

5

The Structure of Reflection-in-Action

Introduction

In the two previous chapters, I have discussed examples of practice in two professions usually considered very different from one another.

The differences between architecture and psychotherapy are so very striking that at first glance there seems to be very little point in searching for resemblances. To begin with, the goals of the two professions have almost nothing to do with one another. The one aims at designing good buildings on a site; the other, at curing mental illness or helping people to cope with the problems they encounter in their lives. One uses the media of sketchpad, delineations, scale models; the other, talk. The architect works in his studio; the therapist, in a clinic or office. And the two professions draw on very different bodies of professional knowledge.

The Structure of Reflection-in-Action

But in the two cases there are also similarities. To be sure, these are partly a function of my methods of selection and study, but they are also, in part, a function of the practices themselves.

In both examples, the practitioner approaches the practice problem as a unique case. He does not act as though he had no relevant prior experiences; on the contrary. But he attends to the peculiarities of the situation at hand. Quist pays attention to the special problem of this screwy site and the Supervisor, to the special problem of this frustrated patient. Neither one behaves as though he were looking for cues to a standard solution. Rather, each seeks to discover the particular features of his problematic situation, and from their gradual discovery, designs an intervention.

In neither example is the problem given. Or rather, the student presents a problem that the teacher criticizes and rejects. The student has gotten stuck and does not know how to go further. The teacher, who attributes the student's predicament to his way of framing the problem, tries to make new sense of the problematic situation he is encountering at secondhand. The situation is complex and uncertain, and there is a problem in finding the problem.

These points of similarity create the conditions for reflection-in-action. Because each practitioner treats his case as unique, he cannot deal with it by applying standard theories or techniques. In the half hour or so that he spends with the student, he must construct an understanding of the situation as he finds it. And because he finds the situation problematic, he must reframe it.

The cases are similar in the further sense that in both architecture and psychiatry there are many competing views of the nature of the practice. There is controversy not only about the best way of solving specific problems, but about what problems

are worth solving and what role the practitioner should play in their solution. I propose that by attending to the practitioner's reflection-in-action in both cases it is possible to discover a fundamental structure of professional inquiry which underlies the many varieties of design or therapy advocated by the contending schools of practice.

Finally, in each case the practitioner gives an artistic performance. He responds to the complexity, which confuses the student, in what seems like a simple, spontaneous way. His artistry is evident in his selective management of large amounts of information, his ability to spin out long lines of invention and inference, and his capacity to hold several ways of looking at things at once without disrupting the flow of inquiry.

It is the art of these practitioners that I shall compare and discuss in the following pages. Their art seems to me to be, in considerable measure, a kind of reflection-in-action. In spite of the very great differences between their two cases, Quist and the Supervisor engage in a process whose underlying structure is the same: a reflective conversation with a unique and uncertain situation.

The main lines of this process can be readily drawn. Indeed, they are not very far below the surface of the examples as I have described them.

In each case, the student has set and tried to solve a problem and has been unable to solve the problem as set. Petra cannot butt the shapes of the building into the contours of the slope; neither can the Resident unravel the puzzle of the patient by analyzing her relationships with others. In each case the teacher responds by surfacing and criticizing the student's framing of the problem. He does this implicitly, leaving his criticism of the old problem to be inferred from his way of restructuring it. Petra must infer that the site is incoherent and cannot give an order to the design. The Resident must infer

that he cannot make sense of the patient's stalemated relation to her boyfriend without looking at it in relation to her stalemate with himself.

As the practitioner reframes the student's problem, he suggests a direction for reshaping the situation. Petra is urged to impose a geometry onto the slope, a geometry seen as generated by the L-shaped classrooms. The Resident is invited to join the two streams of experience drawn from the patient's life in and out of therapy. The practitioner asks the student to step into the situation, to make himself part of it—in Quist's case, by imposing his own order onto the site; in the Supervisor's, by treating his own relations with the patient as a microcosm of the patient's life outside of therapy.

The practitioner then takes the reframed problem and conducts an experiment to discover what consequences and implications can be made to follow from it. Quist's global, frame-testing experiment begins with "You must impose a discipline" and ends with "which works slightly with the contours." The Supervisor's begins with "How is she stuck . . . ?" and ends with, "This is really a woman who feels quite guilty . . . and that's how she's stuck."

In order to see what can be made to follow from his reframing of the situation, each practitioner tries to adapt the situation to the frame. This he does through a web of moves, discovered consequences, implications, appreciations, and further moves. Within the larger web, individual moves yield phenomena to be understood, problems to be solved, or opportunities to be exploited. Quist discovers spaces that can be made into nooks. The Supervisor finds a procedure for answering the question, "Punishment for what?" These are local experiments nested within larger ones.

But the practitioner's moves also produce unintended changes which give the situations new meanings. The situation

talks back, the practitioner listens, and as he appreciates what he hears, he reframes the situation once again. When Quist discovers that his moves have produced a gallery which is "in a minor way . . . the major thing," he becomes aware of a new whole idea, which sets criteria for the further designing. When the Supervisor discerns in the patient's stories the pattern which he describes as "continual self-frustration," he sets a restructured problem of interpretation which guides his further inquiry.

In this reflective conversation, the practitioner's effort to solve the reframed problem yields new discoveries which call for new reflection-in-action. The process spirals through stages of appreciation, action, and reappreciation. The unique and uncertain situation comes to be understood through the attempt to change it, and changed through the attempt to understand it.

Such is the skeleton of the process. It suggests several further questions.

1. The practitioner conducts an experiment in reframing the problematic situation. But how is such an experiment to be evaluated? The practitioner judges his problem-solving effectiveness in terms of an objective function, but how ought he to judge the problem setting which establishes the objective function?
2. When the practitioner takes seriously the uniqueness of the present situation, how does he make use of the experience he has accumulated in his earlier practice? When he cannot apply familiar categories of theory or technique, how does he bring prior knowledge to bear on the invention of new frames, theories, and strategies of action?
3. Reflection-in-action is a kind of experimenting. But practice situations are notoriously resistant to controlled experiment. How does the practitioner escape or compensate for the prac-

The Structure of Reflection-in-Action

tical limits to controlled experiment? In what sense, if any, is there rigor in on-the-spot experiment?

4. Technical problem solving involves a characteristic stance toward inquiry, as suggested by terms such as objectivity, control, and distance. These terms have limited application to the processes demonstrated by Quist and the Supervisor. Nevertheless, *their* stance toward inquiry is critical to the quality of their reflection-in-action. How should we describe it?

