To the Graduate Council:

I am submitting herewith a dissertation written by Michael Lowell Crist entitled "Science, Art, and Educational Evaluation: A Model." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, with a major in Educational Administration and Supervision.

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SCIENCE, ART, AND EDUCATIONAL EVALUATION:

A MODEL

A Dissertation

Presented for the

Doctor of Education

Degree

The University of Tennessee, Knoxville

Michael Lowell Crist

August 1977

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ABSTRACT

This was a conceptual study about educational evaluation. Its purpose was twofold: 1) to explore the similarity between knowing in science and knowing in the arts and 2) to conceptualize a technique for the evaluation of classrooms based on this similarity.

With regard to the first purpose, after examining methods used by scientists and artists it was concluded that 1) knowing in science, though rigorous, lacks the fundamental objectivity, exactitude, and certainty popularly ascribed to it and 2) the process of discovery in science resembles the process of creation in art. However, a simple resemblance between the fundaments of knowing in science and knowing in the arts was not considered satisfactory for the purpose of the study. What was sought was a substantive similarity, a shared epistemology which might help unite these separated modes of knowing.

To attempt such a synthesis, the works of philosopher-scientist-moralist Michael Polanyi were invoked. Specifically, his concept of tacit knowing was used to define knowing-learning as a fundamentally personal and tacit process which functions in all instances of knowing whether perceptual, conceptual, or physical and whether scientific, artistic, or otherwise. Knowing-learning is a purposive and imaginative act of anticipating meaning among perplexing and seemingly disparate pieces of information and of integrating these pieces into understandable wholes. Substantiation of this definition helped yield the following, tentative conclusions: 1) Discovery in science and

creation in art both proceed by means of the process of purposive and imaginative anticipation followed by integration of parts into wholes. 2) The process of knowing-learning which explains discovery in science and creation in art also explains the ordinary acquisition and utilization of knowledge by students. This is especially apparent among those students pursuing what educator-artist Elliot Eisner called expressive and Type III objectives. 3) The same process of knowing-learning is used by some teachers to teach.

With regard to the second purpose, the study undertook a critique of conventional methods of educational evaluation and a review of several unconventional approaches. These efforts brought forth four historical conclusions regarding educational evaluation. Additionally, the study argued that some teaching methods are epistemologically similar to learning methods. It reasoned that an evaluation technique which uses the epistemology of learning and some teaching might have substantial explanatory power for those who study teaching. The model of educational evaluation developed in the study is an epistemological model. It relies on interactions between standards tacitly held by evaluators and their judgments about educational activities based on those standards. Interesting features of the model are associated with the decision to hold the specification of standards in abeyance until standards and judgments based on them have evolved by means of these interactions. Such evolution has the potential to yield enhanced and more meaningful evaluations.

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CHAPTER I

INTRODUCTION

> . . . [students] are not there to worship what is known but to question it.
>
> Jacob Bronowski

This is a conceptual study about educational evaluation. It has grown out of several concerns regarding educational evaluation, not the least of which has been the feeling that the "state of the art" in education does not seem to be improving, at least substantially.

Presumably, the raison d'etre for evaluation is the improvement of teaching practices which would in turn heighten learning by students. The justification for this study resides in the following argument: If evaluation techniques do affect teaching methods and if evaluation techniques can be improved, then teaching methods may also be improvable. The study rests on the belief that evaluation techniques can teach about teaching and improved evaluation techniques can teach about improved teaching. The pitfall should be obvious however: If evaluation is to improve teaching, then evaluators must themselves know what "good" teaching is or at least what it looks like. The difficulty of defining good teaching is notorious. For this reason, many evaluators and evaluation techniques may simply presume to know and presume to mirror good teaching without ever attempting to define it rigorously. This study asks, "Are the particularistic evaluation techniques which currently predominate able to describe fully the activities and goings-on of classrooms?

Is it reasonable to suggest that accurate as well as more complete views of educational activities may be required before classrooms can be judged as being good, bad, or otherwise?" The thrust of the study is to conceptualize a more complete or holistic way of looking at classrooms which would render them capable of being judged.

Statement of the Problem

Some common notions about science may be erroneous, and as a result, some applications of science to education may lead to practices which are fallacious and mistaken conclusions.

For three hundred years, since the age of Francis Bacon, science and the experimental method have been rising to a place of supremacy in Western society. (See Bronowski, 1959; Polanyi, 1965; Jones, 1971; Schwartz, 1974.) During this time, scientific knowledge and the scientific method have come to be thought of as remote and different from ordinary and artistic or humanistic knowledge. The esteemed position which science occupies in modern society has led to the beliefs that scientific knowledge is the paradigm of all knowledge and artistic knowledge, because it is thought to be different, is inherently suspect. Scientific knowledge, if not viewed as being totally objective, exact, and certain, is at the very least considered to be more objective, exact, and certain than ordinary and artistic knowledge. Similarly, the practitioners of science are popularly thought to be dispassionate, indifferent problem solvers who proceed mechanically by a method called logical inference.

Kuhn (1962) has done much to dispel the notion of the development of science by serial accumulation and the characterization of scientists as bricklayers who add their neatly circumscribed contribution to an unassailable wall of knowledge. He said that these ideas about science come primarily from textbooks of science, popularizations of science, and philosophy of science. According to Kuhn, these sources are perpetuating an already articulated body of scientific paradigms. They are not (and should not be assumed to be) accounts of how these paradigms were arrived at in the first place. (See, particularly, 1962:135-136.)

It may be that the objectivity of science and the immutability of its laws and methods are a myth. Popular standards of objectivity and certainty with regard to knowledge and knowing may not obtain even in such quantifiable sciences as physics and chemistry to say nothing of a field such as education where the objects of study are human beings. Practitioners and researchers in education have borrowed extensively from science, and in their exuberance for the application of science to education (for example, see Mitra, 1974 and Eisner, 1975), they may have fallen victim to some specious ideas about the substance of scientific knowledge and methodology. The partial result of the application of specious principles of science to education has been specification of objectives when specificity was neither desirable nor legitimately possible; the result has been to deny that intervening between the phenomena observed and the evaluation document is the observer; and it has been to subject education to a rigidification of ideas brought about

by widely used and abstract evaluation techniques based on pre-determined and fixed prescriptions of student and teacher behaviors.

This study is concerned with the prevalence of scientism in education, specifically in educational evaluation. Many current practices of educational evaluation may not be merely inadequate, they may be wrong. They may not be coincident with how students learn and how teachers teach. Eisner (1975:6) has drawn attention to the far-reaching influence that evaluation techniques are having on educational efforts beyond any philosophical beliefs of practitioners. It may be that evaluation techniques, instead of being patterned after learning and teaching, are themselves doing much to determine teaching methods. Learning and teaching may be idiosyncratic processes and attempts to assess them should be sensitive to spontaneous developments as well as to preordained outcomes.

Statement of the Purpose of the Study

The purpose of this study is twofold: 1) to explore the similarity between knowing in science and knowing in the arts and 2) to conceptualize a technique for the evaluation of classrooms based on this similarity.

The study seeks to examine the nature and the limits of the objectivity of scientific knowing and the degree of exactitude and certainty attributable to the knowledge which science yields. It relates this view of knowing in science to knowing in the arts. Any attempt to define science should heed the lesson which has been

demonstrated repeatedly during the last three centuries. Namely, dogma has no place in attempts to understand the world. In view of this admonishment to skepticism, it is with some diffidence that this study attempts to establish what science is rather than what it is thought, by many, to be. The history of science is rife with primitive concepts and discarded ideas that have succumbed to the continually changing view of the universe. Kranzberg noted, "If anything, the history of science teaches that scientific 'facts' merely give current answers to questions which will be answered differently tomorrow. There may even be different questions tomorrow" (1963:548). This is not to say that these ideas were not useful at certain stages of cultural and intellectual development. Were it not for prior theorization, current theory would not possess the explanatory value which it does. It is in the spirit that the beliefs of today are only steppingstones toward the understandings of tomorrow that the assertions of this study are made. Mankind is always in need of better theory and shall continue to be as long as it desires to know.

The study argues that knowing in science and knowing in the arts are similar and that this shared process is fundamental in the acquisition and utilization of knowledge by students. It may be that a modification of how learning is viewed warrants new methods of classroom evaluation in much the same way as the belief that students learn objectively by stimulus-response has contributed to the current emphasis on preordinate and quantitative evaluation techniques. Accordingly, the study presents a new technique or model

for evaluating classrooms which can be used to complement current practices and which recognizes the personal and tacit aspects of learning. To posit an epistemological discontinuity between "scientific" knowing and "artistic" knowing may be a misrepresentation of the actualities of knowing. It may be that all knowing is fundamentally personal and tacit and that efforts to portray it as mechanical and logically detached are fallacious. The model of educational evaluation presented here is based on a synthesis between knowing in science and knowing in the arts. A challenge to the scientism which pervades both society and a specific activity such as educational evaluation is a grave undertaking. However, the needs of education and society justify the risk.

Assumptions and Definitions of the Study

The plan of this study is to bring together a variety of notions from science, art, education, and epistemology for the purpose of developing a new and complementary approach to educational evaluation. To develop this new approach, it is thought necessary to try to explicate the nature of knowing in science and to try to show the resemblance and substantive similarity between scientific knowing and a type of knowing which many think is totally opposite, namely artistic or humanistic knowing. The study assumes that "good" teachers adapt their teaching methods to the learning methods of students. It also assumes that evaluation techniques, if they are to be of highest benefit to teachers and other educators, should be capable

of explaining how teachers teach. The belief that some teaching is patterned after learning may require an explication of learning and teaching which posits the same epistemological structure for both processes. Moreover, the belief that some types of evaluation ought to try to explain teaching suggests the need for an evaluation technique based on the same structure. Such is the shared epistemological nature of the processes of learning, teaching, and evaluating conceptualized in this study.

The following concepts are developed expressly for the arguments of this study. Their definitions appear below and in the glossary of terms in the Appendix. Definitions of other concepts which are already in use in education and other fields yet which have unusual and specialized meanings also appear in the glossary.

Educational evaluation is defined as observation of the actual and uncontrived day-to-day operations of a classroom. The observation results in description of what is happening and judgment as to the value of what is happening. That the observation is of the actual and uncontrived is in accord with the distinction which Guba (1969:34), Hawkins, in Stake (1975:21), and Hein (1976:1-2) made between experimental investigation and naturalistic investigation.

Knowing is meant to signify mental conceptions and sense perceptions as well as the acquisition and deployment of motor skills. Additionally, knowing and learning are considered to be but different states in the same act or process. Both knowing and learning are purposive, striving activities initiated and directed by the knower (learner) in whatever field. While knowing is ordinarily associated

with a state in which knowledge has been attained and is held and learning signifies the acquisition of knowledge which is new to the learner, both knowing and learning are composed of the same epistemological structure. Polanyi has regarded the similarity between knowing and learning as substantive:

> The dynamic impulse by which we acquire understanding is only reduced and never lost when we hold knowledge acquired and established by this impulse. The same impulse sustains our conviction for dwelling in this knowledge and for developing our thoughts within its framework. Live knowledge is a perpetual source of new surmises, an inexhaustible mine of still hidden implications (Polanyi, 1961:244).

Knowing-learning requires effort by persons as they try to make meaning out of, or see meaning in, as yet disparate pieces of information. The process is not characterized by rules nor does it have necessary and certain ends. It is a process of discovery, creation, and problem solving. Dewey's concepts of "logical method" and "reflective thinking" help clarify the meaning of the concept knowing-learning. He said that thinking is logical if it has order and consecutiveness to it and if it aims at conclusions which are based on supporting evidence (Dewey, 1933:75-76). Logical thinking is in contrast to thinking which is haphazard, aimless, and untrained. Elsewhere, he said that reflective thinking begins in a state of perplexity, hesitation, or mental difficulty and involves a search or inquiry which is intended to end in the resolution of the perplexity (1933:12). In this study, knowing-learning is defined as a purposive activity initiated by persons as they attempt to discover or create

that which is perplexing them and as they attempt to resolve the perplexity.*

The classroom is an entity which emerges out of the myriad of parts which comprise it in a manner suggested by Getzels and Thelen (1960:65-82). Among these parts are the individual and collective behaviors, intentions, and emotions of teacher and students. It is a comprehensive entity which exists as an integrate, not just an aggregate, of the parts which comprise it. Getzels and Thelen (1960:53-62) have listed and described some of the influences which affect classrooms. According to them, goals, backgrounds of teachers and students, types of control and leadership activities, and relationships with groups external to classrooms all help to characterize classrooms. They recognized that learning is the overriding planned and stated goal of classrooms but that this goal can be modified or shunted as a result of interactions between participants within classrooms or between classrooms and other groups. They concluded that indicative of education's central importance with regard to society "there is not much that is of immediate consequence for the social order that is not reflected in some way in the classroom" (1960:61).

This study regards classrooms as integrations of myriad

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*In the interest of good scholarship, it should be noted that this study does not embrace all five phases of Dewey's "reflective thinking." The description of knowing-learning put forward in this study most closely resembles Dewey's phase one, "suggestion," and his phase two, "intellectualization." Whereas Dewey said that these two phases usually operate only at the beginning of problem solving, this study suggests that such processes act initially and throughout problem resolution.

influences. Each of these influences is a clue to the character of a specific classroom. However, because of the probability for wide variation among the influences of any given genre and because of the multiplicity of combinations of influences, each classroom may be unique. The concept of the classroom recognizes both this uniqueness and the comprehensiveness of the character of an entity which emerges out of the integration of an indefinite number of contributing influences. In speaking of the existence of comprehensive entities and the tendency toward wholeness in the natural realm, Smuts remarked,

> Compared to its parts, the whole constituted by them is something quite different, something creatively new, as we have seen. Creative evolution synthesizes from the parts a new entity not only different from them but quite transcending them. That is the essence of a whole (Smuts, 1961:34).

The object of a holistic approach to educational description and judgment is understanding the classroom. The classroom is an empirical object.

That a teacher's behavior is purposive and discovery-oriented suggests the presence of strategy. Strategy is the name given to the overlying plan or means by which a teacher pursues educational goals and educational experiences for students. It overlies a teacher's behavior, gives the behavior consistency, and helps make it explicable. A teacher employs numerous strategies simultaneously. That which a teacher pursues is termed educational aims. The teacher orchestrates numerous aims simultaneously and sequentially. Some aims are rather generalized and global, applying to a variety of students over an extended period of time, and others are quite specific and short-term.

The characteristic which strategies and educational aims have in common is that of changeableness, neither of them being fixed and immutable. As a teacher pursues aims, it may be necessary for the teacher to adjust strategies. Similarly, as particular strategies are employed, the teacher may have to adjust aims. Just as the heuristic surmises which beckon scientists toward discoveries and toward solutions to problems are not formal, well-defined hypothetical statements (see Polanyi and Prosch, 1975:59), the educational aims of a teacher for an individual student or for a group of students are initially only vaguely circumscribed and stated in the broadest of terms. Because aims are in a process of development, strategies for reaching those aims are also changing and developing. The teacher, by imaginative effort, gradually evolves educational aims and strategies for achieving them and thus in a sense brings the two entities closer together. Rather than fixing preordained and what may be arbitrary and inappropriate objectives and means for achieving them, the teacher develops aims and strategies together, simultaneously. Portions of this development can (and should) take place before instruction begins. However, the most beneficial development may occur during the teaching process and as an integral part of the process.

Not postulating separate and discontinuous ways of knowing and learning between teachers and students lends support to the notion that some teaching proceeds as discovery, creation, and problem solving. Also, likening teaching to an artistic process supports the same notion. Discovery and creation may be fundamental

and pervasive in the acquisition and utilization of knowledge by scientists, artists, students, teachers, and all persons. Discovery and creation may be an intuitive and imaginative process not explicable by formal rules. Some teachers may proceed toward the development of strategies and educational aims in much the same manner as scientists toward a discovery, artists toward the creation of art, and students toward the comprehension of new knowledge. Educational evaluators should perhaps use a similar approach to try to discover the value of the classroom. That is, they should "feel their way," even as the teacher is doing, in an effort to judge the classroom and in an effort to imbue with greater meaning the standards on which the judgement is based. Unlike preordinate evaluators who arrive with fixed ideas and fixed standards against which they measure all or nearly all classrooms, evaluators utilizing the model developed in this study consider classrooms, like students, to be unique. They evaluate the classroom in terms of an open-ended definition of quality, value, and appropriateness. Such an evaluation is capable of subsuming an unexpected variety of ideas and practices.

