHING

Design Model I of section V. contrasts design with execution. But Schon's understanding of design conception is more nuanced; in some cases the execution of a design itself involves further design. Here I contrast musical performance with teaching to make this clear.[4] Unlike musicians, I argue, teachers, like builders (and surgeons), do not *produce* designs so much as execute procedures others (e.g. curriculum designers) have designed.[5]

As Schon's analysis of musical performance makes clear, the fact that teachers execute the designs of others does *not imply* that teaching is *not* designlike in the relevant sense. For musical performance is *also* operative: the musical performer executes another professional's composition. Yet, as Schon demonstrates, that prior design is only one factor in a total situation upon which the performer must still impose a new pattern of meaning through performance acts. In musical performance there is thus a three step sequence:

(Design Model II): design l > (design 2 > execution)

where the performer is responsible for both design 2 and execution.

Musical performance is 'designlike' in his sense, because design 2 is a new design for the specific performance; the performer makes a frame

experiment which concludes with a new pattern of musical meaning realized in the performance. Performance is thus not merely the operation of executing the design already inherent in the composition, but rather involves the search for and discovery of a specific *new* musical meaning to be executed in this performance.

Teaching is also a three step sequence. The curriculum and textbooks leave ample room for the application of the teacher's professional knowledge-in-use. But the fact that the total situation is indeterminate does not prove that a *new pattern of meaning* is called for. Builders also contend with indeterminate situations, but building is not on the whole 'designlike.' Builders coordinate the factors in the construction situation to realize the *architects'* designs, not their own. By contrast, musical performers are judged on the basis of the pattern of musical meaning they themselves have created; their proficient execution of the composer's design is more or less taken for granted.

Teaching is designlike in Schon's sense if and only if the 'design 2' activities of teaching constitute 'frame experiments.' These experiments may take place in lesson planning or virtual environments akin to rehearsal spaces in music. The musician's preliminary stage of preparing for performance consists of a *first reading of* the score, noting all annotations and forming an initial idea about its overall musical meaning. The musician then *works on* the composition in practice sessions and rehearsals. These are virtual performances, in which performers do not *express* musical meaning but *search* for it and for means adequate to its coherent expression, putting an experimental frame upon the materials, and testing for implications and consequences. Because such virtual performances approximate real world conditions, such frame experiments are possible.

In lesson planning teachers engage in the analog of a *first reading* of the score, taking note of curriculum and textbook chapters and student attributes, then settling upon a preliminary meaning for the lesson. But frame experimentation also requires operational moves and observations of implications and consequences, without which a teacher's preliminary planning is analogous to 'Judith' *imposing* a mental meaning on the materials.

The availability of this space for practice and rehearsal facilitates 'design 2' in musical performance. But teachers do not have equivalent virtual contexts approximating real classrooms. The musical performer can rehearse the same composition over and over, but teachers can not analogously rehearse a lesson because the materials that 'talk back' – the students – are missing. The reflective practicum as Schon explains it does *not* fit the content and media of teaching.

More significantly, lesson planning rarely even initiates a search for new meaning. In *didactic* lessons teachers seek to realize an existing design (e.g. in the school knowledge of the curriculum) and not a new design of their own.[6] In *discursive* activities, teachers open and facilitate a discussion, a search of a meaning. A design or pattern emerges from the give and take of intellectual moves; if a teacher imposes a pre-existing design, it is

not facilitation but manipulation. In *heuristic* activities skills are selected for their own value to society or to the learners, or because learning them provides a fruitful context for incidental didactic or discursive learning (e.g., the gardening case above) In either case the skills are either operational, in which case they are relatively settled and do not need further design through frame experiments, or designlike, in which case the new meaning is discovered not in lesson planning but through *joint* experimentation of teacher and learner, reflection-in-action within the lesson itself.[7]

IX. LEARNING TO DESIGN AND LEARNING TO TEACH

Schon frequently discusses heuristic teaching. For him teaching in professional education settings is primarily coaching – heuristic teaching – facilitating learning-by-doing (as opposed to just memorizing or discussing outside of an operational context) through a combination of demonstrations and operational descriptions/explanations.

Oddly but significantly, while Schon's master teachers all have had intense formal study of their professional arts, they have not (formally) studied *anything* about the art of teaching-coaching. And surprisingly, Schon's model teachers do not appear to *design* their lessons. Rather, they just plunge in spontaneously, guided sufficiently by *their own* already formed professional arts. These paradoxes should alert us that teaching is very different from more paradigmatic 'designlike' professions like architecture and engineering.