Questions such as these point to a further elaboration of reflection-in-action as an epistemology of practice. One might try to answer them by appeal to a structure of inquiry, but I do not know what such a structure might be or how it might be discovered, if not by reflection on the actual practice of experienced, competent practitioners who reflect-in-action. Accordingly, I shall approach these questions by looking for answers to them implicit in Quist's designing and in the Supervisor's interpretive inquiry.

Evaluating Experiments in Problem Setting

Quist and the Supervisor act as though they were judging their reframing of the students' problems in terms of these questions:

- Can I solve the problem I have set?
- Do I like what I get when I solve this problem?
- Have I made the situation coherent?
- Have I made it congruent with my fundamental values and theories?
- Have I kept inquiry moving?

Although a problem-setting experiment cannot be judged in terms of its effectiveness, the practitioner tries nevertheless to set a problem he can solve. If Quist and the Supervisor failed to do this, they would be stuck as their students are stuck. Hence they step into the situation with a framing of the problem for which they feel they can find a solution. Quist chooses a geometry of parallels which can be made to work slightly with the contours of the slope; at the same time, he sets a threshold standard of fit which enables him to say that "slightly" is enough. The Supervisor frames the patient's problem in terms of the transference which lends itself both to a strategy of inquiry and a strategy of intervention. Neither practitioner can know, at the moment of reframing, what the solution to the problem will be, nor can he be sure that the new problem will be soluble at all. But the frame he has imposed on the situation is one that lends itself to a method of inquiry in which he has confidence.

When the practitioner tries to solve the problem he has set, he seeks both to understand the situation and to change it. Quist's moves test the new geometry's suitability to the slope and at the same time they carve the L-shaped classrooms into the slope, producing a new configuration of buildings on the site. The Supervisor, operating at one remove from the patient, sees the therapeutic situation through the Resident's reports. As he elicits new stories and probes them, he tests his evolving understanding and at the same time draws out new phenomena which alter his experience of the situation.

The practitioner's moves produce some unintended effects. Quist discovers that as he carves the classrooms into the slope, he makes intervals of five feet. He finds that the gallery can be "extended to look down into here" and that it contrasts with the classrooms. The Supervisor's line of questioning elicits the surprising and puzzling story of the patient's fight with her boy-

friend. The practitioner evaluates his problem-setting experiment by determining whether he likes these unintended changes, or likes what he can make of them. Quist observes that five feet is maximum height for a kid, so that the five-foot intervals can be made into nooks. The extension of the gallery is "nice" and makes a "soft back area" to the hard-edged classrooms. The Supervisor sees in the story of the fight the signs of the patient's passivity and dependence which he will pursue in his further questioning.

In these instances, the practitioner affirms his reframing of the problem, because he values the unintended changes he has made and discovered. Quist values nooks, nice views, and a softening of hard-edged forms. The Supervisor values self-assertion, independence, and the ability to free oneself from dead ends; the story, which reveals the absence of these qualities in the patient, gives him a direction in which to seek interpretative understanding. The evaluation of the frame experiment is grounded in the practitioner's appreciative system.

Through the unintended effects of action, the situation talks back. The practitioner, reflecting on this back-talk, may find new meanings in the situation which lead him to a new reframing. Thus he judges a problem-setting by the quality and direction of the reflective conversation to which it leads. This judgment rests, at least in part, on his perception of potentials for coherence and congruence which he can realize through his further inquiry.

Quist interweaves local experiments with one another, honoring in each new experiment the implications generated by earlier moves. He finds that the spaces created by carving the L-shaped classrooms into the slope open out into "precincts" which must be given precedence. He observes that a middle area has been created whose treatment must be consistent with the overall geometry. By the time the new configuration has

been found to work slightly with the contours and the gallery has emerged as the focus of the design, there is, at the level of the global geometry of the buildings on the site, a whole idea so powerful for Quist that he calls Petra's placement of the administration "horrible" because it would spoil that idea.

The Supervisor builds gradually from his perception of the patient's dilemma toward an interpretive synthesis congruent with his fundamental values and theories. He reaches for partial interpretations which stay close to the data of the thematic stories he has elicited from the Resident. He guides his search for explanations by reference to the psychoanalytic themes of "inner conflict" and "guilt." By the time he has fully surfaced his interpretive synthesis, he has imbued it with the capacity to account for the earlier, partial interpretations and has made it congruent with psychoanalytic theory.

Thus the practitioner evaluates his experiment in reframing the problematic situation not only by his ability to solve the new problem he has set but by his appreciations of the unintended effects of action, and especially by his ability, in conversation with the situation, to make an artifact that is coherent and an idea that is understandable. But the achievement of coherence does not put an end to inquiry. On the contrary, the practitioner also evaluates his reframing by its ability, in Erikson's phrase, to keep inquiry moving. Quist concludes his review by describing new questions which flow from the design—the size of the middle area, the dimensions of the grid, the treatment of the trees. And the Supervisor, fearful of premature closure, rounds off his interpretive journey with the exhortation, "If only we can get an idea of the way this woman keeps herself frustrated. . . ." A successful reframing of the problematic situation leads to a continuation of the reflective conversation.

Bringing Past Experience to Bear on a Unique Situation

Quist recognizes many familiar things in Petra's situation, and he places them within familiar, named categories such as "parallels," "classrooms," "slope," and "wall." Similarly, the Supervisor recognizes and names examples of "self-assertion," "dependence," and "guilt." But when it comes to the situation as a whole, each practitioner does not subsume it under a familiar category but treats it as a unique entity for which he must invent a uniquely appropriate description.

The Supervisor's initial description of the patient's problem opens up a line of inquiry into the unique experience of this woman. He may have seen other patients who were continually self-frustrating or guilty, but he does not diagnose this patient as a case of guilt as a physician might diagnose someone as a case of mumps or chicken pox. Rather, he attends to her particular way of being guilty and to the role guilt plays in her inability to satisfy herself. The notions of guilt and self-frustration guide his attempts to discover what is *different* about this patient's experience.

Quist has very likely seen other screwy sites, but his initial description of this one does not place it within a design category that calls for a standard solution. Rather, it sets in motion an inquiry into the peculiar features of *these* slopes which respond in very special ways to the imposition of a geometry of parallels, creating a particular set of problems and a particular coherence.

It is in relation to the unique features of his problematic situation that each practitioner undertakes the problem-setting experiment we have just discussed. But just this is puzzling. How

can an inquirer use what he already knows in a situation which he takes to be unique?

He cannot apply a rule drawn from past experience, like the rule Quist gives for uses appropriate to slopes of various grades; for he would then ignore the uniqueness of the situation, treating it as an instance of a class of familiar things. Nor does he invent a new description out of whole cloth, without any reference to what he already knows. It is clear that Quist and the Supervisor use a great deal of their experience and knowledge, and it is far from clear what might be meant by the spontaneous generation of a description.