Limitations and Delimitations of the Study

This is a conceptual study and it is, therefore, limited by the extent of its reasonableness and persuasiveness. It is necessarily philosophic and relies on syntheses of prior researches and conceptualizations. Because this study has not undergone empirical test, it must be carefully judged against criteria applying to

theorization. According to Hawkins (1972:289), such criteria are self-consistency, completeness, thoroughness of definition, organization, adequacy to subject matter, and fruitfulness. Hawkins argued against the belief that education is not sufficiently developed to justify theory which may go beyond the availability of hard, supportive evidence. He implied that education is undeveloped, in part, because of a dearth of theory, and he said that the field of education manifests a readiness for additional theory:

> For we do in fact already know a great deal about education and development; the problem is rather to marshall that knowledge in a coherent usable form. Empirical investigations conceived within such a framework of theory can react upon, can modify or extend knowledge. They cannot amount to much without it (Hawkins, 1972:288).

A growing number of persons (among them, Scriven, Broudy, Gowin, Hawkins, and Campbell) have indicated that something is missing in approaches to educational evaluation. By relying on the insights of these and other experts as a foundation, this study seeks to broach new territory with its new and complementary evaluation technique based on the similarity between knowing in science and knowing in the arts. Interestingly, in the development of this evaluation technique, the study has employed the method of creative discovery that is used by scientists and artists. That is, problems associated with current efforts of educational evaluation and solutions to these problems were perceived only broadly and indefinitely at first. Gradually and as a result of imaginative effort, they were conceived with greater definition and clarity. Dewey (1933:71-78) distinguished between the process of actual thinking and the product of this thinking. According to Dewey, treating actual thinking

logically casts thinking into forms and provides for the testing of its value. This study, concerned as it is with how students learn, how teachers teach, and how classrooms might be evaluated, deals more with the process of thought than with its products. Logical inference is playing a part in verifying beliefs about problems related to educational evaluation, but it is the imagination which is apprehending them and creating solutions.

Had the study and the evaluation technique developed in it been subjected to application, improvements would undoubtedly be numerous and their need lucidly demonstrated. On the other hand, the effort to develop an idea in theory before it is ready to be applied in practice should be welcomed by many. One ought not assume from this that the ideas developed here are developed fully however. Rather, what is devised here should serve to give those who follow a foothold toward greater understanding.

Organization of the Study

Chapter I of this study consists of an introduction, a statement of the problem to which the study addresses itself, and a statement of the purpose of the study. It also contains the assumptions and definitions of the study, a statement regarding the study's limitations and delimitations, and this delineation of the organization of the study.

Chapter II deals with epistemology. It is divided into discussions of the influence of science, knowing in science, and knowing in the arts.

Chapter III is an account of methods of educational evaluation. It contains a critique of conventional methods of educational evaluation and a review of unconventional methods of educational evaluation.

Chapter IV is a detailed explanation of Polanyi's concepts regarding tacit knowing.

Chapter V presents the conclusions of the study and a conceptual model of educational evaluation.

Chapter VI contains a summary of the study and recommendations for future study.

CHAPTER II

EPISTEMOLOGY

> In science, it's against the rules to ask questions when we have no way of approaching the answers.
>
> J. Allen Hynek

Epistemology is the systematic study of knowing. It is one of three major divisions of philosophy, the other two being metaphysics and axiology. The divisions are only artificial and hence the boundaries are not totally fixed and definite, especially between epistemology and metaphysics. That is, it is difficult to discuss the fundaments of how one knows without some implication as to the reality or essence of what one knows. The division between epistemology-metaphysics and axiology is somewhat broader and more clearly defined however. This may be true, in part, because the split between the seekers of reality and seekers of the good occurred as long ago as the ages of pre-Socratic and Socratic musings. Difficulties not withstanding, it is felt that whereas this study has to do with epistemological matters it need not intrude substantially into the domains of either metaphysics or axiology. To this end, this study avoids the use of the word "reality" as much as possible. In its place, such epistemologically referenced terms as meaning, coherence, and harmony are used.

Besides the implications of the philosophy of knowing for learning theory (see Petrie, 1972; McKenna, 1976:409), the pervasiveness of science in education and in virtually every sphere of Western

thought warrants an epistemological investigation into how scientists think and proceed in their professional explorations. Juxtaposed with this view into science is a view into the nature of the artistic process. It is felt that a better understanding of science and art will help justify alternative approaches to educational evaluation. If it can be shown that science, like art, proceeds on the basis of judgments, beliefs, intuition, and imagination, then evaluation techniques which employ these same processes may be due more serious consideration. In a similar vein, Scriven (1972) recommended reducing the separation between the qualitative domain and the quantitative domain in education and educational research. His concern was that an unjustifiably narrow concept of what is both qualitative (subjective) and legitimate has restricted the methodology of educational research. Specifically, he discussed the influence that methodological bias has had on explanation, evaluation, and discovery.

The Influence of Science

It would be difficult to overestimate the influence of science in the Western world. Western society has been struck by three revolutions, each of them having scientific origins and suprascientific effects: The Copernican revolution displaced mankind from the center of the physical universe; the Darwinian revolution removed it from the center of the spiritual universe; and the Freudian revolution took from mankind its consciousness as the seat of self-control. Still another revolution had occurred earlier and perhaps made the other three possible: The Aristotelian revolution appealed to

mankind to look to this world and nature to resolve questions of cause. One has only to compare the voluptuousness and beauty of the human form as sculpted in Renaissance art with distorted and emaciated contemporary figures to see how mankind's image of itself has changed. A possible contributor to this changed self-image is the ascendancy of science which has occurred since the Renaissance along with a decline in appeal to religious and ethical authority. In its broadest sense, the effect of science on the human outlook has been the substitution of authority which is grounded in this world and in nature for authority which invoked causes transcending nature. Schwartz (1974:24) noted that the spread of modern science was aided by two key battles. In the sixteenth century Aristotelian mechanics and astrology fell victim to burgeoning science, and in the nineteenth the thrust was against the cosmology of the Bible: "Both of these led to long-drawn campaigns in which the ideas of science spread rapidly, generation by generation, and finally extended their influence over all the peoples led by the West." Polanyi, in Grene, observed,

> . . . the three centuries after the founding of the Royal Society sufficed for science to establish itself as the supreme intellectual authority of the post-Christian age. "It is contrary to religion!"--the objection ruled supreme in the seventeenth century. "It is unscientific!" is its equivalent in the twentieth (Grene, 1969b:40).

Similarly, Kranzberg noted, "It [science] has become almost a religion, a faith which is not to be questioned but enthusiastically worshipped as it bestows its bounty upon us" (1963:546).

The rise of science has helped create a dichotomy of endeavors

variously described as the two cultures, art and technic, and even soft-headedness and hard-headedness. Dewey, in Dewey and Bentley (1949:276-277), observed the tendency that psychology and philosophy have of making artificial distinctions between entities and then of petrifying or solidifying these distinctions into permanent separations. Specifically, he noted what has come to be thought of as "inherent, essential, and therefore absolute" separations between mind and nature, subject and object, inner and outer, moral and physical, fact and value. He attributed the readiness to view the environment dichotomously to the growth of modern science. Pirsig (1975:72) has warned that the intellectual "knife" which is used to categorize and systematize phenomena may create illusions of fixed entities. Piaget (1971:56-59) and Scriven (1972:95-97) have offered similar warnings.

Pirsig (1975:66-67) noted the separation of romantic understanding from classic understanding:

> The romantic mode is primarily inspirational, imaginative, creative, intuitive. Feelings rather than facts predominate. "Art" when it is opposed to "science" is often romantic. It does not proceed by reason or by laws. It proceeds by feeling, intuition and esthetic conscience (Pirsig, 1975:66).

The classic mode, on the other hand, proceeds by reason and rules or laws. A classic example of the classic mode is the Laplacian view (expressed in his Méchanique Céleste) which says that an intellect of sufficient power knowing all the forces acting in the universe at a given instant and the position of all material objects at the same instant could predict with certainty all things, both past and future. In other words, nature is subject to immutable laws

which, at least in principle, can be known by human beings and applied by them. By rendering these laws explicit, all knowledge would become objective and certain. Polanyi, in Schwartz, noted that logical positivism is the formal and philosophical apex in the attempt to objectify knowledge. Positivist theory asserts that human beings respond regularly and predictably to stimuli (Schwartz, 1974:49-50). It may be that the effects of positivism are still being felt in educational learning theory and educational evaluation while physics has largely moved beyond atomistic reductionism toward relativity and quantum mechanics.

Molecular biology, in the life sciences, and education, in the social sciences, may still be in the throes of destructive analysis. Hein (1976) pointed out that biology and education are two fields out of many in which a struggle exists between analysts on the one hand and holists on the other. (Among other labels for holists are structuralists and humanists.) Importantly, he expressed the belief that holists have as much claim to scientific validity and legitimacy as do analysts. (See, particularly, 1976:5-7 and 9-10.) As physics had to deal with a mechanical universe composed of discrete particles of matter behaving in perfectly predictable ways, education is confronted by those who say that predictable educational outcomes can be produced using a highly refined and directed stimulus. Whereas the one said that by knowing the complete history of all particulate matter a deterministic future of all living things could be set down detail by detail, the other still holds that a teacher in control of all classroom stimuli can determine

the mental and physical lives of students. Eisner has observed,

> If we examine the past, we will find that since the turn of the century, since the early work of Edward L. Thorndike, there has been a strong aspiration among psychologists to create a science of education that would provide educational practitioners, administrators, as well as teachers, with the kind of knowledge that would allow them to systematically predict, through their ability to control the process and consequent of schooling. The search for educational laws, laws that would do for educational practitioners what the work of Einstein, Maxwell, and Bohr have done for physicists was the object of the educational scientists' dream (Eisner, 1975:1).

Such a dream in education (as well as in science) may stem more from desire than from the actualities of knowing. Eisner (1977) presented what he referred to as a "nonscientific" supplement for observing and evaluating classrooms. It may be, however, that Eisner's approach is not at all nonscientific. The knowledge and method of evaluation on which Eisner's connoisseurship and criticism are based may be as legitimately scientific as, for example, the knowledge and method of Newton and Einstein. Indeed, artistic or humanistic knowledge and awareness may only appear nonscientific when compared to idealized notions about scientific knowing. Perhaps by examining closely the nature of scientific knowing it will be shown that

> . . . science rests ultimately on such intangible powers of our mind. This [belief] will help to restore legitimacy to our convictions, which the specious ideals of strict exactitude and detachment have discredited.
>
> These false ideals do no harm to physicists who only pay lip service to them, but they play havoc with other parts of science and with our whole culture, which try to live by them (Polanyi, 1966a:93).

Knowing in Science

The difference between the methods of Aristotelian science and modern science reflects the difference between the classical-medieval mind and the modern mind. Morris and Pai noted that Aristotelian epistemology was based on a priori and self-evident principles. Natural phenomena were viewed from the perspective of these principles, and interpretations of phenomena were made in light of and to conform with these principles (Morris and Pai, 1976:145). The modern school, on the other hand, begins with observations of individual and immanent phenomena and seeks generalized laws based on these observations. Morris and Pai quoted Herbert Dingle:

> The Galilean-Newtonian philosophy, on the contrary, brought knowledge in apparently boundless measures but was logically (from the Aristotelian standpoint) outrageous. From a few phenomena, or experiments, it proposed to derive principles to be applied universally. Some bodies attract one another; this is a body; therefore it attracts every other body in the universe. No more patently invalid syllogism could be imagined; it was an error in Aristotelian logic of which even the youngest scholastic child could hardly have been capable (Morris and Pai, 1976:145).

What could be more objective than the modern method? The implied lesson for scientists and ordinary knowers pursuing solutions to problems is to gather all relevant data and generalize a system to explain the data. However, this rendering may not comprise the whole of the method of modern science nor the method of knowing of any kind. The fallacy is both subtle and powerful: How can anyone gather all or any relevant data without first having a vision in mind of that for which one is searching? Relevancy is always relevancy to

something, and without an idea in mind to which the data can relate, one would be forced to gather all data, not just all relevant data. The popular notion says to gather data and then formulate the hypothesis. It may be that persons strive to garner an insightful hypothesis first (regardless of how tentative it is initially) and then gather data relevant to it. According to Pirsig (1975:258-262 and 274-275), Henri Poincaré realized the futility and senselessness of trying to collect all data. He recognized the necessities of choosing between facts and of preselecting facts. Moreover, Poincaré recognized that this preselection might occur on the basis of criteria which could not be fully defined. In his own case, choices between alternatives were made on the basis of what he called an aesthetic feeling for mathematical beauty.

This study suggests that hypothesis formation precedes the selection of data. Otherwise, there would be no basis on which to select data. Relevancy is determined in light of an hypothesis (albeit a tentative one), and the concept of relevancy lacks meaning in the absence of a subsuming hypothesis. Dewey (1933:122-126) emphasized the primacy of judgment in the acts of gathering data and forming ideas. He noted that the "facts" of a case are "<u>those traits that are used as evidence in reaching a conclusion or forming a decision</u>." There are no tags or labels indicating that these data or those ideas are important, have merit, or are relevant to a conclusion. He cited an example of craftsmanship that implies a personal and tacit aspect of knowing and thinking which is not quantifiable and which is suggestive of Polanyi's premise "we can

know more than we can tell." (See Polanyi, 1966b:4.) Regarding idea formation, Dewey said,

> No hard and fast rules decide whether a meaning suggested is the right and proper meaning to follow up. The individual's own good (or bad) judgment is the guide. . . . The thinker has to decide, to choose; and there is always a risk . . . (Dewey, 1933:125).

Thus the "objective" process of inducing hypotheses and laws depends on the ability of the investigator to choose between alternative sets of data and ideas. Furthermore, these choices are based on an initial "bias" or tentative hypothesis, the necessity of which further erodes the notion that science and problem solving proceed on objective bases.

In discussing the rise of modern science, Bronowski said that Whitehead dated the scientific revolution from the instant that Galileo and others brought together logical or rational thought with observation and experimentation. Whitehead believed that the Middle Ages were quite as logical as modern times. He attributed current success to the joining of logic with empirical data (Bronowski, 1959:32). Bronowski said,

> Most of us today have a strong bias for the empirical. As laymen we feel that the facts are wonderful and the theory is always difficult; and we tend to think of all science as a logical process taking the facts and deducing from them some system which they determine. This is not what Newton did, nor indeed, surprising as it may seem, is it the usual method of science as we know it. . . . What Newton did now was to suppose that the general rules which fair-sized masses seem to obey are true of every piece of matter, whatever its kind or its size. And having decided to try this thought, he made himself a new world of his own, which he built up from minute pieces of matter each following the same laws or axioms. This world is just as much a construction as the abstract world of geometry which Euclid built up out of his axioms. . . .

> This was very much Newton's method too, but Newton almost for the first time applied it to the physical world. He supposed that everything in the world is assembled from small particles. . . .
>
> Newton then built up his world of unknown small particles assembled in such masses as the apple, the moon, the planets, and the sun. Each of these assemblies is alike in his view in being made up of these minute pieces of matter. And in each of them the minute pieces obey the same laws . . . (Bronowski, 1959:35-37).

This extended excerpt is included not only because it indicates what Newton thought but because it may also reveal how he came to think it. There are no rules of induction by which Newton could have taken information regarding masses in motion furnished him by Galileo and contemporaries and derived either the laws of motion or the law of gravitational attraction. Furthermore, he could not have induced his theory of an atomistic universe from his generalized laws. Far from being a logical process which moved objectively, exactly, and necessarily from empirical observations to the joint meaning of the observations, the process was an act of the imagination. Newton did not deduce his world from a set of Aristotelian first principles, nor did he induce it from observation. He created it. It was a fiction which explained the tangible universe as it was perceived in the seventeenth and eighteenth centuries, and it remains a close approximation of physical reality even today. Newton's process of knowing was certainly rational in that it sought to order and explain disparate nature. However, it was just as certainly not logically derived.

There is another sense in which science and all knowing are not objective and exact. The criteria by which a person who is making the leap from observation to an explanatory system judges the

explanation to be grounded in reality are known and held personally. For example, by what standards did Copernicus judge his world to be more real than Ptolemy's? Or, what standards did Einstein apply for the nine years it took him to formalize his belief that relativity was a superior explanation of the universe than Newtonian mechanics? In describing the structure of the creative imagination, Polanyi (1966a) said that discovery is a dynamic process of both imagination and intuition. He said that the act of striving toward a vision of hidden reality is sustained by a "gradient of deepening coherence." Yet there are no universal standards of coherence. Polanyi remarked,

> I have acknowledged that the final sanction of discovery lies in the sight of a coherence which our intuition detects and accepts as real; but history suggests that there are no universal standards for assessing such coherence (Polanyi, 1966a:90).