Schon's account of the reflective practicum and the tasks of coaching helps explain the paradoxes. The novice learns the professional art by joint experimentation with the coach, either modeling his moves and self-descriptions after the coach (the 'follow me' mode of coaching) or working together with the coach reworking and correcting the novices moves (the 'joint experimentation' mode). In either case he learns *both* how to solve the substantive problems posed in the professional practice *and* how to 'negotiate the ladder of reflection' about the practice. He learns how to think and talk about the problems and how to step back from that talk for meta-consideration about it. Thus he learns to handle the first two tasks of coaching simply by learning the designlike profession itself. The primary task confronting teacher training for professional education in the university is learning the third, interpersonal task: managing the strains specific to the initiate-novice relationship.[8]

X. SCHON'S EPISTEMOLOGY OF PRACTICE AND A NEW DESIGN FOR EDUCATION

I conclude with a brief discussion of Schon's new design for the university and its implications for general education and design education in the secondary school.

First, Schon sees the contemporary university as undermined by the epistemology of technical rationality, and wishes to construct a new university upon a new, design-centered view of learned practice. Lee Shulman, President of the Carnegie Foundation for the Advancement of Teaching, recently confused this point when citing Schon to support the new forms of scholarship (of integration, application, and teaching) promoted by Ernest Boyer and the Foundation. Shulman says 'far too many interpreted Schon's writings as advocating a rejection of scholarly research in the professions and applied fields. Far from it! The strategy we must pursue is one that legitimates more than one kind of research'. Shulman added that Schon thought 'the principles of technical rationality are necessary for this work . . . but must be joined with reflective practice' (Shulman 1999, p. 15).

In fact Schon rejected 'technical rationality' entirely. He saw is as the defective epistemology of practice generating the flawed normative professional education and research program of the research universities, an outdated 19th century idea that generated the crisis of rigor vs. relevance, a dead end. The problem of the 21st century as Schon saw it was to break up the university founded on this idea and rebuild it on a new epistemology of practice, freeing researchers in the practical fields to do something new and different (Schon 1995, p. 34).

Of course science would and should have its own domain within this university. Schon regarded science as a one designlike profession among others, and the school of science as just another professional school. But the new form of practical research Schon and Boyer call for is 'a kind of research with norms of its own, that conflict with the norms of technical rationality' (Schon 1995, p. 27). Indeed, this research is 'inimical to the conditions of control and distance that are essential to technical rationality' (Schon 1995, p. 34). Thus he calls for an 'epistemological battle' against technical rationality, not a peace settlement with it (Schon 1995, p. 32).

Second, as indicated above, Schon, unlike Dewey, rejects science as *the* method of reflection for practice, and so rejects the spirit of science as the soul of the research university. Instead he makes design inquiry the core, finding many 'family resemblances' between design processes in the different professional schools of the university. But design problems are always specific to particular design fields with their traditions and funded experiences of practice. Professionals learn design practice in the practica of their fields, not in some generic course on methodology or design itself. Although Schon's university of associated design schools is no multiuniversity without a soul, the only coherence it possesses is that of a 'family resemblance' between its constituent schools.

Third, Schon's conception of design as frame reflection suggests an important role for general education, as conveying a common reservoir of meanings and exemplars – generative metaphors for frame reflection in

and among the several professional fields. Schon is comfortable with the idea of 'school knowledge'and perhaps he would see the materials of general education as 'school knowledge' akin to the 'math facts' of the elementary school (see Schon 1995, pp. 27–28). This raises two questions for Schon that Dewey addressed directly and he did not: at what educational level should this curriculum site be established, and what normative practices of teaching and learning might secure its intended ends?

Schon might agree with Dewey that general education be confined to secondary education, leaving the university free to devote itself entirely to professional training, including (but not privileging) training in the scholarly professions.[9]

I think he would also agree with two other ideas characteristic of Dewey: first, if the materials of general education – the texts, ideas, and concepts – are not organized and presented for use in subsequent inquiries, then they cannot serve effectively as a reservoir of tools in inquiry – that is, as generative metaphors in Schon's scheme. And second, the only way to assure this 'reflective transfer' from the learning site to later design inquiries is to organize student learning of the materials of general education as incidental to work on virtual or real design problems and projects.[10] These propositions would place project-based learning in a position where it could draw upon and reinforce learning in subject matter disciplines, and would thus establish design education as the *central hub* of the secondary school in Schon's educational design.