What I want to propose is this: The practitioner has built up a *repertoire* of examples, images, understandings, and actions. Quist's repertoire ranges across the design domains. It includes sites he has seen, buildings he has known, design problems he has encountered, and solutions he has devised for them. The Supervisor's repertoire includes patients he has seen or read about, types of stories he has heard and psychodynamic patterns associated with them, interventions he has tried, and patients' responses to them. A practitioner's repertoire includes the whole of his experience insofar as it is accessible to him for understanding and action.

When a practitioner makes sense of a situation he perceives to be unique, he *sees* it *as* something already present in his repertoire.¹ To see *this* site as *that* one is not to subsume the first under a familiar category or rule. It is, rather, to see the unfamiliar, unique situation as both similar to and different from the familiar one, without at first being able to say similar or different with respect to what. The familiar situation functions as a precedent, or a metaphor, or—in Thomas Kuhn's phrase—an exemplar for the unfamiliar one.² Kuhn's description of the functioning of exemplars in scientific problem solving is apposite here:

The Structure of Reflection-in-Action

confronted with a problem, [one] seeks to see it as like one or more of the exemplary problems he has encountered before . . . his basic criterion is a perception of similarity that is both logically and psychologically prior to any of the numerous criteria by which that same identification might have been made . . . Under appropriate circumstance . . . there is a means of processing data into similarity sets which does not depend on a prior answer to the question, similar with respect to what?³

Seeing *this* situation as *that* one, one may also *do* in this situation *as* in that one. When a beginning physics student sees a pendulum problem as a familiar inclined plane problem, he can set up the new problem and solve it, using procedures both similar to and different from those he has used before. Just as he sees the new problem as a variation on the old one, so his new problem-solving behavior is a variation on the old. Just as he is unable at first to articulate the relevant similarities and differences of the problems, so he is unable at first to articulate the similarities and differences of his problem-solving procedures. Indeed, the whole process of *seeing-as* and *doing-as* may proceed without conscious articulation.

On the other hand, the inquirer may reflect on the similarities and differences he has perceived or enacted. He may do this by consciously comparing the two situations, or by describing *this* situation in the light of a tacit reference to the other. When Quist immediately calls Petra's site "screwy" and says that she must impose a discipline on it, which she can always break open later, I believe he is seeing her situation as one or more others with which he is familiar and carrying over to her problem variations of strategies he has employed before. And when the Supervisor asks how the woman is stuck in her relation with her boyfriend as she is stuck in her relation to the therapist, I believe he is doing very much the same sort of thing. In both cases, the later descriptions of the situation are

reflections on and elaborations of the first, unarticulated perceptions of similarity and difference.

It would be a mistake to attribute to the inquirer at the beginning of such a process the articulated description which he achieves later on—to say, for example, that Quist must have known unconsciously at the beginning just how this site is screwy and just how the geometry of parallels can be successfully imposed on it. To do so would be to engage in instant historical revisionism. The perception of similarity and difference implicit in Quist's initial description of the situation is, as Kuhn says, both logically and psychologically prior to his later articulation of it.

It is our capacity to see unfamiliar situations as familiar ones, and to do in the former as we have done in the latter, that enables us to bring our past experience to bear on the unique case. It is our capacity to *see-as* and *do-as* that allows us to have a feel for problems that do not fit existing rules.

The artistry of a practitioner like Quist hinges on the range and variety of the repertoire that he brings to unfamiliar situations. Because he is able to *see* these *as* elements of his repertoire, he is able to make sense of their uniqueness and need not reduce them to instances of standard categories.

Moreover, each new experience of reflection-in-action enriches his repertoire. Petra's case may function as an exemplar for new situations. Reflection-in-action in a unique case may be generalized to other cases, not by giving rise to general principles, but by contributing to the practitioner's repertoire of exemplary themes from which, in the subsequent cases of his practice, he may compose new variations.

Rigor in On-the-Spot Experiment

Seeing-as is not enough, however. When a practitioner sees a new situation as some element of his repertoire, he gets a new way of seeing it and a new possibility for action in it, but the adequacy and utility of his new view must still be discovered in action. Reflection-in-action necessarily involves experiment.

Indeed, as we have seen, Quist and the Supervisor conduct reflective conversations with their situations which are experiments in reframing. From their repertoires of examples, images, descriptions, they have derived (by seeing-as) a way of framing the present, unique situation. They try, then, to shape the situation to the frame; and they evaluate the entire process by criteria I have described earlier in this chapter—whether they can solve the problem they have set; whether they value what they get when they solve it (or what they can make of what they get); whether they achieve in the situation a coherence of artifact and idea, a congruence with their fundamental theories and values; whether they can keep inquiry moving. Nested within the larger problem-setting experiment, there are also local experiments of various sorts.

But in what sense is this really experimenting?

The question arises because there is another sense of experiment which is central to the model of professional knowledge as technical rationality, one which Quist and the Supervisor, in their inquiries, do not seem to exemplify at all. In this sense, experimenting is an activity by which a researcher confirms or refutes a hypothesis. Its logic is roughly as follows.⁴

The researcher wants to account for a puzzling phenomenon, *Q*. He entertains several hypotheses about *Q*, each of which explains it. That is, from each hypothesis, if true, *Q* would follow. Suppose, for example, that the question were one

of discovering how mosquitoes find their way to their warm-blooded targets.⁵ A researcher might entertain three hypotheses: that they are attracted to the target by distinctive smells, by temperature, or by humidity. Then the explanatory relation might look like this: "If the target is humid, and mosquitoes are attracted to humidity," then "mosquitoes are attracted to the target (other conditions being equal)."

But how does the researcher determine which of the hypotheses is correct? John Stuart Mill's description of the logic of experimental method still seems to me to be the most useful. He identified three fundamental methods of experiment. Given phenomenon Q and competing hypotheses A , B and C ,

- The Method of Agreement consists in showing that when A (or B or C) is present, Q is also present. For example, when the target exceeds a certain threshold of humidity, then mosquitoes are attracted to it.
- The Method of Difference consists in showing that when A (or B or C) is absent, then Q is also absent. For example, when the target is *not* humid, then mosquitoes are not attracted to it.
- The Method of Concomitant Variations consists in showing that variations in A (or B or C) are accompanied by comparable variations in Q . For example, when the target's humidity varies, the degree of mosquitoes' attraction to it also varies.