He illustrated the valuational ground of coherence by pointing out that aspects of an explanation which are considered vital by one person may not be considered at all necessary by another. For example, Copernicus criticized the Ptolemaic system as being incoherent because it did not make use of circular planetary orbits. Kepler overthrew the notion of circular orbits and replaced them with the geometrical coherence of mechanical interaction. Galileo and Newton supposed mechanical interaction to be an unnecessary fiction and postulated that all pieces of matter, large and small, behaved according to mathematical laws (Polanyi, 1966a:90-91).

Simplicity is often identified as a characteristic of coherence. Yet just as there are no objective methods for defining relevancy and coherence, there are no rules for identifying what "simplicity" is

and is not. Polanyi observed that the Copernican system of planetary movements was much more complicated than the system of Ptolemy which it replaced. He called the Copernican system "a veritable jungle of ad hoc assumptions" (1966a:86). Butterfield (1966) concluded that the view of the sky developed by Newton was more complicated than that espoused earlier by Kepler, though it was no less harmonious for all its complexity. Whereas Kepler considered the sun to be the sole moving force behind the planets, Newton saw that planetary motions resulted from an intricate network of interactions between the sun and planets, the planets themselves, and between the planets and their satellites. Butterfield said, "The whole system was therefore much more complicated in the 1670's than had been envisaged in the early part of the century--the whole sky presented a more intricate set of mathematical harmonies" (1966:167). In addition to these examples, Darwin's theory of evolution is almost certainly more complicated than the concept of the Chain of Being which it replaced. In sum, that which convinces people who are striving to know that they are "on the right track," namely simplicity, coherence, and a sense that things fit together harmoniously and seem to be leading somewhere, is a matter of personal judgment.

The precariousness of the pursuit of coherence and harmony, like the pursuit of beauty, can surely be attested to by researchers and theoreticians. Many times, that which is pursued is mere illusion. As has already been mentioned, Kepler envisioned a positive force emanating from the sun which pushed the planets around their orbits (Butterfield, 1966:161). Descartes embraced the existence of the

plenum (space entirely filled with matter) in an attempt to explain the motion of the planets. The plenum, according to Descartes, developed whirlpools which captured the planets and carried them, like pieces of straw, around the sun (Butterfield, 1966:159-160). Einstein's thirty-year abortive attempt to synthesize the laws of gravitation and electromagnetism in a unified-field theory has been documented in several accounts. (Among them, see Clark, 1971:405-409.) Of this pursuit Einstein wrote in 1944, "I am in an agony of mathematical torment from which I am unable to escape" (Clark, 1971:612-613).

The tenuousness of the feeling for coherence is illustrated by Newton's on-again, off-again quest for his grand synthesis. Butterfield reported that Newton had essentially achieved the synthesis by 1665-66 yet was dissatisfied with some of its aspects and set the work aside for almost twenty years. In 1678-79 Newton expressed doubt in his earlier work. It was not until the mid-1680's that Newton returned to the synthesis and completed it to his satisfaction in 1686-87 (Butterfield, 1966:164-168). The emotion that accompanies the tenuous feeling for coherence was expressed by Darwin in remarks made by him prior to the publication of the Origin of Species:

> How awfully flat I shall feel, if when I get my notes together . . . the whole thing explodes like an empty puff-ball. . . . I am horribly afraid. . . . I trust to a sort of instinct and God knows can seldom give any reason for my remarks (Eiseley, 1969:130-131).

Though students in a classroom may be striving after knowledge that is possessed by a large part of humanity, they remain muddled until they have stretched themselves toward comprehension by seeking

to apprehend what makes seemingly disparate bits and pieces of information hang together. Those who theorize that learners are passive receptors of sensory data who mechanically process these data may be speaking of mythical ways of knowing which may not exist. In the introduction to his book, Sullivan (1961:7-14) said that one of the great motives behind science is "disinterested curiosity." This unusual juxtaposition of terms may misrepresent how scientists and students acquire knowledge. The statement is an attempt to portray scientists as dispassionate and uncaring with respect to the directions their researches may take. Yet Sullivan himself rendered only a shallow portrayal and soon began to speak of such emotional qualities as the "beauty" of science, its "breathless excitement," its "poetry," and the sense of "unlimited adventure" which it creates (1961:13). In discussing the application of research to art education, Wold and Hastie (1965:329) have observed that the characterization of research as "a disinterested search carried on with an attitude of neutrality regarding results," while traditional, probably represents an "unrealistic view of human nature." They pointed out that scientists are likely to initiate investigations in an attempt to support a point of view to which they subscribe or in order to discredit one of which they do not approve. Regarding the supposed dispassionate character of science, Polanyi said,

> There is indeed an idealization of this current today, which deems the scientist not only indifferent to the outcome of his surmises, but actually seeking their refutation. This is not only contrary to experience, but logically inconceivable. The surmises of a working scientist are <u>born of the imagination seeking discovery</u>. Such effort <u>risks</u> defeat but never <u>seeks</u> it; it is in fact his craving for success that makes the

> scientist take the risk of failure. There is no other way. Courts of law employ two separate lawyers to argue opposite pleas, because it is only by a passionate commitment to a particular view that the imagination can discover the evidence that supports it (Polanyi, 1966b:78-79).

The acquisition of knowledge, whether scientific, artistic, or otherwise, may be based on the personal commitment by the learner that seemingly loose and unrelated information and sensations have meanings which can be successfully grasped through imaginative surmises. Knowing-learning may be a deliberate and purposive act in which persons attempt to bring into focus a meaning or coherence which is initially seen only vaguely and which is gradually perceived with increasing clarity.

Another of the notions concerning science is that the knowledge which it yields is certain knowledge. That is, there is a belief that the knowledge which comes from science can be equated with truth. Aside from the lack of certainty in judging relevancy and coherence, there are other aspects of scientific knowledge which create risks for the knower. In commenting on an address by C. P. Snow, William O. Baker said,

> Scientific findings, scientific facts, are usually thought of as symbols of certainty. But people must realize that these findings are certain only with respect to a particular frame of reference. That frame of reference is, broadly, the present state of knowledge or the present position of scientific thought (Snow, 1961:261).

In alluding to Werner Heisenberg's principle of uncertainty which asserts that because of the interaction between the observer and the thing observed it is not possible to know simultaneously the position

of an electron and its speed and direction of movement, Baker said,

> Hence, in a quite technical way, but with an abiding philosophical meaning, the scientists of our age . . . have already come to terms with the kind of uncertainty and incomplete truth with which they must live (Snow, 1961:262).

It is interesting to note that some practitioners and spectators of science realize the limits of scientific knowledge while popular notions about its objectivity, exactitude, and certainty continue to flourish. It is also worth noting that these limitations are recognized in the most "exact" science, namely physics. After assessing the contributions of Heisenberg, Max Planck, Max Born, and others, Bronowski concluded that knowledge without judgment (i.e., objective and certain knowledge) is not possible:

> The world is not a fixed, solid array of objects, for it cannot be fully separated from our perception of it. It shifts under our gaze, it interacts with us, and the knowledge that it yields has to be interpreted by us. There is no way of exchanging information that does not demand an act of judgment (Bronowski, 1973:64).

Ironically, practitioners of educational evaluation, a far less exacting endeavor than any of the natural sciences, have tried to avoid judgment in evaluation. Conventional evaluators have often pursued methodologies designed to reduce or even to deny the role of the observer in the observational process. They may have done this, in part, in an effort to be more "scientific" and objectively impartial. Only with the rise of unconventional approaches to educational evaluation, do practitioners seem to be accepting the responsibility of making judgments.

Laws of nature are generalizations. If many and only white swans are observed and consequently it is asserted that all swans are

white, then a number of specific cases have been generalized into a statement of law. Each time another white swan is observed, the law is verified. However, without being able to observe all swans, the universal law that all swans are white can never be completely verified. Indeed, no finite number of test implications will ever verify an hypothesis or law. In short, there are no rules of verification. Polanyi has asserted, "No scientific discovery can be strictly verified, nor even proved to be probable. Yet, we bet our lives every day on the correctness of scientific generalizations . . . " (1966a:85). Scientists, like all persons, eventually come to expect certain phenomena based on past experience. When the quantity and variety of evidence are such or when a single belief conforms nicely to a number of widely accepted beliefs, scientists are apt to say that a given statement has the power of law. Their expectations are, however, rooted in judgment and rational common sense, not logical necessity (the degree of training and professional skepticism notwithstanding).

Whereas an hypothesis or law can never be logically verified, logical falsification is possible. If one black swan were to be observed, then obviously it could be denied that all swans are white. However, the power of the so-called crucial test in science is a myth. Scientists, and all people, do not relinquish past beliefs easily. Faced with a discordant observation, they can be expected to display anything but disinterested curiosity. Polanyi, in Polanyi and Prosch, noted,

> The relation of the scientist to his surmises is one of passionate personal commitment. The effort that led

> to a surmise committed every fiber of his being to the quest; his surmises embody all his hopes. . . . To think of scientific workers cheerfully trying this and trying that, calmly changing course at each failure, is a caricature of a pursuit that consumes a man's whole person (Polanyi and Prosch, 1975:59-60).

As rational and passionate beings faced with a false implication, investigators seek a reasonable explanation of the unexpected outcome not far removed from the original hypothesis or surmise.

A tentative hypothesis is a heuristic surmise which investigators construct in an intuitive and imaginative effort aimed at pursuing deepening coherence.* They are committed to their hypothetical beliefs and seek their confirmation; they give up the beliefs only reluctantly. Perhaps the false test implication is not really an implication of the hypothesis or law in question; perhaps some mistake was made in the method of observation; perhaps there are confounding hypotheses. Polanyi said,

> It is true that a single piece of contradictory evidence refutes a generalization, but experience can present us only with apparent contradictions and there is no strict rule by which to tell whether any apparent contradiction is an actual contradiction. The falsification of a scientific statement can therefore no more be strictly established than can its verification. Verification and falsification are both formally indeterminate procedures (Polanyi, 1966a:85).

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*Whitehead was aware of the heuristic surmise which underlies all modern science. As paraphrased by and quoted in Eiseley, Whitehead understood "the sheer act of faith that the universe possessed order and could be interpreted by rational minds (Eiseley's emphasis). . . . The philosophy of experimental science was not impressive. It began its discoveries and made use of its method in the faith, not the knowledge, that it was dealing with a rational universe controlled by a Creator who did not act upon whim nor interfere with the forces He had set in operation" (Eiseley, 1961:62). Eiseley himself said, "It is surely one of the curious paradoxes of history that science, which professionally has little to do with faith, owes its origins to an act of faith that the universe can be rationally interpreted, and that science today is sustained by that assumption" (1961:62).

As information begins to accumulate against an hypothesis, law, or theory, it is a matter of judgment whether the observations should be ignored (perhaps labeled mere oddities or gliches) or set aside for the time being. Some modification in the expected beliefs might be warranted or maybe the old beliefs should be scrapped entirely. Whatever the ultimate decision might be, Polanyi, in Polanyi and Prosch, has asserted,

> There is no rule--and can be no rule--on which we can rely for deciding whether the discrepancies between theory and observation should be shrugged aside as observational errors or be recognized, on the contrary, as actual deviations from the theory. The assessment in each case is a personal judgment (Polanyi and Prosch, 1975:30).

Campbell (1974:12) noted that laboratory scientists discount much of the error in their meter readings and attribute it to such things as faulty calibrations, misconnections, and so forth. The continual discounting of discrepancies between theory (expectation) and observation (identification) are instances of what he called the necessary cross-validation between common sense or qualitative knowing and quantitative knowing. Kuhn (1962:145) said the imperfection of fit between theory and observation furnishes much of the subject matter of normal science. So usual are the occurrences of these imperfections that Kuhn said, "If any and every failure to fit were ground for theory rejection, all theories ought to be rejected at all times." That such discrepancies do occur with regularity and that these discrepancies are rejected for the most part are ordinary aspects of the method of science. Furthermore and importantly, there is no methodology which stipulates when the deviations should be

ignored and when they should be treated as legitimate discontinuities between theory and observation. According to Polanyi, in Polanyi and Prosch,

> Even the most exact sciences must therefore rely on our personal confidence that we possess some degree of personal skill and personal judgment for establishing a valid correspondence with--or a real deviation from--the facts of experience (Polanyi and Prosch, 1975:31).

A celebrated example of the discontinuity between theory and observation and how it was treated comes from the observation of perturbations in the orbit of the planet Mercury. These perturbations are not explained in terms of Newtonian mechanics. Their presence and the inability of Newton's laws to explain them were known for years before the appearance of the general theory of relativity. Yet Newtonian mechanics was replaced only after a new construct had been created, not because it was seen to be an inadequate explanation of all the phenomena subsumed under it. As Campbell (1974:3) emphatically noted, "When a scientist argues that a given body of data corroborate a theory, invalidation of that claim comes in fact only from equally plausible or better explanations of those data." Invalidation may not occur as a result of the mere observation of discordant data. Kuhn (1962:8) arrived at the same conclusion regarding comprehensive movements in science when he said, "Competition between segments of the scientific community is the only historical process that ever actually results in the rejection of one previously accepted theory or in the adoption of another." Regarding the

rejection of paradigmatic theory, he said,

> . . . a scientific theory is declared invalid only if an alternate candidate is available to take its place. No process yet disclosed by the historical study of scientific development at all resembles the methodological stereotype of falsification by direct comparison with nature. . . . The decision to reject one paradigm is always simultaneously the decision to accept another, and the judgment leading to that decision involves the comparison of both paradigms with nature and with each other (Kuhn, 1962:77).

The method of scientific knowing, though rigorous, may lack the fundamental objectivity, exactitude, and certainty popularly attributed to it. Scientists rely on ordinary knowing and personal judgment in the process of discovery and problem resolution. Such a reliance on elements which are less logically compelling than they are personally judgmental suggests that scientific knowing has an intrinsic kinship with or a substantive similarity to artistic knowing.

There are other instances in which logic is but the servant of good judgment and imagination. The relationship between natural laws and theories is an interesting one. Laws are statements of regularity in nature. They refer to observable phenomena and are expressed in everyday terms such as angle, velocity, acceleration, pressure, and so forth. Theories, on the other hand, sometimes refer to phenomena which are not observed. Theories are an attempt to construct a comprehensive explanation of why physical phenomena behave as they do. A single theory usually explains many laws. The word "construct" is used advisedly and intentionally. Newton constructed a universe of atomic particles. As Bronowski noted, it was a fictitious world, a product of Newton's rational imagination. Admittedly,

Newton's ability to calculate planetary orbits, tides, and the orbits of comets has given credence to his world of speculation. Repeatedly, Newton's world has been shown to be in accord with the "real" world which is experienced daily through the senses. Indeed, Newton's atomic particles have had a fundamental influence on humanity:

> And it is this success which gives us our faith in the substratum of tiny particles each obeying the laws on which Newton's picture is built. This assumption under the picture, this faith in a minute substratum has had important consequences in shaping our methods and our metaphysic ever since . . . (Bronowski, 1959:37-38).

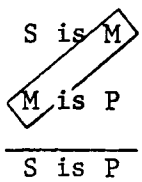
Yet Newton's world was theory only. After having been replaced by relativity, Newton's world, it can now be seen, was not the only explanation. Sullivan (1961:170-171) used examples from physics and mathematics to illustrate the personal and valuational aspects of science. He cited Michael Faraday, Sir Arthur Eddington, and Einstein as assenting to theories which were not themselves convincing to others. He noted that the mathematician Poincaré often classified other mathematicians into two psychological types. One group, according to Poincaré, was amenable to one kind of reasoning, and the other group could only be convinced by yet a different kind. Sullivan observed,

> In view of these facts it is obviously misleading to present science as differing fundamentally from the arts by its "impersonal" character. There is no absolute difference here, but only a difference of degree (Sullivan, 1961:171).

Herein lies the nature of theory: It is argument by simile; it is Newton saying that the universe behaves as if it were composed of tiny, discrete particles of matter. Theory is only a model of reality, not a reproduction. Theory is like a map. Some maps are

better than others, but no map depicts all features of a territory. A map is only a rendering of or a guide to the territory. A good one is sufficient to represent the territory, but it is never complete; another map can always be drawn. The final map with respect to a given territory does not exist. A theory may be sufficient to explain the empirical laws subsumed under it, but it is not logically necessary. It is feasible that a different theory can be constructed to explain the same laws.