But secondary level design education when positioned in this manner raises altogether new questions which Schon's account of *professional* education in the *university* does not address. Secondary students, unlike those in the professional schools, will *not* in general be novices in vocations they have chosen. School design educators will *not* in general be masters in these specific occupations, with true insider understanding of their languages and operational moves. Teaching-learning thus can *not* adequately be framed as initiation through reflective dialogue into esoteric traditions and knowledge codes, as it might be in architectural or engineering education.[11] This points to the need for a more generic discipline of school design education with generalist teachers capable of responding flexibly to the mostly *amateur* design projects generated by school students. Design teachers in this capacity must use heuristic approaches (coaching), first motivating students to initiate projects that require and make essential use of general knowledge, then guiding them through frustration and delay to successful completion. The cognitive and motivational problems involved are of a different nature than those faced in professional education in the university and discussed so eloquently by Schon (see especially Section VII above). But his system of ideas will provide a fruitful standpoint in addressing them.

NOTES

1. Schon never *systematically* compared his epistemology to Dewey's, and some scholars have simply run them together. Bauer (1992), for example, promises a comparison but never sets out the significant differences. Tremmel (1993, p. 439) notes in passing that Schon's similarity with Dewey may be a source of confusion.
2. Educators in technology and design use the concept of 'design and build,' to mean both conceiving or planning a project and also carrying it through, executing it, bringing what is conceived or dreamed up into reality. The implication of this usage is that designing and building are two different but complementary activities.
3. Schon's theory of inquiry as design can be seen as an attempt to update Dewey's theory of inquiry by substituting within it ideas from the later philosophy of Wittgenstein in place of those of Pierce. Significantly, Schon places Wittgenstein, along with Dewey, Piaget, and Vygotsky, in his pantheon of exemplary educators (Schon 1992, p. 37).
4. In this section I recapitulate an argument developed in Waks 1999.
5. The name of occupations suggests the relative dominance of conception and execution, but this can be misleading. A surgeon performs surgical operations – but may also design them.
6. A didactic teacher is akin to a performer, and a lecture is like a dramatic monologue. But while the performance of a dramatic monologue Gray strives for an overall aesthetic unity, the unity of a lecture serves primarily to intensify attention and thus facilitate memory of the content. When this priority order is reversed, the teacher is said to no longer be teaching but (merely) performing.
7. University teachers sometimes combine their own research with teaching. Their preparations for lectures may then be frame-experiments. But they would be searches for meaning in their disciplines. School teachers *sometimes* engage in curriculum construction, a paradigm design activity, lying beyond teaching *per se*. If we broaden the conception of school teaching we *may* include designlike activities. The reflective practicum in Schon's sense may then be the preferred site for training in these *associated* tasks.
8. The third task is not learned in the reflective practicum in his profession. Schon (1987) devotes two chapters to teaching and learning this task of interpersonal management. His cases are psychoanalysts, counselors and consultants. These professionals 'mirror' the behavior of their clients in their own relations with their supervisors in the practica, which thus become 'halls of mirrors' in which they can 'reflect-in-action' on the task of relationship management. A practicum in coaching becomes akin to a psychotherapeutic session in teacher self-awareness.

   Schon also indicates some secondary tasks of training for university teaching in professional fields, including training in the scholarship of teaching, a form of action research involving reflections upon one's own teaching in forms that meet standards of rigor and are available for the use of colleagues facing similar problems (Schon 1995).
9. Dewey discusses the location of general education in the secondary school and the dominant role of the university as center for professional studies in chapters 2 and 3 of *The Educational Situation*, MW I, pp. 283–299 and pp. 300–313.
10. Dewey introduced the notion of project work or 'occupations' in *The School and Society*, chapters 1–3, MW I, pp. 1–56. He provides a diagram of his design for the elementary school (Chart III, p. 49) in which the four corners of the school represent 'practical areas', the center the library or 'theoretical area' and the zones between the 'clearing areas' where students and teachers work together to direct practical activity. Much of the formal curriculum content is acquired as students experiencing difficulty in practical work are directed by teachers from the clearing areas to the library.

    Dewey develops the idea that only concepts and materials acquired in the context of practical reflection can be applied in subsequent reflective practice in *How We Think* (Dewey 1933, LW 8, 105–350), and sums it up neatly as follows:

> . . . there is all the difference in the world whether the acquisition of information is treated as an end in itself, or is made an integral portion of the training of thought. The assumption that information that has been accumulated apart from use in the recognition and solution of a problem may later on be, at will, employed by thought is quite false. The skill at the ready command of intelligence is the skill acquired with the aid of intelligence (p. 163).

11. A useful comparison may be made between 'design education' as here positioned and typical subject matters of secondary vocational education such as auto-mechanics, where the students *are* eager novices and the teachers skilled tradesmen.

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