Some version of the Method of Difference is essential to valid experimental inference. For when A and Q are co-present, there may be some other factor— C , for example—which is also co-present and is the cause of Q . For example, if the distinctive smells always accompany humidity when mosquitoes are attracted to a target such as a human hand, how can the experimenter distinguish the effects of smell from the effects of humidity? In order to make such a discrimination, he must be able to produce a situation in which he can selectively con-

trol the presence, or absence, or variation of the several variables named by the competing hypotheses. For example, researchers have devised an artificial target in which they can produce and vary independently the intensity of smell, temperature, or humidity. They have been able to show that, in the absence of smell, a combination of temperature and humidity will attract mosquitoes; whereas the distinctive smells of human skin, in the absence of temperature and humidity in the required ranges, will fail to do so.

The method of experimental hypothesis testing follows a process of elimination. The experimenter tries to produce conditions that disconfirm each of the competing hypotheses, by showing that the conditions that would follow from each hypothesis are not the observed ones. As Karl Popper has put it,⁶ the experimenter conducts a competition among hypotheses, rather like a horse race. The hypothesis that most successfully resists refutation is the one that he accepts. Popper also points out, however, that hypotheses must always be accepted tentatively. For another hypothesis might be found which resists refutation more successfully still. For example, there might be some other factor, as yet undiscovered, which is present along with humidity and temperature and in the absence of which mosquitoes are no longer attracted to the target.

In order to stage such a competition of hypotheses, employing Mill's Methods of Agreement and Difference (or Concomitant Variations), the experimenter must be able to achieve selective variation of the factors named by the competing hypotheses. He must be able to vary the degree of humidity, for example, while keeping temperature and smell constant. And he must also be able to isolate the experimental situation from confounding changes in the environment—a human smell wafted into the apparatus, for example. These are central functions of the research laboratory. If laboratory experiment

is not feasible or desirable, the experimenter may have recourse to records of large numbers of naturally occurring variations of the phenomena in which he is interested. To these records he can apply the Method of Concomitant Variations, through statistical analysis of naturally occurring correlations of variables. In this case, he simulates, or provides a substitute for, the technique of laboratory experiment.

In association with this model of controlled experiment, there is also the requirement for a particular kind of stance toward inquiry. The experimenter is expected to adhere to norms of control, objectivity, and distance. By controlling the experimental process, he is to achieve objectivity, seeing to it that other inquirers who employ the same methods will achieve the same results. And to this end, he is expected to preserve his distance from experimental phenomena, keeping his biases and interests from affecting the object of study.

Under conditions of everyday professional practice the norms of controlled experiment are achievable only in a very limited way. The practitioner is usually unable to shield his experiments from the effects of confounding changes in the environment. The practice situation often changes rapidly, and may change out from under the experiment. Variables are often locked into one another, so that the inquirer cannot separate them. The practice situation is often uncertain, in the sense that one doesn't know what the variables are. And the very act of experimenting is often risky.

Hence, according to the model of Technical Rationality, emphasis is placed on the separation of research from practice. On this view, practice should be based on scientific theory achievable only through controlled experiment, which cannot be conducted rigorously in practice. So to researchers and the research setting falls the development of basic and applied science, while to practitioners and the practice setting falls the

use of scientific theories to achieve the instrumental goals of practice.

On this view, reflection-in-action is not really experiment.

In what, then, does the experimenting of Quist and the Supervisor consist? What is the logic of experimental inference which they employ? In what sense, if any, is their experimenting rigorous?

Let us step back to consider what experimenting means. I want to show that hypothesis-testing experiment is only one of several kinds of experiment, each of which has its own logic and its own criteria of success and failure. Because in practice these several kinds of experiment are mixed up together, experiment in practice is of a different order than experiment in the context of research.

In the most generic sense, to experiment is to act in order to see what the action leads to. The most fundamental experimental question is, "What if?"

When action is undertaken only to see what follows, without accompanying predictions or expectations, I shall call it *exploratory experiment*. This is much of what an infant does when he explores the world around him, what an artist does when he juxtaposes colors to see what effect they make, and what a newcomer does when he wanders around a strange neighborhood. It is also what a scientist often does when he first encounters and probes a strange substance to see how it will respond. Exploratory experiment is essential to the sort of science that does not appear in the scientific journals, because it has been screened out of the scientists' accounts of experimental results (perhaps because it does not conform to the norms of controlled experiment). Exploratory experiment is the probing, playful activity by which we get a feel for things. It succeeds when it leads to the discovery of something there.

There is another way in which we sometimes do things in

Read in the book - get the idea

basic
of the
structure
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experiment

order to see what happens: we take action in order to produce an intended change. A carpenter who wants to make a structure stable tries fastening a board across the angle of a corner. A chess player advances his pawn in order to protect his queen. A parent gives his child a quarter to keep the child from crying. I shall call these *move-testing experiments*. Any deliberate action undertaken with an end in mind is, in this sense, an experiment. In the simplest case, where there are no unintended outcomes and one either gets the intended consequences or does not, I shall say that the move is *affirmed* when it produces what is intended for it and is *negated* when it does not. In more complicated cases, however, moves produce effects beyond those intended. One can get very good things without intending them, and very bad things may accompany the achievement of intended results. Here the test of the affirmation of a move is not only Do you get what you intend? but Do you like what you get? In chess, when you accidentally checkmate your opponent, the move is good and you do not take it back because its results are unexpected? On the other hand, giving a child a quarter may not only get him to stop crying, but also teach him to make money by crying—and the unintended effect is not so good. In these cases a better description of the logic of move-testing experiments is this: Do you like what you get from the action, taking its consequences as a whole? If you do, then the move is affirmed. If you do not, it is negated.

A third kind of experimenting, *hypothesis testing*, I have already described. Hypothesis-testing experiment succeeds when it effects an intended discrimination among competing hypotheses. If, for a given hypothesis, its predicted consequences fit what is observed, and the predictions derived from alternative hypotheses conflict with observation, then we can say that the first hypothesis has been *confirmed* and the others, *disconfirmed*—or, in Popper's more accurate formulation, the first

hypothesis has demonstrated a greater competitive resistance to refutation.

In practice, the hypothesis subjected to experiment may be one that has been implicit in the pattern of one's moves, like the geometric center and center of gravity theories of the block-balancing experiments. In the on-the-spot experimenting characteristic of reflection-in-action, the *logic* of hypothesis testing is essentially the same as it is in the research context. If a carpenter asks himself, What makes this structure stable? and begins to experiment to find out—trying now one device, now another—he is basically in the same business as the research scientist. He puts forward hypotheses and, within the limits of the constraining features of the practice context, tries to discriminate among them—taking as disconfirmation of a hypothesis the failure to get the consequences predicted from it. The logic of his experimental inference is the same as the researcher's.

What is it, then, that is distinctive about the experimenting that goes on in practice?