As noted on page 22, classical science aspired to argue syllogistically from first principles. Its paradigm was:



The middle term, "M," of the syllogism is logically connected to the two premises, and the conclusion must follow, necessarily. Such is not the case with inductive reasoning. There is no logical chain between empirical phenomena and the law which subsumes them. Neither is there a logical chain between laws and the theory which subsumes them. Speaking as a scientist, Cassidy (1962:54) suggested that "no scientific theory or pattern is necessarily given by the data." He observed that Ptolemy, Copernicus, and Newton were dealing with much the same data yet arrived at differing conclusions regarding their meaning. As an educator and commentator on educational research, Gowin has expressed a similar point of view:

> It seems to be clear today that any set of complex events can be validly described under an almost infinite number of conceptual systems. This plurality comes about because the

> relation between concepts and the objects and events to which they refer is forever open (Gowin, 1972:19).

A purposive, striving intelligence is necessary to bridge the gap between empirical phenomena and laws and between laws and theories. The same deliberate intelligence is needed to bridge the gap between the representation of topography given on a map and actual topography or between the comparisons made in a literary metaphor. A deliberate intelligence manifests itself as it proceeds from actual events to perceptions of and thoughts about those events.

Since hypotheses, laws, and theories are the "stuff" of science, it is of no little importance to ask where they come from if they are not generated by logical processes. Schwartz (1974:6) noted that two explanations have traditionally been given for the origin of hypotheses. Bacon, on the one hand, believed that it was possible to reason inductively from observations of specific phenomena to their general explication. Descartes, to the contrary, advocated the belief that one could intuit a hypothesis directly by an insightful and imaginative act of the mind. While submitting that scientists may in actuality use both methods as they proceed from perception of a problem to its solution, Schwartz said that the Cartesian method, because it is more mysterious and less given to analysis, is deemphasized, if not ignored, even by some scientists (1974:7). (Pirsig, 1975:106-107, an educator and a writer of science, has recognized the fruitfulness of the Cartesian method.) Schwartz cited Copernicus, Newton, Einstein, and George Gamow as examples of scientists who at times tried to deny the originality and speculativeness of their hypothetical formulations yet who did indeed

posit highly original ideas which were based on minimal amounts of empirical information (1974:7-8). He quoted J. D. Watson, who with Francis Crick formulated the chemical structure of DNA, as describing his work as "an adventure characterized by youthful arrogance and by the belief that the truth, once found, would be simple as well as pretty" (1974:13). Arrogance, belief, simplicity, and beauty are not rational elements, they are suprarational. Polanyi's premise, "we can know more than we can tell," and his arguments in support of tacit knowing acknowledge the ability and necessity for going beyond induction in the resolution of problems and in the acquisition of new knowledge. In Schwartz's words,

> Matters would be greatly simplified if science were merely a collection of facts, based essentially on the inductive method. If that were true, then one could simply order research, based on social need, with little regard to the scientist's own creativity and motivation. But if it is not true, then some allowance must be made for the ability of scientists to formulate new ideas, based on their own good sense (Schwartz, 1974:13).

The introduction of indefinite elements such as surmises, beliefs, intuition, creativity, and imagination into the method of science is in contrast to its portrayal as a detached and exact process which moves according to rules from the perception of a problem to its solution. The creation of hypotheses, laws, and theories may be acts of insight and imagination, not logic, which are grounded in the observer's good judgment and skill for choosing between alternative explanations. Dewey (1934:73) recognized the possible error in separating the methods of artists and "thinkers" (i.e., scientists). In speaking of scientists, he observed, "They,

too, press forward toward some end dimly and imprecisely prefigured, groping their way as they are lured on by the identity of an aura in which their observations and reflections swim." He said that in both science and art "there is emotionalized thinking and there are feelings whose substance consists of appreciated meanings or ideas." Dewey quoted Edgar Allan Poe's revelation regarding the thoughts behind literary expression:

> The public is rarely permitted to take a peep behind the scenes at the vacillating crudities, of the true purpose seized at the last moment, at the wheels and pinions, the tackle for scene shifting, the step ladders and demon traps, the red paint and black patches, which, in ninety-nine cases out of a hundred, constitute the properties of the literary histrio (Dewey, 1934:74).

It may be that such a background characterizes scientific investigations and the ordinary acquisition and utilization of knowledge as well as artistic endeavors.

In describing science and philosophy, Dewey said, "When there is genuine artistry in scientific inquiry and philosophic speculation, a thinker proceeds neither by rule nor yet blindly, but by means of meanings that exist immediately as feelings having qualitative color" (1934:120). Neither scientist nor artist proceeds according to rules which lead to inevitable and necessary conclusions. Their work is not the result of their being carried along by criteria to which they submit passively. Rather, in the pursuit of plausible, coherent, and even aesthetically pleasing discoveries and creations, they are thrown back on themselves to define what is and what is not at once plausible, coherent, and beautiful.

Knowing in the Arts

Knowing in science resembles knowing in the arts is one of the premises of this conceptual study. Elements of passion, personalness, tacitness, and inexactitude have been introduced into a description of the method of scientific knowing. This study suggests that science and the acquisition and utilization of knowledge proceed with these elements as fundamental contributors to the process of knowing. In science these elements are unexpected and their presence and importance require acknowledgment and explication. They are not unexpected in artistic endeavors.

Both science and art are creative, imaginative processes. Cassidy (1962) has sought to delineate authentic differences and similarities between the sciences and the arts. He found that science differs from art in its purposes and objectives; he noted that the kinds of phenomena observed and the emphases given them are different in the two disciplines; and he observed differences in the nature of the knowledge yielded and the uses to which it is put. On the other hand, Cassidy suggested that science, art, and all vocations engage in activities of analysis, synthesis, and practical application (1962:21). Moreover, scientists and artists both participate in construct formation (1962:51). Aside from these contrasts and comparisons, Cassidy found the most notable similarities between science and art residing in their methods, specifically the creative ones of discovery, invention, and experiment construction.

Regarding these methods, he said,

> Artists and scientists are at no time more alike than when they are engaged in their creative acts. . . .
> . . . . . .
> As far as I can see, there is no marked distinction between the way creative thoughts come to scientists and the way they come to artists. At this level of endeavor an intrinsic, human potentiality is functioning (Cassidy, 1962:56 and 58).

In the statement by Schwartz regarding science which was quoted on page 40, he noted the impossibility of ordering research and guaranteeing preordained results. Researchers in science, like artists, must be free to pursue hunches and potentially fruitful ideas without the stricture of even laudable social and humanitarian desires. With regard to artists, Dewey said,

> Impulsion beyond all limits that are externally set inheres in the very nature of the artist's work. It belongs to the very character of the creative mind to reach out and seize any material that stirs it so that the value of that material may be pressed out and become the matter of a new experience (Dewey, 1934:189).

The process may come to fruition and result in something of substance, a new form, increased understanding. Or, it may not. In either case, the pursuit is personal and creative and of the scientist's and the artist's own making.

Dewey (1931:100-116; 1934:191-194) recognized a kind of knowing or thought which he termed qualitative. According to Dewey, qualitative knowing operates in art, in science, and in ordinary knowing. The existence of quality and its apprehension is "the background, the point of departure, and the regulative principle of all thinking" (1931:116). To illustrate his point, he pointed out that it is possible for a person to recognize the author of a painting without that person's having to analyze the individual elements of the

painting and identify them explicitly. Similarly, the expression on a person's face is known by another without the need to refer to the individual features of the face (1931:113-114). Dewey quoted Schiller as having said, "With me the perception is at first without a clear and definite object. This takes shape later. What precedes is a peculiar musical mood of mind. Afterwards comes the poetical idea" (Dewey, 1934:191-192). The perception of a pervasive quality, coherence, and unifying wholeness, vague at first, precedes attention to and knowledge of the parts which comprise it. Dewey (1934:192-193) said that even though such a feeling can be immediately experienced it cannot be described fully. Whether it is termed intuition, anticipation, or something else, the ability of a knower to apprehend an "undefined pervasive quality" which "qualifies everything in the focus, everything distinguished as a part and member" suggests that knowledge of an object or an idea may never be complete and may never be made fully explicit. Dewey went on to say, "About every explicit and focal object there is a recession into the implicit which is not intellectually grasped" (1934:194).

Qualitative knowing is not restricted to artists or to the consumers of art. Such exclamations as "Alas," "Yes," "No," "Oh," or "Good," which Dewey (1931:101) said represent the apprehension of aesthetic quality, are reminiscent of Archimedes' cry of "Eureka" on comprehending the principle of the displacement of matter. Indeed, Dewey has acknowledged the "Oh" of wonder and the consummating "Good" which open and close every scientific investigation (1931:102). In establishing the significance of qualitative thought, Dewey suggested

that it characterizes artistic, ordinary, and scientific thought. The logic of the artist (i.e., the ability to see "the underlying quality that defines the work, that circumscribes it externally and integrates it internally") may also be the logic of the scientist and of all people. Dewey remarked,

> In a looser way, it [qualitative thought] is a characteristic of all non-technical, non-"scientific" thought. Scientific thought is, in its turn, a specialized form of art, with its own qualitative control. The more formal and mathematical science becomes, the more it is controlled by sensitiveness to a special kind of qualitative consideration (Dewey, 1931: 103-104).

Though the details of the object of attention can be analyzed later, the object is comprehended by a type of knowing which is itself qualitative and which is capable of apprehending quality. In speaking of the recognition and appreciation of art, Dewey said,

> With a trained observer such a judgment based on pervasive quality may lead later to definite analysis of elements and details; the result of the analysis may confirm or may lead to rejection of the original ascription. But the basic appreciation of quality as a whole is a more dependable basis of such point by point analysis and its conclusion than is an external analysis performed by a critic who knows history and mechanical points of brushwork but who is lacking in sensitiveness to pervasive quality (Dewey, 1931:113).

The suggestion that a kind of knowing termed qualitative knowing operates in science as well as in art may help to legitimize and refine efforts in education to see classrooms holistically and to evaluate them qualitatively. The association of the thoughts of Dewey with such an effort may lend credibility to the effort. However, though Dewey may have helped establish the existence and essentialness of qualitative thought, he did not explain it. Indeed, the very existence of the concept is easily challenged by the lack

of explication he was able to give it. In a word, "What is qualitative knowing?" This study suggests that Polanyi's concept of tacit knowing does much to explain the quiddity of qualitative knowing. When Dewey (1931:100) spoke of the ability of a knower to perceive a "dominating quality in a situation as a whole" or when he said a person can have a "sense of something problematic, of something perplexing and to be resolved" before the problem is specified in words, he may have recognized the tacitness of all knowing.

It is suggested that knowing and learning, whether by scientists, artists, students, or teachers, ultimately rest on elements which because of their nature are not specifiable. In such a scheme, so-called facts and things proven are more accurately described as beliefs and convictions. Moreover, efforts to turn learning and teaching into explicit and mechanically applied processes may be inappropriate because students and teachers know more than they can tell and therefore proceed as much by craft, artistry, and skill as they do by formal technique. Polanyi's two-term epistemology which posits the tacit integration of tacitly known clues may be able to explain scientific discovery as well as the process of artistic creation and thereby establish a substantive similarity between science and art. To this juncture, it has only been possible to refer to such a similarity as a resemblance between science and art. This same epistemology may also have the capacity to explain the ordinary acquisition and utilization of knowledge by knowers and learners.

Further speculation regarding the explanatory power of tacit

knowing is postponed with this brief exception. Tacit knowing may be able to establish a link among learning, teaching, and educational evaluation. According to Johnson, the following description applies to school children as well as to artists:

> Factual knowledge is assembled and ideas are set into motion. Then there is a period of groping, selection and rejection, a fumbling through chaotic material. As feeling develops and imagination becomes activated and applied, organized form begins to take shape, and a new creation is brought forth. This is the way the artist works, also the composer and the poet (Johnson, 1965:67).

Those seeking to capture and encapsulate the activity and efficacy of classrooms through educational evaluation should perhaps pattern their efforts after the behaviors of students and teachers. To do this, evaluators may need to realize that qualitative knowing, discovery, and creativity may operate vitally throughout the acquisition of knowledge by students and the process of teaching by teachers. In preparation for the development and explanation of such an evaluative technique, attention is directed to the practices and concerns of contemporary educational evaluators.

CHAPTER III

METHODS OF EDUCATIONAL EVALUATION

> One cannot expect to know what is going to happen. One can only consider himself fortunate if he can discover what has happened.
>
> Pierre du Pont

The nature of educational evaluation may be undergoing a transition from what has been considered conventional and orthodox toward what, until recently, was thought to be unconventional, even radical. The once unconventional is by no means displacing its predecessor. Rather, it is more accurate to say that the concept of conventional evaluation is expanding and encompassing a broader range of methodologies. It is not yet clear what the extent of this expansion will be.

In truth, it is somewhat strange to refer to the orthodoxy and conventionality of educational evaluation because the discipline (if indeed it has attained an identity and a recognizable level of expertise of its own) is still callow and undeveloped. In this instance, conventional, instead of denoting that which is performed out of long-standing custom and practice, may mean that which is done out of convenience or ease because it comes readily to mind. The conventional method of educational evaluation has been devoted, almost exclusively, to student-gain-by-testing, outcomes compared to fixed objectives, reliance on quantification, and the rules of experimental research (Stake, 1967b:2-8; Guba, 1969:31-34; House,

1976:76-83; SEC, 1976:200-205 and 210-214).

It was during the 1960's that the fomentation which characterized American society began to express itself in demands for accountability and improved methods of evaluation (Halperin, 1975:9; Glass, 1976:9; SEC, 1976:197). The increased demand for innovation and evaluation in education may have helped spawn what were then unconventional approaches. The continuance of this demand may be encouraging the evolution and development of these approaches just as it may be helping the unconventional become legitimate. According to House (1976:80), the "counterstream" movement in educational evaluation had an identifiable source in the mid-sixties in papers by Stake (1967a) and Scriven (1967).

That educational evaluation is in a state of transition is manifested in several ways. One way was indicated by Glass and concerns the absolute number and essentialness of unresolved conceptual and methodological questions pertaining to evaluation. He listed these questions:

> 1. Is meaningful evaluation necessarily comparative? Or are there absolute standards of performance or quality against which results can be compared?
> 2. What are the differences between evaluation and research? Is evaluation the same as building theories? Or is it dependent on theories? Or is it unaffected by theories?
> 3. How does evaluation differ from the explanation of why an endeavor produced its results? How does it differ from the narrative portrayal of the endeavor? In what sense is a narrative portrayal evaluative?
> 4. How should stated goals and objectives be treated? Should they be evaluated too? Must they be specified in advance for the evaluator? Or by the evaluator?
> 5. How should "goodness" or "value" be defined and measured? Is "value" properly measured as a weighted sum of constituent scales? Is the better program the one with

> the greatest average result or the one with the fairest distribution of desired goods?
>
> 6. How should evaluation be organized to reduce role conflict, censorship, and bias?
>
> 7. What are the implications of the distinction between process and product (or outcome) evaluation for organization and technique? (Glass, 1976:12.)

In a detailed study concerning evaluation, Kremper (1975) did not find general agreement regarding a definition of evaluation. He also concluded,

> There is little agreement among evaluation-researchers on a common language, the purposes of evaluation-research, whether or not experimental methods are appropriate, and the relationship of evaluation-research outcomes to actual public policy decisions (Kremper, 1975:6).

Kremper, Achilles, Verplanck, and Wiberly (unpublished MS) reviewed a variety of types of evaluation. According to their schema, type is determined by the purpose of the evaluation and the point in the life of a program at which the evaluation is introduced. The authors noted the lack of a standardized terminology of evaluation and disagreements among practitioners regarding methodology.

Another indication of the unsettledness of the field of educational evaluation is exhibited in the Proceedings of the Conference on Educational Evaluation and Public Policy. That such an alternative conference was even held is noteworthy. Also worthy of note are the kinds of issues regarding evaluation which the meeting raised. Stemming from a concern that evaluation may be as much a part of the problems of education as it is a resource for their solutions, the Conference raised the following "points of departure":

1. What is the meaning of evaluation?
2. What value premises underlie educational evaluation?
3. How adequately are educational experiences being evaluated?

4. Are evaluators participants in a conspiracy of silence?
5. To what degree does evaluation contribute to social fragmentation?
6. What are the potential destructive and alienating effects of evaluation?
7. How can evaluation reflect humanism and social pluralism?
8. Can evaluation work for communication and personal development?
9. How does evaluation affect the individual student?
10. How does evaluation affect the school-community?
11. Who controls evaluation?
12. What are the consequences of not participating in evaluation?
13. What is the relationship between evaluation and funding decisions?
14. How does evaluation relate to program and curriculum decisions?
15. How does evaluation affect alternative education?
16. How are evaluation instruments evolved?
17. How is choice of instrument made?
18. Who evaluates evaluators?
19. What information are we getting with present techniques?
20. What are the alternatives?
21. How can evaluation be conducted in the arts?
22. Are resources being allocated to evaluation at the expense of program?
23. Is self-evaluation possible?
24. What do administrators and other groups need to learn about evaluation?
25. How does evaluation contribute to or detract from the education of doctors, lawyers, the clergy, artists, teachers, etc.?
26. Why is evaluation necessary? From the point of view of teachers? parents? students? taxpayers? policymakers? administrators? curriculum planners? society?
27. What are the biases of "objective" social scientists?
28. How can the technician and the humanist work together to create a new form of educational evaluation?
29. What kind of policy changes should be made regarding evaluation and how can this be done? (Proceedings, 1976:9-10.)

Lastly, an examination of the review of the Handbook of Evaluation Research by the Stanford Evaluation Consortium (SEC) reveals that the concept of evaluation is by no means fixed and fully developed. The SEC regarded publication of the Handbook as

a "significant event." It said, " [The Handbook] constitutes a claim that evaluation has come of age in the last decade, that the field's accumulated wisdom merits codification in two volumes, 38 chapters, and 1,432 pages" (1976:196). It seems reasonable to assume that such a comprehensive work renders an accurate perspective on the status and condition of the field of evaluation.

The picture of the field which emerges is that it is populated by practitioners of diverse experiences having equally varied outlooks and recommendations for evaluation. There exists widely differing opinion as to the assumptions underlying evaluation, the purposes to which it should be put, the targets of evaluation, and the appropriateness of differing methodologies. Missing from the dynamic, according to the SEC, is sufficient clash and direct argument between the divergent groups. The groups are talking among themselves, but the amount of inter-group conflict is not sufficient to result in evolved answers to the many questions and issues that have been raised (SEC, 1976:199 and 214).

Among the issues is the need to distinguish between evaluation research and other types of research. The need for such a distinction has been voiced by several practitioners and writers. Achilles (1976) noted that while evaluation and experimental research share some practices in common there are substantial differences. For instance, evaluators, rather than being detached experimenters, should be viewed by program leaders as sources of advice and counsel who can help the leaders avoid pitfalls and achieve success. Ingle (1975:7) distinguished between evaluation and research by stating that

evaluation is designed to "produce data in order that a decision may be made regarding specific individuals or programs in specific situations." Research, on the other hand, is designed to produce knowledge that can be generalized to other settings. Guba (1969:34) also embraced the notion that evaluations are not designed to produce universal laws. Another of the differences he noted is that the aim of evaluation is to improve programs. However, trying to improve programs by altering treatments or variables in the midst of a program hopelessly confounds experimental results. Despite these and other incongruencies between evaluation and the methodology of research, Guba said that the two methodologies have become equated with each other "with disastrous consequences." The failure to make the distinction between evaluation and research was considered by the SEC as the "most serious weakness" of the Handbook (SEC, 1976:202).

The SEC reported that it was unable to extract a consensual message regarding so basic an issue as the purposes and priorities of evaluation. It found instead a variety of individuals and groups advocating that the purposes of evaluation should be "to assess needs, to guide a 'go/no-go' decision, to provide support for a decision already made, to improve program plans and policies, to assist management by monitoring daily operations, [and/or] to test social theories." As the Consortium observed, it is doubtful that all these purposes can be served by a single set of evaluative criteria or a single genre of research methodology (SEC, 1976:204-205). Finally, the SEC reported a dissatisfaction by several contributors with aspects of conventional approaches to evaluation and a call by these

contributors for revisions or even a new paradigm. Though the rudiments of a paradigm were gleaned from the Handbook by the SEC, evolved aspects were not apparent (SEC, 1976:211-212).

For the purposes of this study, educational evaluation is defined as observation of the actual and uncontrived day-to-day operations of a classroom. The observation results in description of what is happening and judgment as to the value of what is happening. That the observation is of the actual and uncontrived is in accord with the distinction which Guba (1969:34), Hawkins, in Stake (1975:21), and Hein (1976:1-2) made between experimental investigation and naturalistic investigation. Hawkins, in Stake, said,

> In an experiment one puts the system in a prepared state, and then observes the behavior of it. Preparation is what psychologists call "stimulus.". . . In naturalistic investigation one does not prepare the system, but looks for patterns, structures, significant events, as they appear under conditions not controlled or modified by the investigator . . . (Stake, 1975:21).

Experimental investigators may seek to control variables, establish conditions, and institute treatments. The naturalistic approach, on the other hand, is more flexible because it is rooted less in what is planned for and expected and more in what occurs without interference. It is less sensitive to design and more sensitive to the unique and unexpected. In short, experimental investigators intervene in a setting while naturalistic investigators "watch and wonder" (Hein, 1976:2).

That evaluation is to be bifurcated into description and judgment is a notion also espoused by Stake (1967a:525; 1967b:5). Indeed, Stake said such a division is necessary in order to approach

more complete evaluations of curriculum. This study suggests that description and judgment which rely on phenomena in addition to those which can be quantified and compressed into mathematical statement are necessary in order to yield more complete or holistic views and evaluations of classrooms. Moreover, it suggests that such a technique is by no means nonscientific. Interestingly, in the review of the Handbook of Evaluation Research by the SEC, the popular and perhaps inaccurate conceptions of science once again make their appearance:

> The Handbook is committed to "evaluation research" as distinguished from "evaluation." The coded message in such a distinction is that the evaluator is to act as an objective scientist, emphasizing quantitative and reproducible techniques and eschewing judgment. Many of the authors are sophisticated enough to warn that distancing oneself from the project for the sake of objectivity and confining one's attention to what is quantifiable can result in a sterile and uninformative evaluation. . . . [Nevertheless most] Handbook authors urge the evaluator to formulate sharp questions or hypotheses, to collect data systematically, and to compress them systematically into conclusions. Scientifically valid conclusions are held to be the hallmark of excellence in evaluation (SEC, 1976:200).

The arguments of Chapter II may show that scientists and the scientific knowledge which they discover and produce are not as objective, exact, and certain as many popular notions hold. There may, in fact, be a fundamental, epistemological similarity between scientific knowing and ordinary and artistic knowing. Perhaps it is possible to produce evaluations which are at once informative, scientifically valid, and not sterile.

The purpose to which the evaluation model of this study is to be put is simply the observation of classrooms. While some

evaluation in education has political overtones and concerns the expenditure of large sums of money and the employment of many persons, other types of evaluation should perhaps focus on the interface between students and their teacher. With such efforts, it may be possible to add to the "science" and "art" of pedagogy so that better teachers and evaluators can be trained and rewarded accordingly. The conceptual appeal of the evaluation technique advocated here is that it seeks to remain malleable and pattern itself after the methods of teaching and learning which teachers and students may use. It does not seek to impose a definition of good teaching; it seeks to discover it, first by describing the occurrences of a classroom and second by judging the occurrences as to their appropriateness, quality, and effect.

The earliest classroom observation systems were generated by teacher supervisors immediately prior to World War I. Medley and Mitzel (1963:254-255) reported that Horn in 1914 and Puckett in 1928 devised systems for measuring student participation. Wrightstone in 1934 developed a more sophisticated system comprised of nine categories designed to denote teacher actions and reactions toward students. According to Medley and Mitzel (1963:258-269), two broad classifications into which many types of observation techniques fall are 1) systems for measuring effective teacher behavior and 2) systems for measuring classroom climate. Within the first group Medley and Mitzel listed Barr in 1929, Jayne in 1945, and Morsh in 1956. The second classification, climate, has probably received more attention from researchers attempting to measure classroom

behavior than any other class of technique. Withall in 1949 conceived of classroom behavior as a continuum of activity from "learner-centeredness to teacher-centeredness." At a point on this continuum, Withall located his "climate index." In 1958 Medley and Mitzel used the Observation Schedule and Record technique (OScAR) to test the reliability and validity of the Withall Climate Index. This study was one of the first which attempted to measure the teachers' nonverbal as well as verbal behavior. Also in the 1950's, Flanders began to develop his System of Interaction Analysis. Medley and Mitzel called it "the most sophisticated technique for observing climate thus far . . . " (1963:271). French (1968) and Galloway conceived a modified version of Interaction Analysis. Their technique, called the IDER System, is sensitive to both verbal and nonverbal classroom behavior. French (1968) and French and Galloway (1970) also devised another technique, PIT, which is sensitive to verbal and nonverbal teacher-pupil behavior. Crist (1975) used PIT to compare the behavior of teachers in public junior high schools with the behavior of teachers in schools for adjudicated youth.

The compendium edited by Simon and Boyer (1974), Mirrors for Behavior, has an intriguing title and imposes some improbable requirements for observation systems. The editors said,

> To be useful for describing communication, such a [meta-]language must be descriptive rather than evaluative, deal with what can be categorized or measured, and must deal with bits of action or behavior, not global concepts (Simon and Boyer, 1974:xi).

In the first place, it is questionable whether the production of value-free language is possible or desirable. Though this study

recommends that evaluation be divided into description and judgment, it recognizes that in practice such a separation may not be complete and is perhaps artificial. In some cases, the evaluator may want to "gather the data" before intentionally subjecting them to judgmental scrutiny. Regardless of the evaluator's intended purpose, however, some overlap between description and judgment (i.e., between that which is seen and that which is thought) may be inevitable. Second, the decision to deal only with phenomena which can be measured is a decision to continue a practice already ingrained in the field of education.* It is, in its effect, a decision not to see additional phenomena which may have equal educational and explanatory value. Hein (1976:8) observed, ". . . a discipline is defined in terms of the topics which are amenable to the approach advocated." If the approach continues to aspire solely or mostly to measurement, other topics and phenomena may fail to evoke widespread interest since the chosen approach will have no way of explaining them. Third, to define a bit of behavior so that the concept can be operationalized by a large number of individuals with a high degree of predictable results (i.e., to make bit a so-called scientific entity) might be to strip behavior of much of its meaning. To reduce behavior to discrete and narrow categories called bits of behavior may be to abstract portions of behavior from the contexts necessary to explain

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*"Thorndike's dictum to the effect that whatever exists, exists in a measurable amount," noted Broudy (1972:219-220), "assured researchers that the search for quantifiable units in education was theoretically sound, but it also relieved them indirectly of the burden of inquiring into what could not be measured. It was difficult to refrain from inferring that what could not be measured did not exist and therefore was not worth teaching or researching."

it accurately. (See Campbell, 1974:11.) Furthermore and crucially, a bit of behavior is just as much a concept or mental entity as those recognized and labeled as such forthrightly. "Bits," "global concepts," and "the classroom" are all mental entities, none having more or less claim to reality than another. It is doubly misleading to imply that a bit of behavior can be observed automatically because it exists independently of the observer and to intimate that global concepts are constructs emanating from the theoretical and philosophical beliefs of the observer.

On examination of the techniques anthologized in Mirrors, one wonders, "Are these techniques able to portray accurately and fully the goings-on of classrooms, or by using them, does an observer impose a preconceived form on the classrooms being observed? Is what the observer sees determined by how the observer sees, and might the observations and conclusions represent, to some degree, observer-dependent or theory-dependent phenomena despite protestations to the contrary?" Kuhn (1962) and Petrie (1972) noted that even such entities as "facts" are theory-dependent. Gestalt psychology and the works of Polanyi suggest that no firm distinctions exist between the knower and the known or between the observer and the observed. It may not be possible to remove the observer from the process of observation and to avoid observations which have their roots in the assumptions and theoretical beliefs of the observer. Unbiased observations may not be possible. Moreover, it is doubtful that any system which categorizes, synthesizes, and compresses information into more usable forms can do so and still be said to reflect passively

or mirror, item for item and point for point, the image of the original phenomenon. To suggest that such is possible may be misleading. An active intelligence, complete with assumptions and beliefs, must categorize and reduce the information in the first place, and in the second, that same active intelligence must interpret and evaluate the new, reduced entity.

A Critique of Conventional Methods of Educational Evaluation

This study suggests that some types of educational evaluation should occur at the interface between students and their teacher. It also suggests that the propensity by many researchers for measurement and quantification may result in a kind of tunnel vision in which other phenomena of equal educational value are not perceived. Gowin (1972:17-18) listed curriculum studies and studies pertaining to the concepts of teaching as two areas, rich in educational phenomena, which are perhaps being slighted as a result of methodological bias in research. In the process of developing his argument, he used several examples. Among them was one regarding the student who is said to "understand" his arithmetic lesson because he had correctly worked a number of problems. The link between the assertion (i.e., understanding) and the supporting evidence (i.e., correctly answered problems) is tenuous, and it is frequently a target of those opposed to the exclusive use in schools of behavioral objectives. Gowin's point was more subtle than the usual criticism however. He said that even if the link is proven to manifest understanding it

nevertheless represents a preoccupation with phenomena which are easily quantified while other educational phenomena are missed. He continued,

> While we can say that in a sense the relation between evidence and assertion is made clear (a child understands arithmetic if a number of test items are passed), the advice has the bad consequence of leading us away from, rather than into, the educational phenomena of interest. We can establish the relation between assertion and evidence, but not the relation between assertion-evidence and the human experience of teaching children arithmetic (Gowin, 1972:21).

The researcher-evaluator may be sacrificing some kinds of methodological validity for the convenience of methodological familiarity. (See Hein, 1976:11-12.)

After reviewing American educational research practices, Mitra (1974:43) concluded that a decided reliance on statistical and psychometric techniques by researchers to the exclusion of other practices has resulted in emphasis being placed on those problems which lend themselves to these techniques. Macdonald (1974:3) and Mitra both agreed that the "tail" of research is wagging the "dog" of education. An example of methodology assuming the role of determinant of educational ends evinces itself in an article by Harris and Oosterhof. They suggested that educators should "propose only educational tasks for which there are appropriate means of assessment" (1976:67). Later they said, "Don't show me your educational objectives, but show me your assessments or tests of them--then I'll know what your real, rather than rhetorical, goals are" (1976:78). By appropriate means of assessment, Harris and Oosterhof apparently mean criterion-referenced achievement tests. Any stance which puts

assessment practices (regardless of their sophistication) in such an extreme position of priority thereby bases improvements in education on improvements in assessment techniques. Such a situation may lead to a rigidification of ideas in education.

Scriven (1972:112) noted that classical physics has long served as a paradigm for research in the social sciences and education. Mitra contended that a large part of the stimulus toward quantitative methodology has come from a desire by educators to be objective and scientific. He said,

> It is time one gives up this overemphasis on the so-called "scientific method." Critical thinking need not be equated with statistical thinking, and controlled observation need not necessarily be the so-called measurement. In the field of education, one would like to see a systematic study of significant problems rather than a scientific study of insignificant problems (Mitra, 1974:43).

According to Mitra, the statistical technicalness of educational research is reducing the number of persons who can understand it. He argued that such a development is affecting the influence of research on practice and decision making in education. Importantly, the enthusiasm of researchers for their own technical growth is having a harmful effect on other kinds of contributions. Both the quantity and quality of theoretical and philosophical contributions to research are declining because the legitimacy and respectability of these contributions are being questioned (Mitra, 1974:43-45).

Macdonald (1974:3) said that the goals of education are being "miniaturized" so they can be measured. According to him, the preoccupation with measurement of goals and the subordination of worthwhile goals to measurable goals have resulted in the choosing

of goals which are neither in the best interest of students nor society (1974:3-7). Moreover, he echoed Broudy (1972) in the belief that tests which are currently given to students do not adequately assess the attainment of knowledge or goals since these tests misrepresent the nature of knowledge. Macdonald argued that knowledge is uncertain, personal, and functional, yet the inference to be drawn from achievement tests, curriculum designs, and teaching practices is that knowledge is certain, impersonal, and not necessarily to be used (1974:7-9). (To support his contention, Macdonald cited Polanyi's The Tacit Dimension, 1966b.) Macdonald warned against practices in education and evaluation which equate behavior or "performative acts" with the total person and treat as "illusory or irrelevant" that which occurs within a person (1974:9). He observed that the association of science with empirical methods has only recently occurred. As little as a century ago science

> . . . meant the act of reasoning systematically about reality. It was not necessary to reason only in an empirical form. . . . Throughout history men have insisted that aesthetic rationality, the rationality of non-empirical phenomena, is appropriate and desirable, and indeed it is (Macdonald, 1974:10).