The practice context is different from the research context in several important ways, all of which have to do with the relationship between changing things and understanding them. The practitioner has an interest in transforming the situation from what it is to something he likes better. He also has an interest in understanding the situation, but it is in the service of his interest in change.

When the practitioner reflects-in-action in a case he perceives as unique, paying attention to phenomena and surfacing his intuitive understanding of them, his experimenting is at once exploratory, move testing, and hypothesis testing. The three functions are fulfilled by the very same actions. And from this fact follows the distinctive character of experimenting in practice.

Let us consider, in this light, the reflection-in-action of Quist and the Supervisor.

When Quist imposes his geometry of parallels onto the screwy slope, he undertakes a global sequence of moves whose intent is to transform the situation into one that fits the geometry. His move-testing experiment succeeds because he solves the problem he has set and because, in addition, he likes what he can make of what he gets.

The Supervisor's situation, the experienced situation, is the one he perceives through the Resident's reports. In his framing of the problem of the situation, he focusses on the need to connect two streams of experience—the patient's experience in therapy and outside it—and in solving the problem, he connects them.

In both cases, the global moves are affirmed.

The practitioners' moves also function as exploratory probes of their situations. Their moves stimulate the situation's back-talk, which causes them to appreciate things in the situation that go beyond their initial perceptions of the problem. Quist perceives a new whole idea, created unexpectedly by the gallery's appearance as centerpiece of the design. For the Supervisor, there is the surprising story of the patient's fight with her boyfriend, which signals the patient's passivity and dependence and sets the course of his inquiry toward a new interpretive synthesis. In both cases, the exploratory experiment consists in the practitioner's conversation with the situation, in the back-talk which he elicits and appreciates.

In both cases, further, the practitioner's reframing of the problem of the situation carries with it a hypothesis about the situation. He surfaces the model of the phenomena associated with his student's framing of the problem, which he rejects. He proposes a new problem and with it, a new model of the

phenomena, which he proceeds to treat as a hypothesis to be tested.

In Quist's case, the hypothesis is that this slope and this geometry of parallels can be made to fit one another. In the Supervisor's case, it is that the patient's transference will reveal how she is stuck in her therapy as she is stuck in her relationship with her boyfriend.

When we compare the practitioner's hypothesis-testing experiment to the method of controlled experiment, however, there are several notable differences.

The practitioner makes his hypothesis come true. He acts as though his hypothesis were in the imperative mood.⁷ He says, in effect, "Let it be the case that $X \dots$ ", and shapes the situation so that X becomes true. Quist *carves* his geometry into the slope. The Supervisor channels his inquiry toward stories which illustrate the patient's transference and probes them to elicit themes suitable for explanation in terms of the transference. The practitioner's hypothesis testing consists of moves that change the phenomena to make the hypothesis fit.

The practitioner violates the canon of controlled experiment, which calls for objectivity and distance. In controlled experiment, the inquirer is supposed to refrain from imposing his biases and interests on the situation under study. He is supposed to avoid what, in the context of human beings, is popularly called the "Hawthorne Effect."⁸ It is true that in laboratory experiment, experimenters are also expected to manipulate the experimental phenomena (as the researchers manipulate the mosquitoes' attraction to their artificial target). But *their* experiment has to do with a *type* of naturally occurring phenomenon which they study through the artificial situation of the laboratory. They manipulate the artificial situation, but leave the naturally occurring phenomena alone. Moreover,

the canon of experimental method prohibits them from influencing the experimental situation to make it conform to their hypotheses; on the contrary, they are expected to strive for disconfirmation.

In the inquiries of Quist and the Supervisor, the unique situation at hand *is* the domain of inquiry. As the inquirers influence it, they influence the totality of their object of study. And they seek to exert influence in such a way as to confirm, not refute, their hypotheses.

Nevertheless, their situations are not wholly manipulable. They may resist the inquirers' attempts to shape them and in so doing, may yield unintended effects. Quist might have found that his slope could not be made to conform to his geometry of parallels, and might then have gone back to try other geometries. As it is, he sets the criterion of fit so that "slightly" is enough. The Supervisor might have found no evidence of transference of the patient's life pattern to the therapeutic relationship—although he does everything he can to set up the situation so that he will find such evidence. Thus the practitioners' hypothesis-testing experiments are not wholly self-fulfilling.

Their hypothesis-testing experiment is a game with the situation. They seek to make the situation conform to their hypothesis but remain open to the possibility that it will not. Thus their hypothesis-testing activity is neither self-fulfilling prophecy, which insures against the apprehension of disconfirming data, nor is it the neutral hypothesis testing of the method of controlled experiment, which calls for the experimenter to avoid influencing the object of study and to embrace disconfirming data. The practice situation is neither clay to be molded at will nor an independent, self-sufficient object of study from which the inquirer keeps his distance.

The inquirer's relation to this situation is *transactional*.⁹ He

shapes the situation, but in conversation with it, so that his own models and appreciations are also shaped by the situation. The phenomena that he seeks to understand are partly of his own making; he is *in* the situation that he seeks to understand.

This is another way of saying that the action by which he tests his hypothesis is also a move by which he tries to effect a desired change in the situation, and a probe by which he explores it. He understands the situation by trying to change it, and considers the resulting changes not as a defect of experimental method but as the essence of its success.

This fact has an important bearing on the practitioner's answer to the question, When should I stop experimenting?

In the context of controlled experiment, given Popper's dictum, the experimenter might keep on experimenting indefinitely—as long as he is able to invent new, plausible hypotheses which might resist refutation more effectively than those he has already tried. But in practice situations like Quist's and the Supervisor's—where experimental action is also a move and a probe, where the inquirer's interest in changing the situation takes precedence over his interest in understanding it—hypothesis testing is bounded by appreciations. It is initiated by the perception of something troubling or promising, and it is terminated by the production of changes one finds on the whole satisfactory, or by the discovery of new features which give the situation new meaning and change the nature of the questions to be explored. Such events bring hypothesis testing to a close even when the inquirer has not exhausted his store of plausible alternative hypotheses.

In Quist's case, he has made the geometry of parallels work slightly with the contours of the slope. But other geometries might also have been made to do so. Why does he stop here? Because he has produced changes he has found satisfactory, has made of unintended outcomes something that he likes, and

Constrains
situation
what can
be manipulated

Q. Quist's
behavior

has produced an unintended artifact which creates a new whole idea.

In the Supervisor's case, other interpretive syntheses might have accounted for the patient's tendency to keep herself continually frustrated. Her search for punishment might have been stimulated not only by angry thoughts or sexual wishes but by other factors. Why does the Supervisor not seek and test alternatives to these hypotheses? Because he has constructed an interpretive synthesis which accounts for and ties together the several stories he has elicited. He has made something coherent, congruent with his overarching theory, and susceptible to test by intervention.

It is true that the larger inquiry continues beyond these findings, its further directions set by them. But the experimenter need discriminate among contending hypotheses only to the point where his moves are affirmed or yield new appreciations of the situation. Thus hypothesis-testing experiment has a more limited function in practice than in research. And because of this, constraints on controlled experiment in the practice situation are less disruptive of inquiry than they would otherwise be.

On the other hand, the practice context places demands on hypothesis testing which are not present in the context of research. The hypothesis must lend itself to embodiment in a move. Quist has no interest in a hypothesis about the site which he cannot immediately translate into design. The Supervisor has no interest in hypotheses about the patient which are not immediately translatable into interpretive inquiry which can be tested in the intervention.

These distinctive features of experimenting in practice carry with them distinctive norms for rigor. The inquirer who reflects-in-action plays a game with the situation in which he is bound by considerations relevant to the three levels of experi-

The Structure of Reflection-in-Action

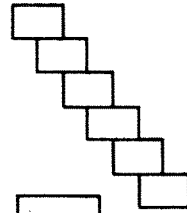
ment—exploration, move testing, and hypothesis testing. His primary interest is in changing the situation. But if he ignores its resistances to change, he falls into mere self-fulfilling prophecy. He experiments rigorously when he strives to make the situation conform to his view of it, while at the same time he remains open to the evidence of his failure to do so. He must learn by reflection on the situation's resistance that his hypothesis is inadequate, and in what way, or that his framing of the problem is inadequate, and in what way. Moreover, he plays his game in relation to a moving target, changing the phenomena as he experiments. Whether he ought to reflect-in-action, and how he ought to experiment, will depend on the changes produced by his earlier moves. The full range of changes, those that match or fail to match his expectations together with those that fall outside the scope of his intentions, are encompassed in this schema:

| Consequences in relation to intention | Desirability of all perceived consequences, intended or unintended |
|---------------------------------------|--|
| 1. Surprise | Undesirable |
| 2. Surprise | Desirable or neutral |
| 3. No surprise | Desirable or neutral |
| 4. No surprise | Undesirable |

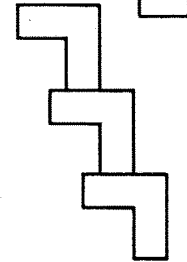
The first is a typical case for reflection-in-action. The move fails to produce its intended result, and its consequences, intended and unintended, are considered undesirable. The move is negated and the theory associated with it is refuted. The inquirer then responds to the negation of the move by reflecting on its underlying theory.

Consider, as an example of this process, Petra's early report of her experiments with classroom units.

I had six of these classroom units, but they were too small in scale to do much with.

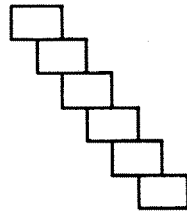


So I changed them to this much more significant layout (the L-shapes). It relates one to two, three to four, and five to six, which is more what I wanted to do educationally anyway. What I have is a space in here which is more of a home base.



Here we have a sequence of two experiments. In the first, Petra's implicit theory of action might be described as something like

If you want a satisfactory arrangement of the classrooms, make it like this.



But she finds the arrangement unsatisfactory and attributes that outcome to the fact that the units were "too small in scale to do much with." She says, in effect,

I had the view that something satisfactory could be made with units of that size, but I was wrong.

She then invents a new arrangement, and finds it (as she seems to have expected) "much more significant." She also becomes aware of additional, apparently unintended benefits: the new arrangement puts proximate grades next to one another and it yields a partially protected space which she calls a "home base."

The two experiments are chained together in a learning se-

quence. Petra's first move fails to produce the results intended for it and yields a situation which she finds on the whole unsatisfactory. She responds by surfacing the theory which she believes had led to her false expectation (here, a theory of the scale appropriate to classroom units), making a theory response to error. She criticizes and restructures her theory, and tests her new theory by producing the more aggregated L-shaped units. She gets the result she intended; hence, her new theory is not refuted. And she also gets some other unintended consequences which, along with the intended ones, she considers desirable; her new move is affirmed.

When a move fails to do what is intended and produces consequences considered on the whole to be undesirable, the inquirer surfaces the theory implicit in the move, criticizes it, restructures it, and tests the new theory by inventing a move consistent with it. The learning sequence, initiated by the negation of a move, terminates when new theory leads to a new move which is affirmed.

good to design a new practice

From the point of view of the logic of *confirmation*, the results of experiment remain ambiguous. Other theories of action or models might also account for the failure of the earlier move and the success of the later one. But in the practice context, priority is placed on the interest in change and therefore on the logic of *affirmation*. It is the logic of affirmation which sets the boundaries of experimental rigor.

The priority of the logics of affirmation and exploration over the logic of confirmation also becomes clear when we consider the other outcomes of experiment identified in our schema. In the second case, the inquirer's expectation is disappointed but the consequences taken as a whole are considered desirable. The associated theory is refuted but the move is affirmed. Petra might have designed the gallery as a pass-

through, for example; she might then have decided that it worked badly as a pass-through but did fulfill a formal function, which justified it. In this case, Petra need not reflect on the theory which underlay her move. According to the logic of affirmation, the move has succeeded. Petra may wonder why her gallery failed to work as expected. But she need not reflect on it unless she wishes to consider the present case as a preparation for future cases where problems of circulation are also likely to arise.

In the third case, the move produces its intended outcome and its consequences are taken on the whole to be desirable. There is no need for reflection-in-action, unless the inquirer—again considering the present case as a preparation for future cases—were to ask himself to account for his present success.

In the fourth case, the move produces the expected results but it also causes unintended changes which are found, on the whole, to be unsatisfactory. Petra places the gym where she had wanted it, for example, in order to give direct access to the field. But she finds that her placement of it has constricted the space and spoiled the whole geometry of the buildings on the site. Here there will be reflection on the theory associated with the move, but it will focus on the theory's scope of relevance rather than its truth. Realizing that she has failed to consider the formal consequences of her move, Petra may consider new theories which take such factors into account. In the learning sequence which she then sets in motion, her new theories will refer not only to access but to the openness of the space and to the global geometry of the buildings on the site.

Thus the perceived changes produced by earlier moves determine the need for and the direction appropriate to reflection-in-action. The logic of on-the-spot experiment is threefold, and rigor in hypothesis testing is in the service of affirmation or exploration.

Virtual Worlds

The situations of Quist and the Supervisor are, in important ways, not the real thing. Quist is not moving dirt on the site. The Supervisor is not talking to the patient. Each is operating in a virtual world, a constructed representation of the real world of practice.