Macdonald recommended a "model bias" in evaluation which would have the flexibility and malleability to enable evaluation to represent the student in the learning process, not just outcomes of the process. He recognized that specification of preordained objectives and outcome measurement in terms of these objectives do not compose the only means to scientific validity. He suggested an evaluation model based on a learning model. The general nature of the learning model he envisioned is such that it would prevent the evaluation technique

from ordaining a universal and fixed definition of learning irrespective of actual and unique learning situations. According to Macdonald, the model of learning on which the evaluation should be based has changing objectives, recognizes intuition, allows and promotes behavior which may be inconsistent with stated objectives, and proceeds complexly in many directions at once rather than in a single, straight line (1974:12-13).

Equating the methodology of evaluation with the methodology of research results in the dominance of some practices to the near exclusion of other practices. For example, conventional methods of educational evaluation most often preordain educational objectives so the performances of students before and after treatment can be compared. Nearly exclusive reliance on preordination helps make evaluators blind to spontaneous and unplanned for phenomena emerging from educational activities. As Eisner said,

> If a teacher focuses primarily on the attainment of clearly specified objectives, she is not likely to focus on other aspects of the educational encounter, for although clearly specified objectives provide windows, they also create walls (Eisner, 1969:14).

Indeed, such reliance has a way of fixing the definition of what is and what is not considered to be educational. There arises the notion that these preordained aspects of teaching and learning are essential and therefore must be present for teaching and learning to occur. Stake, however, has dissented. He said, "There are few critical data in any study because there are few critical components in any learning experience" (1975:16). Specific data and components only become critical when evaluators rely solely on them to measure

outcomes, to define educational activity, and to determine merit.

Proponents of the preordinate approach to education construct long lists of specific behavioral objectives. Stake observed,

> This preordinate approach usually depends on a capability to state the important purposes of education in terms of student behavior, and a capability to discern the accomplishment of those purposes (Stake, 1975:27).

Macdonald (1974:9) warned against equating behavior with the total person; Scriven (1967:54 and 76-77) and Eisner (1972:578-579) recognized the difficulty of and need to measure long-term educational effects; and Stake (1975:16) reasoned, "The value [of education] may be diffuse, long delayed, or forever beyond the scrutiny of evaluators." Is it possible that educators have accepted preordained and fixed objectives rather single-mindedly in deference to researchers who may be confusing educational significance with statistical significance? Are restricting the kinds of data that are gathered and the ways of gathering them working to the detriment of education by blinding evaluators to some kinds of educational phenomena? Preordinate evaluations have the effect of stopping the action of a classroom much as a photographer with a high speed camera freezes movement. These evaluations abstract a limited number of criteria and grant them legitimacy as the sole or, at the very least, major basis for determining program success or failure and student success or failure. It seems to count for little that the freeze or evaluation might have taken place on a bad day for teachers or students; it counts for little that the standardized instructional package assumes few, if any, intellectual and attitudinal differences among teachers and

students; and it makes small difference that teachers and students may be left with a lingering distaste for the subject after it has been "crammed in and tested out."

Methods which deal with the masses as if they were one person appear to be more efficient than methods which recognize and encourage diversity. The result, however, may be that teachers do not know their students except as categories and members of groups striving toward standardized objectives. Few educators are craftsmen or artisans in their approach to teaching on at least two measures. First, an attempt is made in education to routinize procedures in order to reduce wasted effort; one day resembles all the rest, one year looks like all other years, one class like all other classes. Second, educators are continually designing programs of education while knowing little about their students as unique individuals. Perhaps more than anything else craftsmen and artists know the material with which they work. They are intimately aware of its limitations and potentialities. On the one hand, an artist would never say there is one best way to paint a portrait or sculpt a figure; there are inexhaustible numbers of ways in which good and great art can be represented within even a single medium. On the other hand, any artist would recognize as folly efforts of expression without an initial and ongoing regard for the medium of expression.

Hawkins (1976) borrowed from Hans Otto Storm the distinction which Storm made between the principle of design and the principle of eolithism. Hawkins said that the principle of design is characterized by prior and certain knowledge of what is to be built and the

materials which are to be used. Hawkins continued,

> The fashioner of eoliths, on the other hand, must have a continually open mind about materials, and he must be very adaptable in the matter of ends, of what he wants. . . . The essential limitations of the principle of design lie in the givenness and fixity of goals, and in the need to eliminate variety and inhomogeneity from the means and materials, which are thereby reduced in any significance or value they may have except in serving those given ends. . . .
>
> A characteristic of eolithic craftsmanship, he [Storm] says, is that it never goes twice the same, and therefore uniform procedures, theories of design, etc. are of little use (Hawkins, 1976:2).

If teaching and evaluation have any kinship to craftsmanship and artistry, as some have suggested, education may benefit by applying the principle of eolithism. Standardized responses to standardized stimuli are not enough; fixed objectives and fixed methods are to be avoided; teachers ought to acknowledge the uniqueness of students by varying objectives and methods. Hawkins suggested that educators who insist on preordained and rigid educational objectives have placed design on top. In recounting an experience he had while working on a curriculum design project, he said,

> I came to realize that it was somehow expected that we could lay down, in advance, a set of specifications as to what we hoped to accomplish, and by which our work could be--something called evaluated. . . . Somehow one was supposed to be wise enough to define an all-encompassing set of ends before one had acquired the slightest bit of good sense about the nature and potentialities of the materials (Hawkins, 1976:6).

In their enthusiasm for evaluation patterned after research designs, educators may have sacrificed classroom spontaneity and exploration for predictability and measurability. Reasonably, educational evaluation should not determine the form of educational

instruction. However, evaluation and its tool, mathematical abstraction, may be doing that in most instances. In the sense that teaching methods and learning methods are altered to fit preordinate evaluation techniques, teaching and learning are merely the vehicles for reaching the real goal which is evaluation. The process of pedagogy should perhaps start with how students learn, and teaching methods should match learning methods. Second, evaluation techniques should be patterned after, not determine, teaching and learning. Third, some types of evaluation should reflect, holistically, what is going on in classrooms. Evaluation should not sample a slice of time; rather it should span across time, reflecting both the history of a classroom and its future potential.

A Review of Unconventional Methods of Educational Evaluation

In his introduction to Perspectives of Curriculum Evaluation, Stake (1967b:2-3) said that improving the precision of measuring instruments in education is not now all that is needed. Rather, he suggested that more complete views of teaching and learning phenomena are needed, and he indicated that new paradigms on which to base description and judgment are in order. The ten years which have followed Stake's challenge have witnessed several notable attempts to expand the methodologies of educational evaluation. Before reviewing a number of these attempts, however, it would perhaps add perspective to note how the Stanford Evaluation Consortium (SEC) viewed a developing trend in this ten-year period.

In its review of the Handbook of Evaluation Research, the SEC (1976:210) said that the conventional or mainstream view of evaluation is "an event that begins, runs alongside a program for a time as the evaluator makes observations and collects data, and ends rather abruptly." Emerging and unconventional approaches, on the other hand, allow evaluators to "board the train and influence the engineer" instead of just running alongside it. By becoming immersed in a program, evaluators can be "naturalistic observers" concerned with pursuing areas of inquiry suggested by their own investigations as well as with pursuing outcomes of stated objectives. Finally, evaluators can study the interactions of people with the treatments as they occur, not just outcomes of the treatments (SEC, 1976:212).

Guba (1969:31-32) concluded that evaluation in education has been defined in three ways: 1) as synonymous with measurement, 2) as equated with the congruence between performance and objectives, and 3) as professional judgment. It is perhaps this third definition which has been considered unconventional yet which is receiving much of the attention of those attempting to expand the notion and processes of evaluation. For example, in suggesting the need for alternatives to the quantitative-experimental approach to evaluation, Campbell (1974) suggested that qualitative approaches have a major role to play in social science evaluation. Campbell did not advocate the substitution of qualitative alternatives for quantitative approaches. He did, however, advocate using the two approaches together in order to extend the meaningfulness of each. He said that qualitative or common-sense knowing underlies and is entwined with quantitative

knowing and for this reason it is necessary to develop and employ qualitative methodologies to cross-validate studies which use quantitative data and designs (1974:13-15). He recommended using qualitative evaluation (e.g., process evaluation) to critique the validity of the quantitative data and experimental conditions (1974: 18). When used to evaluate the same phenomena, qualitative evaluations and quantitative evaluations should agree. "If they did not," according to Campbell, "I feel we should regard it possible that the quantitative was the one in error" (1974:23). Guba and Campbell were perhaps in accord regarding the value and necessity of common-sense observations applied to sophisticated, quantitative studies. In Guba's words,

> When the evidence produced by any scientific concept or technique continually fails to affirm experiential observation and theory arising from that observation, the technique may itself appropriately be called into question (Guba, 1969:30).

The framework for evaluation which Stake proposed in 1967 represented a divergence from the mainstream. In his paper, "The Countenance of Educational Evaluation" (1967a), Stake presented a model of evaluation designed to help remedy the shortcomings of conventional approaches and to go beyond them. He advocated that descriptions of "antecedent" conditions and classroom "transactions" be included in evaluations. He considered the inclusion of this information obligatory in a meaningful description of outcomes. He also expressed the belief that attention should be paid to the congruence (or lack of it) between that which educators intend to do and that which they actually do (1967a:524). Moreover, Stake's

proposal to legitimate judgment by making it an explicit and intended aspect of evaluation represented a break from those practitioners who sought only to describe (1967a:526-527). Interestingly, the break may not have been complete since Stake suggested that evaluators might want to gather the judgments of others rather than impose their own (1967a:527).

Stake noted that to many practitioners and consumers evaluation meant the administration and interpretation of tests given to students (1967a:525-526). He, on the other hand, recognized the need to describe and to judge the behavior of teachers and others engaged in an educational activity (1967a:531-532). Stake also advocated a broadening of the variables considered relevant by evaluators. According to him, evaluators should continue to be concerned with variables represented by the stated objectives of educators. Besides these, however, the evaluator "must designate additional variables to be observed. He must search for unwanted side effects and incidental gains" (1967a:532). Stake acknowledged that deciding which variables are relevant is a subjective decision on the part of the evaluator or team of evaluators. Another subjective decision had to be made with regard to the choice of standards against which to rate the activity being evaluated (1967a:536). He noted that these standards are either absolute and thus representative of a universal set of qualities applicable across time and space or relative and thus dependent on a comparison between two or more similar programs. As to the actual act of judging, Stake said little.

Scriven's paper, "The Methodology of Evaluation" (1967),

exuded the enthusiasm and optimism which attended the prospect of the application of large-scale experiment in education. These prospects appeared after the infusion of federal monies in large sums in the mid-sixties. Although it too can be described as a break with the mainstream (House, 1976:80), the paper's emphasis was on experimental designs of educational evaluation. At times, it is as if Scriven glimpsed ways out of traditional problems only to return to more familiar stances during the course of his short treatise. As examples, Scriven digressed into a discussion of procedures to use to avoid threats to validity in comparative studies (1967:66-71). Whereas Stake (1967a) acknowledged the subjectivity of the choice of criteria, Scriven settled on "Bloom's convenient trichotomy" without as much as a pause (1967:72). Furthermore, Stake's lack of discussion regarding the act of judging (presumably, in part, because of the magnitude of the problem) is in contrast to Scriven who routinely referred to weighting the criteria (1967:73). In short, Scriven's paper belongs as much to evaluation's past as it does to what may be its future.

Nevertheless, there are reasons to think of the paper as a change from the conventional even though it represents more of a gradual transition than a clean break. In the course of distinguishing between "formative" and "summative" evaluations, Scriven indicated that formative evaluators may need to become immersed in the project being scrutinized and their efforts may be hindered if they are not "fully sympathetic" to the aims of the project participants (1967:45). He also asserted that evaluations have at times

been assigned inappropriate roles which are beyond their "reliability or comprehensiveness" (1967:41). Elsewhere, he suggested that evaluation of educational goals should be a major part of evaluation (1967:52). (The terms goals, criteria, and intentions were used synonymously by Scriven. They were meant to be in contrast to actual outcomes.) Like Stake, Scriven acknowledged the essentialness of judgment in evaluation. Furthermore, Scriven rejected the notion that the presence of judgment in a process renders that process less scientific (1967:47-49).

Another indication of the transitional character of Scriven's methodology paper was the polemical nature of his arguments regarding "intrinsic" and "pay-off" evaluations. Intrinsic evaluation deals with the curriculum, program, classroom (or whatever is being assessed) itself. It involves evaluation of the goals, grading procedures, content, teacher attitudes, and so forth. Pay-off evaluation, on the other hand, focuses on the effects of the program (1967:53). Though he clearly leaned toward assessing the pay-offs or actual outcomes of programs and thus toward judging the merits of programs in terms of these pay-offs, Scriven also seemed to recognize (see 1967:54 and 76-77) the difficulty of evaluating long-term effects. Additionally, Scriven observed that actual outcomes must be judged against some criteria in order to imbue the outcomes with meaning. Evaluation which restricts itself to actual outcomes without regard to goal-oriented or intended outcomes lacks meaning because it is the intended outcomes which serve as standards against which to judge the merits of actual outcomes. According to Scriven, it may

not be possible to separate totally evaluation in terms of pay-offs or actual outcomes from evaluation in terms of intended outcomes and still have meaningful evaluations. Whereas Stake (1967a:524) advocated a comparison between what is done and what is intended, Scriven said that in evaluating the one it may not be possible to avoid evaluating the other (1967:60-61). Thus the introduction of goals (i.e., intentions) into evaluation may be the introduction of a subjective element amidst the ideal of objective outcome measurement. In a later conceptualization, Scriven (1973) has sought ways to reduce the influence of the subjective element. His goal-free method may represent the rational extreme in attempts to separate actual outcomes from goals or intended outcomes. In this approach, care is taken not to apprise the evaluator of intended program outcomes prior to the evaluation. According to Scriven, the evaluator under these circumstances is less likely to prejudge the situation and is thus more likely to perceive actual outcomes, not imagined ones.

Owens (1973) and Wolf (1974) proposed judicial models of educational evaluation to be used to supplement conventional approaches. Their models place a premium on human judgment and testimony, rely on qualitative as well as quantitative data, and seek to weld an intrinsic link between evaluation and decision-making in education. In Wolf's words, "The procedure for presenting evidence and the expectation that the evidence will be used in reaching a decision is certainly more structured in law than it is in educational evaluation" (1974:80). It was the purpose of Owens and Wolf to capitalize on this legal structure.

Owens (1973:297) believed that adversary proceedings could be used to evaluate curricula, textbooks, and innovations, and Wolf's legal paradigm was directed at summative evaluations of large-scale educational programs of national significance. However, Wolf believed his model could be tailored to accomodate formative evaluations, evaluations of curricula, and small-scale programs at local levels (1974:vi). Both Owens and Wolf embraced the notion of adversary or contentious confrontation as a means of getting at the truth regarding educational programs and phenomena. They saw the contending thrusts of opposed forces as capable of pushing toward valid and reliable judgments or verdicts. Such a system of confrontation between litigants is based on "fight theory" which holds that "the facts in a case can best be ascertained if each side strives as hard as it can, in a keenly partisan spirit, to bring to the court's attention the evidence favorable to that side" (C. Auerbach, in Owens, 1973:296). Owens (1973:296-297) and Wolf (1974:91-93) noted that the evolution of legal practice is meliorating the procedures for adversary proceedings away from the most partisan and zealous forms of fight theory. Consequently, they advocated some degree of cooperation between opposing sides. As examples of melioration through cooperation Wolf listed the pretrial sharing of evidence between opposing advocates, the pretrial sharing of general lines of argument, and the right of the judge to examine witnesses and even summon witnesses not called by either opposing party (1974:93).

Owens (1973:296) patterned adversary proceedings after administrative hearings. He said that the hearings officer may serve

in combined roles of judge and litigants' representative. Under different circumstances, the representatives for the defense and the prosecution, the hearings officer, and the jurors may all be different persons. In an application of the adversary proceedings model in Hawaii during 1970 (see 1973:300-303), professional educators served as defense advocate, prosecutor, hearings officer, and jurors.

Wolf (1974:25-26) used concepts and procedures from common law jury trials on which to pattern his judicial model of educational evaluation. While admitting the possible usefulness of such legal proceedings as administrative hearings, civil court cases, and equity adjudication, Wolf believed that procedures from jury trials are most applicable to educational evaluation. He preferred the jury trial model over other types of legal proceedings for a number of reasons. Among them, jury trials provide the opportunity for full-fledged cross-examination of witnesses. Indeed, the right to cross-examine, to challenge the veracity of witnesses, and to provide alternative inferences is the essence, according to Wolf, of adversary confrontations. He sternly criticized those adversary or quasi-adversary evaluations which do not incorporate cross-examination (Wolf, 1974:106-108).