This fact is significant for the question of rigor in experimenting. In his virtual world, the practitioner can manage some of the constraints to hypothesis-testing experiment which are inherent in the world of his practice. Hence his ability to construct and manipulate virtual worlds is a crucial component of his ability not only to perform artistically but to experiment rigorously.

For Quist and Petra, the graphic world of the sketchpad is the medium of reflection-in-action. Here they can draw and talk their moves in spatial-action language, leaving traces which represent the forms of buildings on the site. Because the drawing reveals qualities and relations unimagined beforehand, moves can function as experiments. Petra can discover that her building shapes do not fit the slope and that her classrooms are too small in scale to do much with. Quist can find nooks in the intervals he has created and can see that his geometry works slightly with the contours of the site. Considering the gallery he has made, he can observe that "there is this which is repetitive and this again which is not repetitive."

Constraints which would prevent or inhibit experiment in the built world are greatly reduced in the virtual world of the drawing.

The act of drawing can be rapid and spontaneous, but the residual traces are stable. The designer can examine them at leisure.

The pace of action can be varied at will. The designer can slow down, to think about what he is doing. On the other hand, events that would take a long time in the built world—the carving of a slope, the shaving of the trees—can be made to “happen” immediately in the drawing.

No move is irreversible. The designer can try, look, and by shifting to another sheet of paper, try again. As a consequence, he can perform learning sequences in which he corrects his errors and takes account of previously unanticipated results of his moves. Petra can explore the size and shape of her classroom units and the placement of the administration building. Quist can propose that she “draw and draw” to determine the proper dimensions of her grid, figure out how to treat the “middle area” and “shave off the trees.” Moves that would be costly in the built world can be tried at little or no risk in the world of the drawing.

It is possible to eliminate changes in the environment which would disrupt or confound experiment. In the drawing, there are no work stoppages, breakdowns of equipment, or soil conditions which would make it impossible to sink a foundation.

Some variables which are interlocking in the built world can be separated from one another in the world of the drawing. A global geometry of buildings on the site can be explored without any reference to particular construction methods. A building shape can be considered while deferring the question of the material from which the shape is to be made.

In order to capture the benefits of the drawn world as a context for experiment, the designer must acquire certain competences and understandings. He needs to learn the traditions of graphic media, languages and notations. Quist, for example, has a repertoire of media which enables him to choose the graphic system best suited to the exploration of particular phenomena. Sketches enable him to explore global geometries;

The Structure of Reflection-in-Action

cross-sectional drawings, to examine three-dimensional effects; drawing to scale, to experiment with the dimensions of design; models, to examine relationships of building masses, comparative volumes, sun, and shade. He uses media selectively to address the issues to which he gives priority at each stage of the design process.

Quist has also learned to use graphic languages transparently. When he represents a contour of the site by a set of concentric lines, he sees *through* it to the actual shapes of the slope, just as practiced readers can see through the letters on a page to words and meanings. Hence he is able to move in the drawing as though he were moving through buildings on the site, exploring the felt-paths as a user of the building would experience them.

But the virtual world of the drawing can function reliably as a context for experiment only insofar as the results of experiment can be transferred to the built world. The validity of the transfer depends on the reliability with which the drawn world represents the built one. As an architect's practice enables him to move back and forth between drawing and building, he learns how his drawings will “build” and develops a capacity for accurate rehearsal. He learns to recognize the representational limits of graphic media. He learns, for example, how drawings fail to capture qualities of materials, surfaces, and technologies. He learns to remember that drawings cannot represent soil conditions, wind, costs of materials and labor, breakdowns of equipment, and man-made changes in the environment. Drawing functions as a context for experiment precisely because it enables the designer to eliminate features of the real-world situation which might confound or disrupt his experiments, but when he comes to interpret the results of his experiments, he must remember the factors that have been eliminated.

analog
to
reading

Weak!
The Supervisor constructs, through his interactions with the Resident, a virtual world of talk which represents the experienced world of therapist and patient. Storytelling represents and substitutes for firsthand experience.

By his selective questions and acts of attention, the Supervisor shapes the experienced situation to which he will address interpretive inquiry. Like Quist, he is able to hold some features of the situation constant. Once a story has been told, it can be held as a datum, considered at leisure for its meanings and its relationships with other stories. Transient events, widely separate in time, can be held steady and juxtaposed with one another to permit exploration of such phenomena as dependency or guilt. Some stories can be ignored, or reduced to mere outlines, while others are expanded and elaborated. By attending to a few features which he considers central, the Supervisor can isolate the main thread of a story from the surrounding factors which he chooses to consider as noise. And by putting a term to his questioning or attention, he can set the boundaries of the universe of data which will serve as material for his experiments in interpretation. Trying now one interpretation, now another, he can make his experimental moves reversible and design his own learning sequences.

But in the therapeutic context, the practitioner's world is virtual in a twofold sense. The Resident's stories can be used to represent the therapeutic interaction, and the therapeutic interaction can be shaped to become a representation of the patient's life outside of therapy. In fact, the Supervisor tries to get the Resident to do precisely this when he urges him to tell his patient that "here, in the relationship with you, she can see what is going on and you can work it out together." The power of the transference lies in its use as a world representative of the patient's other relationships. In such a world, it becomes possible to slow down phenomena which would

The Structure of Reflection-in-Action

ordinarily be lost to reflection. Actions which might be otherwise irreversible can be examined for their meanings, revised, and tried again. Once the transference has become an object of shared inquiry, the therapist can experiment with moves that would ordinarily carry a risk of angering or alienating the patient.

The therapist's ability to use the transference as a virtual world depends on his ability to read its signs. He must become adept at listening to the patient's utterances as moves comparable to those she uses in the life outside. As the Supervisor comments,

And yet she will find ways of distancing you, just as she does her boyfriend.

Further, the therapist must become adept at converting his relationship with the patient into a world of inquiry in which thoughts and feelings can be seen as sources of discovery rather than as triggers to action. The therapist's ability to make this happen depends both on his ability to reflect on his experience of being with the patient, detecting the signs of his own countertransference, and on his ability to elicit the patient's trust. This depends, in turn, on his ability to empathize with the patient, to establish and honor the norms of their mutual obligation, and to help the patient gain insight from revealed thoughts and feelings so that the effort of the special relationship comes to seem worthwhile. The creation and maintenance of the virtual world of therapy is both a method of inquiry and a strategy of intervention.

But the representative reliability of the virtual world has its limits. The Resident can guess, but cannot know, that the patient's decision to remain in therapy is a response to his becoming "the bastard she needs." He cannot be sure that her way

of keeping herself frustrated in therapy is similar to her continual self-frustration outside of therapy. Only through further experience with the patient, as she risks bringing more of herself into the therapeutic relationship, can he test such inferences as these.

The therapist's use of the transference and the architect's sketchpad are examples of the variety of virtual worlds on which all the professions are dependent. A sculptor learns to infer from the feel of a maquette in his hand the qualities of a monumental figure that will be built from it. Engineers become adept at the uses of scale models, wind tunnels, and computer simulations. In an orchestra rehearsal, conductors experiment with tempo, phrasing, and instrumental balance. A role-play is an improvised game in which the participants learn to discover properties of an interpersonal situation and to reflect-in-action on their intuitive responses to it. In improvisation, musical or dramatic, participants can conduct on-the-spot experiments in which, as improvisation tends towards performance, the boundaries between virtual and real worlds may become blurred.

Virtual worlds are contexts for experiment within which practitioners can suspend or control some of the everyday impediments to rigorous reflection-in-action. They are representative worlds of practice in the double sense of "practice." And practice in the construction, maintenance, and use of virtual worlds develops the capacity for reflection-in-action which we call artistry.

Stance Toward Inquiry

A practitioner's stance toward inquiry is his attitude toward the reality with which he deals.

According to the model of Technical Rationality, there is an objectively knowable world, independent of the practitioner's values and views. In order to gain technical knowledge of it, the practitioner must maintain a clear boundary between himself and his object of inquiry. In order to exert technical control over it, he must observe it and keep his distance from it—as Bacon said, commanding Nature by obeying her. His stance toward inquiry is that of spectator/manipulator.

In a practitioner's reflective conversation with a situation that he treats as unique and uncertain, he functions as an agent/experient.¹⁰ Through his transaction with the situation, he shapes it and makes himself a part of it. Hence, the sense he makes of the situation must include his own contribution to it. Yet he recognizes that the situation, having a life of its own distinct from his intentions, may foil his projects and reveal new meanings.

From this paradoxical source derive the several features of a stance toward inquiry which are as necessary to reflection-in-action as the norms of on-the-spot experiment and the uses of virtual worlds.

The inquirer must impose an order of his own, jumping rather than falling into his transaction with the situation. Thus the Supervisor tries to get the Resident to recognize his contribution to the patient's stalemate and to see in the transference a medium for inquiry and intervention. Thus Quist tries to get Petra to see that coherence does not exist in the site but must be imposed upon it by the designer. But the inquirer must also take responsibility for the order he imposes. As Quist draws

to scale and the Supervisor probes the Resident's stories, they engage in a disciplined pursuit of the implications of their chosen frames.

At the same time that the inquirer tries to shape the situation to his frame, he must hold himself open to the situation's back-talk. He must be willing to enter into new confusions and uncertainties. Hence, he must adopt a kind of double vision.¹¹ He must act in accordance with the view he has adopted, but he must recognize that he can always break it open later, indeed, *must* break it open later in order to make new sense of his transaction with the situation. This becomes more difficult to do as the process continues. His choices become more committing; his moves, more nearly irreversible. As the risk of uncertainty increases, so does the temptation to treat the view as the reality. Nevertheless, if the inquirer maintains his double vision, even while deepening his commitment to a chosen frame, he increases his chances of arriving at a deeper and broader coherence of artifact and idea.

His ability to do this depends on certain relatively constant elements that he may bring to a situation otherwise in flux: an overarching theory, an appreciative system, and a stance of reflection-in-action which can become, in some practitioners, an ethic for inquiry.

Technical Rationality and Reflection-in-Action Compared

As we have described similarities of patterns and principles in Quist's designing and the Supervisor's therapeutic inquiry, we have also begun to describe an epistemology of reflection-in-

The Structure of Reflection-in-Action

action which accounts for artistry in situations of uniqueness and uncertainty. On this view of professional knowing, technical problem solving occupies a limited place within the inquirer's reflective conversation with his situation; the model of Technical Rationality appears as radically incomplete.

The Positivist epistemology of practice rests on three dichotomies. Given the separation of means from ends, instrumental problem solving can be seen as a technical procedure to be measured by its effectiveness in achieving a pre-established objective. Given the separation of research from practice, rigorous practice can be seen as an application to instrumental problems of research-based theories and techniques whose objectivity and generality derive from the method of controlled experiment. Given the separation of knowing from doing, action is only an implementation and test of technical decision.

In the reflective conversations of Quist and the Supervisor, these dichotomies do not hold. For Quist and the Supervisor, practice is a kind of research. In their problem setting, means and ends are framed interdependently. And their inquiry is a transaction with the situation in which knowing and doing are inseparable.

These inquirers encounter a problematic situation whose reality they must construct. As they frame the problem of the situation, they determine the features to which they will attend, the order they will attempt to impose on the situation, the directions in which they will try to change it. In this process, they identify both the ends to be sought and the means to be employed. In the ensuing inquiry, action on the situation is integral with deciding, and problem solving is a part of the larger experiment in problem setting. For example, Quist applies his rules of thumb, about the uses of slopes ap-

propriate to their various grades, as a component of the larger experiment in which he tries to impose a geometry of parallels onto the site. His frame experiment sets the problem to be solved, and his problem-solving is one element in his test of the frame.

Quist and the Supervisor reflect on their students' intuitive understandings of the phenomena before them and construct new problems and models derived, not from application of research-based theories, but from their repertoires of familiar examples and themes. Through *seeing as* and *doing as*, they make and test new models of the situation. But their on-the-spot experiments, conducted in the virtual worlds of sketchpad and storytelling, also function as transforming moves and exploratory probes. Hypothesis testing has the limited function of enabling them to achieve satisfactory moves or to surface phenomena which cause them to reframe the situation.

The values of control, distance, and objectivity, central to the model of Technical Rationality, take on new meanings in the reflective conversation. Here the inquirer tries, within the limits of his virtual world, to control variables for the sake of hypothesis-testing experiment. But his hypothesis is about the situation's potential for transformation, and in the testing process he steps into the situation. He produces knowledge that is objective, in the sense that he can disconfirm it. He can discover that he has not achieved satisfactory change or that he ought to undertake change of a different order. But his knowledge is also personal, bounded by his commitments to appreciative system and overarching theory. It is compelling only to members of a community of inquiry who share these commitments.¹²

In the following chapters, we will explore other examples of knowing-in-practice which exhibit, in greater or lesser degree,

the process of reflective conversation with the situation which we have so far observed only in the practices of Quist and the Supervisor. We will examine how reflection-in-action varies with the context and domain-specific knowledge of other practitioners, and we will inquire into the contextual factors which set limits to reflection-in-action.