Wolf also preferred the jury trial model because it provides for a clear differentiation of the roles of participants, because it has established procedures by which the judge can guide and protect jurors, and because it utilizes laypersons, not professional experts, as jurors. Wolf (1974:39) contended that the confusion which exists in educational evaluation regarding the responsibilities of

evaluators and those of decision-makers could be reduced by using the jury trial model. Under such a model, the evaluator or expert assumes the role of judge or hearings officer, and decision-makers play the part of lay jurors or panel members. Advocates or teams of advocates for the opposing sides are professional experts whose legal counterparts are attorneys. As a judge guides juries through the technicalities of law, ruling on the quality and admissibility of evidence, and protecting juries from information deemed prejudicial and irrelevant, so should an evaluator guide decision-makers toward inferences "in the most effective and expedient fashion" (1974:62-64). Lastly, Wolf recommended that lay panels ought to function as decision-makers for many of the same reasons that lay juries decide the outcomes of criminal trials. While admitting that groups of experts should perhaps be used on occasion to judge some educational matters (see 1974:26), Wolf embraced the belief that the common sense and freshness of perspective characteristic of laypersons compensate for their lack of professional training and technical understanding (1974:65-67). Moreover, he recognized the democratic and practical appeal of using the lay public, particularly those who are affected most by a program and who may be asked to implement later programs, to judge the merits of a program (1974:82-85).

The judicial model of educational evaluation is strained somewhat when questions involving standards and the definition of issues arise. As Wolf (1974:50-52) pointed out, issues in law emerge with respect to rules and standards and the alleged violations of those rules and standards. In jury trials, laws and standards of

behavior are "givens," and juries decide whether or not transgressions have occurred. There are no such universally agreed on standards in education, hence defining issues, determining admissibility of evidence, and embarking on fact finding are, at best, difficult in educational evaluation. Wolf said, ". . . real issues do not exist in education. . . . Without any standards or rules, similar to those discussed in law upon which violations can occur, there can be no educational issues" (1974:57). It is to Wolf's credit that he recognized the essentialness of establishing standards. For example, as potentially important as adversary proceedings are as supplements to conventional methods of evaluation, Wolf (1974:49) recognized that these alternative approaches must nevertheless address the same questions of rules and standards that torment conventional approaches. It is also to his credit that he recognized that such standards cannot be established arbitrarily or by fiat. They must, instead, evolve naturally. Wolf (1974:56-57) suggested that educational standards should evolve in a manner similar to the evolution of standards in law. Accordingly, he advocated that procedures for comparing cases in evaluation be established so that a system of precedent can gradually be amassed in education. As laws and judicial procedures are founded on precedent, educational evaluation should establish a system of precedent from which standards, and hence issues, can be extracted.

Some notoriety has come to Wolf's judicial model of educational evaluation. (See, for example, Campbell, 1974; House, 1976.) Wolf has, in fact, had the opportunity to apply his approach on a large

scale, under professional scrutiny. Specifically, his judicial model was used to evaluate the impact of the Division of Teacher Education at Indiana University after the Division had operated for three years. Wolf (1975:186-187) reported that six months were required to implement the trial. Two adversary teams presented arguments, one in favor of major changes in the program and the other in favor of less substantial changes. In the two days of hearings, thirty-two witnesses were directly examined, cross-examined, redirectly examined, and recross-examined. The jury consisted of thirteen professional experts in education, a variation in contrast to Wolf's (1974) arguments in favor of lay juries. And, most of the proceedings were videotaped, a case study was prepared covering the process, a journal was kept detailing the hearings, and an external evaluator assessed the entire event. Although Wolf (1975:186) reported that two of the four implementation stages focused on the generation of issues and the selection of issues (hence it is reasonable to conclude that much time was spent discussing issues), Arnstein (1975:188) said, "The formulation of these issues turned out to be a major weakness and produced much confusion . . . ." Interestingly, Wolf (1974:47) had expressed doubts about gaining consensus in education regarding questions of standards and definitions of issues at a time when his judicial model was no more than a concept not due for immediate or certain application. Arnstein, in his reflections after the model was applied, confirmed both the essentialness of specifying standards and the prescience of Wolf's concerns.

Standards serve as bench marks against which the merits of a

set of educational phenomena can be judged. They can also function to determine, in part, the nature of the evaluation method. House (1976) has suggested a means of specifying standards in evaluation which fills both functions. His proposals impress one as being bold, erudite, extremely rational, and probably impractical. The proposals deserve serious inspection for several reasons, not the least of which is that they represent another type of divergence of the unconventional from conventional methods of educational evaluation. House is unconventional because he, like some others, acknowledged the implied presence of values and standards in evaluation and because he recommended that these values be made an explicit part of evaluation. In his words,

> It is not a matter of whether one has a value orientation toward evaluation. It is a matter of what conception one employs and how explicit it is. Evaluation cannot be done without a value framework, however hidden from the evaluator it may be (House, 1976:98).

He is also unconventional because the standards which he proposed for introduction into educational evaluation are moral standards. It was his intention to identify those moral standards on whose strength of authority decisions and judgments in educational evaluation could be based.

By his own admission, House relied heavily on a work by John Rawls, A Theory of Justice, around which to crystallize his ideas concerning standards and justice in evaluation. According to House (1976:85 and 89), the design and implementation of evaluation should be based on a conception of "justice-as-fairness." The ideal of fairness would result in cooperation among all groups of people as

they strive for material advantages and the limitation of individual and group desires based on the recognition of nonnegotiable human rights. One of these rights is the right to self-esteem. Consequently, all evaluation procedures which purposefully (unlikely) or effectively assail self-esteem should be avoided (1976:85-87). Another of these rights concerns the right to determine one's own future. House criticized those procedures which do not allow the individuals and groups affected by a program to express their views about the program. Moreover, he said that the views of those who are most disadvantaged must be given priority over all other views (1976:90-92).

The standards which House said should prevail in society, education, and educational evaluation contrast markedly with those which do prevail. Most evaluation schemes reduce all variables to a single and preferably standardized test score. The emphasis is on test validity and tightness of design, not on any consequences or side effects of the testing. New evaluation schemes which have emerged since the mid-sixties and which House labeled "pluralist-intuitionist" might indeed seek the views of different groups, but they probably would not order those views as to importance, giving the most weight to the views of those persons who are most disadvantaged.*

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*House called the new approaches "pluralist" because they usually derive their data from and are addressed to a diversity of groups of people. Also, these approaches seek to apply a variety of criteria in order to judge programs rather than a single test score. He called these approaches "intuitionist" because their champions are less likely to try to identify formally the moral or valuational standards which underlie judgments about programs and more likely simply to apply the standards tacitly (House, 1976:82-83). Among the advocates of pluralist-intuitionist approaches, House listed Stake, Scriven, Wolf, and Parlett and Hamilton.

In the absence of standards grounded in the principle of justice-as-fairness, basic liberties are apt to be transgressed and social and economic inequalities compounded (1976:97-98).

Even if somewhat dramatically stated, it may be accurate to say that some practitioners of evaluation are throwing off the cloak of "objectivity" and taking on the burden of judgment. The "principle of utility" (House, 1976:76-77) which has dominated evaluation and which continues to do so seeks to reduce the role of judgment by placing a premium on objective test scores. According to House, test scores are the index of what is good and that which maximizes test scores automatically maximizes the good. Once the decision to use test scores as the index is made, the need for further acts of judgment (some might say critical thinking) is reduced substantially. Yet a major argument of this study holds that objective knowing and value-free knowing may not be possible. Chapter II is an attempt to show that objective, exact, and certain knowing may not occur even in science to say nothing of ordinary and artistic knowing. Kuhn (1962), Petrie (1972), Scriven (1972), and House (1976), among others, are cited to show that implied values, standards, and beliefs may operate in explicit acts of knowing, judgment, and decision-making. And the conceptualizations of Polanyi are presented to explain the personalness and tacitness of all knowing and all applications of knowledge. According to these and other persons, that which proceeds under the guise of objectivity may not be.

In speaking of "utilitarian" evaluators, House said,

> He can point to no gain in achievement test scores and shrug his shoulders to his program friends. But hiding behind objective measures is partly deceptive. Actually, he has a number of ways of making the program look good or bad--by judicious selection of instruments, by clever manipulation of research design, by emphasizing certain features over others, and by citing mitigating circumstances in the program context--and, in the language of the report itself, he has considerable leeway, depending on his predilection (House, 1976:93).

If personal values and standards continue to operate behind the scenes of judgment and decision-making regardless of technical and sophisticated attempts to reduce their influence, it seems reasonable to try to identify these values and standards and to improve on them. This argument is even more compelling when it is understood that these new, "less objective" methods of evaluation are meant to supplement, not supplant, conventional approaches. Still another argument in favor of the identification of standards has to do with the avoidance of relativism and mere personal preference. As House (1976:82-83) observed, pluralist-intuitionist approaches to evaluation utilize data in the form of claims and viewpoints from a large variety of groups and for this they should be commended. However, such methods may be lacking in formally identified standards for judging the relative merits of these data. House argued that within the limits of feasibility standards should be specified. His candidate for the principle which subsumes these standards is the concept of justice-as-fairness.

Others who are interested in educational evaluation have recently attempted to draw attention to the good and in so doing

have asserted the need for standards. Achilles (1977) related a connoisseur's appreciation to the recognition of excellence in education. The connoisseur seeks excellence by drawing from a well of past experience, by suspending judgment while comparing the present with the past, and by generating new knowledge in the form of critical judgments regarding the quality of the present experience (Achilles, 1977:48). The connoisseur's pursuit of excellence or quality may imply the notion of absolute good; however, questions regarding the existence of universal goodness are not of concern here. That which is of concern is the pursuit of excellance and the standards which such a pursuit requires. Achilles (1977:47) said, ". . . pursuit is as important as attainment." With respect to standards which guide the pursuit, both Achilles (1977:49) and House (1976:96) suggested that standards may change over time and across settings.* Woodward (1976) in a scintillating piece called for the discovery of standards and techniques for evaluating the form(s) of quality.

In discussing eighteenth-century science, Bronowski (1959: 51-52) described the stultifying effect an erroneous system of beliefs can have on a field of study. He used as an example the theory of humours in the field of medicine which sought to classify

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*Several years ago a professor at Vanderbilt University whose name is beyond recall observed that Hemingway's fascination with bull fights had nothing to do with the outcomes of the events. That the bull would die was a virtual certainty. What the aficionados looked for was the quality of each encounter. They had learned to appreciate bull fights by applying standards of quality, and they were able to do this without ever having witnessed the "perfect" encounter. Hemingway was interested in the quality of life before its inevitable end.

disease and personality into one of four types: earthy, watery, airy, and fiery. He said the folly of these beliefs was that they were not sufficiently grounded in careful and thorough observation. The fanciful system led to a stagnation of creative thinking and reckless treatments. A similar situation may exist in present-day education. Conventional methods of evaluation perhaps amount to less than careful and thorough observation. An almost exclusive reliance on preordained, fixed objectives and quantification in evaluation may be restricting the vision, imagination, and practices of educators. With respect to the influence of evaluation on education, Eisner asserted, "Evaluation procedures, more than a reasoned philosophy of education, influence the educational priorities at work within the schools" (1975:6). He said that assumptions about the usefulness of scientific and technological evaluation procedures (see 1975:6) and even the usefulness of educational objectives in classrooms (see 1967; 1969:12-13) are largely unexamined.* Moreover, the dominant use of approaches to evaluation which admit quantitative data but exclude qualitative phenomena quite obviously limits observation. If those conceptualizations and observations on which the tenets of education rest are not critically derived and do not

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*"Scientific and technological" is Eisner's terminology. This study objects to the label because the study does not equate science with the quantitative and nonscience with the qualitative. Eisner apparently maintains a distinction between the structure of knowledge in science and the structure of knowledge in the arts. One of the purposes of this study, of course, is to show the similarities between scientific knowing and artistic knowing. Some practices only appear nonscientific when compared to an idealized form of science the substance of which may not exist.

admit phenomena of all kinds, then the knowledge base of education today, like that of medicine two hundred years ago, may be both incomplete and inadequate.

Eisner and others are developing an imaginative approach to evaluation in education.* In an attempt to develop a method capable of discerning quality in education, they are seeking to apply the concepts and practices of art criticism to educational evaluation. Eisner's approach is meant to complement those methods which he calls scientific and technological and which this study refers to as conventional.

Eisner began by seeking a method suitable for evaluating school art programs (i.e., programs in which the educational outcomes may not be predictable). He has progressed to the assertion that expansion of the methodology of evaluation is both desirable and possible in most curricular areas. From the arts, he has introduced the concepts of connoisseurship and criticism. Connoisseurship is the art of appreciation whereby one's senses of awareness and understanding are heightened in order to provide the basis for judgment. Connoisseurship is private judgment about the qualities of an object. Criticism is the attempt to disclose publicly those qualities of an object to which the connoisseur attends. It is the attempt to render

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*Several students at Stanford are following Professor Eisner's lead: Wesley Dwaine Greer, The Criticism of Teaching, 1974; Elizabeth Jean Vallance, Aesthetic Criticism and Curriculum Description, 1975; Gail McCutcheon, The Disclosure of Classroom Life, 1976; Leonard Davidman, A Formative Evaluation of the Unified Sciences and Mathematics in the Elementary School Curriculum, 1976. Greer's work is discussed in this study.

understandable, to those who are not themselves connoisseurs, that which is ineffable or at least hidden. Critics suggest or imply rather than translate, and their language is that of simile, metaphor, and analogy. Effective criticism implies connoisseurship. To be a connoisseur does not also require one to be a critic (Eisner, 1975:8-9).

The criticism advocated by Eisner is composed of three aspects: description, interpretation, and evaluation. "The descriptive aspect of educational criticism . . . is an effort to characterize or render the pervasive and sheerly descriptive aspects of the phenomena one attends to" (1975:10). Though it may indeed include quantitative aspects such as the number of times the teacher speaks as against the number of times students speak, its essence is to describe in everyday language the ongoing activity and appearance of the classroom. The description is holistic in the sense that a person reading the description would have a rather clear picture of the room, the teacher, the students, and the activities in which they are engaged. It is likely that a stranger to the school could read the description and by means of it identify the particular class. Holistic descriptions deal with intact classrooms. The description is not, however, a "photograph" in the sense that its author is removed from the process of observation. Eisner (1975:15) said, "The task of the critic is not simply one of neutral observer, nor is it one of disinterested interpretation." Indeed, the observer reports the feelings created within, and these feelings become an integral part of the description

much as the feelings created within an art connoisseur are a fundamental aspect of art criticism.

The meaning of that which is described must also be interpreted. "The interpretative aspect of educational criticism represents an effort to understand the meaning and significance that various forms of action have for those in a social setting," said Eisner. Interpretation requires "an ability to empathically participate in the life of another, to appreciate the meanings of such cultural symbols as lists of books read, handwaving, and time allocation" (1975:13). Interpretation involves ferreting out the functions and purposes of classroom activities. Interpretation, though it begins empirically with overt behavior, posits the reality of feelings and consciousness behind the behavior. Many followers of behaviorism deny the presence of feelings and consciousness. They reason that behavior is manifest and that all human activity is explicable solely in terms of behavior. Consciousness to them is an unnecessary construct. The educational critic, to the contrary, seeks to recreate the thought processes and feelings of people. The critic tries to understand the person residing behind behavior.

An essential part of criticism is evaluation. Educational criticism requires the observer to inquire into the educational importance of what is transpiring in the classroom. Eisner (1975:14) observed, "Educational critics ultimately appraise what they encounter with a set of educational criteria; they judge the educational value of what they see." During evaluation, the critic must be aware of choices the teacher is continually making. The teacher makes choices

regarding various classroom strategies and aims based, in part, on perceptions of the students' capabilities and interests. The teacher chooses during curriculum planning before instruction begins. Equally important, the teacher chooses during the teaching-learning process after instruction has begun. The choices are neither simple nor are the alternatives few in number. (A consideration of teaching as decision-making is presented by Shavelson, 1976.) In an early work Eisner remarked,

> The identification of the factors in the potentially useful educational activity and the organization or construction of sequence in curriculum are in principle amenable to an infinite number of combinations. The variable teacher, student, [and] class group require artful blending for the educationally valuable to result (Eisner, 1967:259).

More recently, he expressed a similar opinion. With regard to teaching, Eisner said that it is not

> . . . likely to be controlled by a set of laws that can be transformed into a prescription or reicpe for teaching. . . . Teaching is an activity that requires artistry . . . and education is a process whose features may differ from individual to individual, context to context (Eisner, 1975:7).

Such a view drawing attention to the artistic characteristics of teaching is, of course, not uncommon. Many have observed the similarities between teaching and artistic creativity. Notable among them was Highet who said,

> Teaching is not like inducing a chemical reaction: it is much more like painting a picture or making a piece of music, or on a lower level like planting a garden or writing a friendly letter. You must throw your heart into it, you must realize that it cannot all be done by formulas, or you will spoil your work, and your pupils, and yourself (Highet, 1950:viii).

Efforts to make teaching a precise, efficient, and predictable activity have concentrated on the institution of precise and narrowly defined educational objectives whose outcomes and means for achieving them can be planned before instruction begins. Simple educational objectives follow the end-means rationale: Narrowly defined and preordained ends are formulated and straight-line, standardized means for reaching them are devised; learning and understanding are usually said to be manifested by specific behavioral displays. Such objectives and the means for achieving them are often characterized by inflexible and uniform applications across widely diverse groups of teachers and students. However, some objectives may not be relevant to all members of even relatively homogeneous groups. Some worthwhile objectives and their means emerge only after students and individual groups of students begin to be perceived as unique. Furthermore, the attainment of some objectives is not made manifest by observing particular and short-term acts of behavior. To this list of objections to simple educational objectives, add those by Eisner which follow:

> Some objectives one cannot articulate, some goals one does not achieve by the end of the academic year, some insights are not measurable, some ends are not known until after the fact, some models of educational practice violate some visions of the learner and the classroom (Eisner, 1977:351).

In an attempt to develop alternatives to simple educational objectives, Eisner (1969;1972) suggested the desirability of using what he called "expressive" objectives and, for lack of a descriptive name, "Type III" objectives in educational planning and evaluation.

According to Eisner (1969:14-16), expressive objectives, unlike

simple "instructional" objectives, do not specify in advance of attempts to reach them a set of behaviors which the student will be able to perform after completing an instructional unit. Expressive objectives do identify activities in which learners are to be engaged, but they do not specify from the outset what the students will learn nor do they predict what the outcomes (behavioral or otherwise) will be. Expressive activities, or "encounters" as Eisner called them, are included in the curriculum to evoke a multitude of reactions, both within and from teachers and students, which cannot be specified in advance. The distinction between simple objectives and expressive objectives can perhaps be aided by a distinction which Dewey (1934: 84-85) made between statement and expression. Statement is like a road sign along a highway pointing the way to a goal or experience. It directs. Expression, on the other hand, is the experience itself. In the belief that learning may be idiosyncratic and akin to discovery, Eisner stated, "An expressive objective provides both the teacher and the student with an invitation to explore, defer, or focus on issues that are of peculiar interest or import to the inquirer" (1969:16). Elsewhere he said,

> The expressive objective is an outcome of an activity planned by the teacher or the student which is designed not to lead the student to a particular goal or form of behavior but, rather, to forms of thinking-feeling-acting that are his own making. The expressive curriculum activity is evocative rather than prescriptive and is intended to yield outcomes which, although educationally valuable, are not prescribed or defined beforehand (Eisner, 1972:580-581).

Eisner (1972:584-585) admitted that some educational outcomes, in particular those that are tied most closely to subject matter, are

homogeneous and relatively predictable across groups. However, he has suggested that many, if not most, outcomes may be unique and specific to the teachers and students involved.

Interestingly, evaluations of the outcomes of expressive and Type III objectives must take place after the fact, not before. Simple objectives are likely to be preordained objectives on at least two counts: 1) Simple objectives are constructed in the absence of an intimate knowledge of the students who will be asked to consume them, and 2) the ultimate outcomes of these objectives are predicted before attempts to reach the objectives have been made. Conversely, expressive objectives, and Type III objectives as well, are valuable for their unique, creative, and unexpected outcomes. Objectives of these kinds are rich in heuristic potential, having the capacity to lead students and teachers to increasing levels of inquiry and problem solving (Eisner, 1969:16-17).

Expressive objectives specify neither the problem with which a student will deal nor its solution (Eisner, 1972:582). Like a scientist pursuing a discovery or an artist engrossed in creativity, the student gradually defines the problem and seeks its solution. (The statement by Johnson on page 47 of this study is a description of this process.) With Type III objectives, the problem is specified, but its solution remains unknown (Eisner, 1972:581-582). For example, an engineer who has been hired to design a municipal water system knows he must attend to such things as population size, water flow needs, water quality standards, and sound engineering principles. However, he has the opportunity to devise a multiplicity of solutions,

given these restraining parameters. Bounds are set, but students pursuing Type III objectives are free to proceed with ingenuity and resourcefulness within these bounds. Expressive objectives can be likened to pure research or full-blown artistic endeavors in which the participant defines both the problem and a solution. Type III objectives are perhaps prevalent in applied research or architecture, for example, where creative answers are tied to specific problems. Simple objectives may represent the constraints under which a technician or a public school student often labors. In this situation, both the problem and agreed on steps to its solution are made relatively explicit.

Greer (1974) has applied the concepts and practices of art criticism to the evaluation of educational classrooms. A major thrust of Greer's work was aimed at elucidating the artistic aspects of teaching. It follows that if teaching is primarily an artistic process, then the concepts and practices of art criticism may be appropriate tools with which to evaluate it. The final chapter of his work was a prototypal attempt to render a public school classroom using art criticism as the descriptive and judgmental mode. The application of art criticism to educational evaluation may represent a methodology capable of accomodating educational objectives which guide but do not direct and outcomes which are spontaneous as well as preordained. However, Greer's description of teaching (particularly "good" teaching) as an artistic process is of major interest to this study. He said, "The teacher does indeed conceive of his task as an artistic one and acts as an artist" (1974:15). Greer maintained

a dichotomy between "scientific" knowing and "artistic" knowing; nevertheless, much of what he said may have a bearing on the actualities of knowing, learning, and teaching. (Artistic knowing was also called, by Greer, qualitative knowing, inside knowing, and aesthetic knowing.)

According to Greer (1974:6-22 and 42-45), teaching qualifies as an art for the following reasons: 1) It cannot be reduced "to the application of predetermined strategies to specific situations according to a general rule." 2) It is an art because classrooms are individual and unique and the qualitative aspects of teaching preclude the possibility of a general theory of teaching applicable to all, or even most, situations. 3) Education is not a definite task whose ends can be fully specified. 4) Because educational ends are not fully specifiable, educational means are likewise not fully specifiable. 5) Rather than being discrete acts of behavior which can be observed separately and tabulated, teaching is a continuous stream of classroom interactions which are both subtle and continually changing. The teacher is immersed within this stream.

In accordance with his assertions that teaching is an artistic process, Greer (1974:18-21) said that teaching ought to proceed in a creative fashion guided by "the feeling mood of discovery," a term he borrowed from Rugg.* Greer suggested that good teaching is artistic and discovery-oriented. He believed that by understanding

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*Harold Rugg is the author of Imagination, New York: Harper and Row, 1963.

the process of discovery one could better understand the process of teaching. He also believed that feelings and intuition play a predominant role in discovery. Greer said that in order to understand discovery it is necessary to understand the individual teacher's "inside stance" or personal mode of knowing. Inside or personal knowing occurs when persons give themselves totally to an activity and is in contrast to "outside" or "mechanistic" knowing. It is preverbal or preconscious knowing. Artistic teaching occurs when teachers are in tune with this preverbal stream of knowing and when they make extensive use of it. Teaching can be improved to the extent that the preverbal and the preconscious can be made explicit: "[I]f we are to train teachers as artists within this [inside or personal] mode, we will need to account for the way in which it can become available in a conscious, verbal form" (Greer, 1974:21). He implied that evaluation procedures, if they are to be of benefit to teachers, must be sensitive to inside or personal knowing.

The artistry of teaching is related to the multitude of variables with which teachers must deal. Greer defined teaching as "a process of initiating, establishing, assessing, changing, and reassessing and reestablishing relationships among the commonplaces of education" (1974:36). The commonplaces of education are the teacher, the learner, the subject matter, and the environment. According to Greer (1974:42-43), teachers orchestrate variables toward an end which is indefinite and only gradually emerging. Moreover, the process of orchestration is atheoretical. That is, as artists are guided in their judgment by the "general aesthetic quality" of

their work, teachers are guided by the perceived quality of relationships between variables, not by theories or rules. (See Dewey's statement on page 41 of this study regarding atheoretical processes.) In teaching, as in the arts,

> . . . theory and skill play a part as necessary conditions, but as the painter paints or the composer or poet writes decisions are not made with reference to some theory. Rather the emerging feeling of the piece suggests what color, word, or note comes next. Only after it has been tried is there reference to some general theory or rule (Greer, 1974:11).

Greer (1974:37) said that the emerging feelings and images which guide the perceptions of teachers may be the "distant," "vague," and "shifting" image of a "whole person" or an "educated man." He also believed that teachers are guided by a vision of "improved society" (1974:36). Elsewhere, he made reference to developing a "mature person" (1974:54). Whatever the nature of the teacher's vision might be, it may be accurate to say that the precise nature of the vision is idiosyncratic to the teacher, is a manifestation of that teacher's values, and that the vision functions to help the teacher choose and develop aims and strategies in the classroom.

On the face of it, Polanyi, the scientist, and Greer, the artist, seem to represent the extremes of human cognition. While the one deals in things and tangibles, the other deals in feelings and phantoms. Yet, and this is vital, Polanyi's explanation of how scientists proceed and Greer's description of how artists proceed are quite similar. Many of the phenomena and processes which Greer described may be explainable in the language of Polanyi's two-term structure of knowing. Greer's language is that of the artist and

only the artist, but his conceptual limitations do not prove his ideas wrong. Polanyi, however, is a bridge between the real extremes represented by Greer's point of view on the one hand and the viewpoint of those who seek objective knowing and neutral language on the other.

One is left with a feeling of dissatisfaction on reading Greer. Persons with a bent toward the scientific (in twentieth-century Western society that is probably most persons) may be left rather flat by such notions as "inside stance," "personal mode," "feeling mood," "in tune with a preverbal stream," and "atheoretical." One is struck by the tenuousness of these terms and is left wanting for something of more substance. What is needed is a more substantial conceptual platform from which to speak about processes of knowing and doing which partake of feelings, intuition, and judgment. The works of Polanyi may provide such a platform. Art, teaching, learning, or any activity which has feelings, intuitions, and personalistic qualities as its foundation will be considered inferior to "scientific" activity unless science itself can be shown to proceed on the same, tacit basis. The contents of Chapter II of this study indicate that science may rest on a nonexplicit foundation and that knowing in science and knowing in the arts share a resemblance. The concepts of Polanyi are invoked in Chapter IV to establish a substantive similarity between knowing in science and the arts. The establishment of such a similarity may suggest a relationship between ordinary knowing-learning and some teaching. Polanyi's concepts may even be capable of furnishing the epistemological framework for a new model of educational evaluation.

CHAPTER IV

TACIT KNOWING

> It is the predicament of mankind that man can perceive the problematique, yet, despite his considerable knowledge and skills, he does not understand the origins, significance, and interrelationships of its many components and thus is unable to devise effective responses. This failure occurs, in large part because we continue to examine single items in the problematique without understanding that the whole is more than the sum of its parts, that change in one element means change in the others.
>
> Club of Rome

Schools are concerned with teaching students that which they do not already know. But how does one come to know what one does not know? How do scientists make discoveries, how do artists create, how do students attain new knowledge? Meno put this question to Socrates in The Dialogues:

> Meno: But how will you look for something when you don't in the least know what it is? How on earth are you going to set up something you don't know as the object of your search? To put it another way, even if you come right up against it, how will you know that what you have found is the thing you didn't know?
> Socrates: I know what you mean. Do you realize that what you are bringing up is the trick argument that a man cannot try to discover either what he knows or what he does not know? He would not seek what he knows, for since he knows it there is no need of the inquiry, nor what he does not know, for in that case he does not even know what he is to look for (Hamilton and Cairns, 1966:363).

Polanyi has sought an answer to this dilemma since 1945,* and he

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*See Grene, 1969b. Also see Polanyi, 1958. Polanyi's book, Personal Knowledge, may represent a leap forward in the understanding of mankind. From it will germinate many ideas in many different fields. Though it is referred to in a number of works, it may not have received careful reading by many.

has concluded that scientific discovery represents the paradigm for all forms of scientific knowing (1966b:24-25).

Schwartz (1974:9-11) explained that Polanyi's concepts belong to the cognitive school of theories of thought (and learning). Schwartz said that theories of thought can be categorized into two basic classifications: additive theories and cognitive theories. Additive theories are sometimes called associationist theories. Other names for cognitive theories are constructive, synthetic, and gestalt theories. Some experts (for example, Petrie, 1972) consider Skinner's operant analysis as a classification all its own, distinct from the associationist school. Advocates of additive theories believe in a direct correspondence between the physical objects of sense perceptions and their mental counterpart. They also believe in a direct correspondence between these mental representations and ideas about the representations. In this view, "ideas are [but] faint copies of visual images--copies of copies, linked together by associative bonds" (Schwartz, 1974:10). One form of the additive school, behaviorism, has no need for ideas and considers, instead, links between specific stimuli and overt responses.

Cognitive theories, on the other hand, have their advocates in part because of a phenomenon called "object constancy." Object constancy refers to the stability of perceptions. Perceived entities (e.g., tables, chairs, species of living forms, patterns of speech, handwriting) are recognizable as belonging to their respective classes of objects even though they are subject to "manifold distortions and transformations" and indeed are infinitely variable across time and

settings. Cognitivists believe that perceptions, memories, thoughts, hunches, biases, and so forth are constructed creatively and imaginatively by the active mind. Perceptions and ideas are syntheses of objective data which emerge from these data. Additive theorists argue that perceptions and ideas are built up in the passive mind much as the images on a video screen are built up by series of discrete black and gray dots. As Schwartz (1974:11) observed, the choice between additive theory or cognitive theory "represents an intellectual bias and is itself not verifiable."

This study suggests that knowing-learning is a purposive, striving act in which the knower "gropes" or "stretches" toward objects of awareness in an intentional effort to understand. Awareness of new objects of understanding is vague at first. With effort, the awareness becomes progressively more definite and focused. Knowing-learning cannot be portrayed as an indifferent process of sense data reception by a sensient being. Neither can it be explained in terms of stimulus-response although it has been superficially described in such terms. Moreover, behavioral displays of so-called understanding may be only shallow demonstrations at best. Understanding or comprehension, which results from striving to know by the knower, is the essential element of knowing according to Polanyi. With regard to understanding, he said,

> . . . [understanding] is the faculty which I recognize as the central act of knowing. For comprehension can never be absent from any process of knowing and is indeed the ultimate sanction of any such act. What is not understood cannot be said to be known (Polanyi, 1961:240).

Dewey (1933:78-79) said, "Information is an undigested burden unless it is understood. It is knowledge only as its material is comprehended." According to Dewey, a knower who understands has grasped the relationship between the various parts of a set of information. In addition, such a knower is able to make use of the information in new situations, whereas a person who relies only on memory would be lost regarding its application.*

That which Polanyi meant by understanding is the kind of awareness which results from the combining of individual clues into their joint or comprehensive meaning. Knowing without understanding may be meaningless mimicry and memorization. It should not be assumed, however, that what is understood can be made wholly explicit any more than the process of understanding is a wholly explicit process. The dilemma expressed by Meno and called a trick argument by Socrates intimates the subtleties of knowing. Equally indicative of this subtlety is Polanyi's premise, "we can know more than we can tell" (1966b:4).

Polanyi (1961:239-243; 1966a:86; 1966b:3-25) has asserted that all knowing is a personal and tacit process which exhibits a "from-to" structure. Functioning as part of this structure are two kinds of awareness, "focal" and "subsidiary." (In his later writing, perhaps because subsidiary awareness was being confused with the unconscious, Polanyi used the term "from-awareness" instead of subsidiary awareness.

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*A discussion regarding the phenomenon of forgetting and the application of information to new situations is presented on pages 130-132 of this study.

See Polanyi and Prosch, 1975:38.) Knowing is an act in which persons attend to an item focally by relying on their subsidiary awareness of a host of clues relating to the focal item. That which is focally known is specifiable. That which is subsidiarily known is essentially unspecifiable for two reasons, one reason having to do with practical considerations and the other relating to absolute conditions. In the first place, hundreds, perhaps thousands, of clues contribute to an item which is focally known. If for no other reason than sheer numbers, it might prove unproductive to try to make all clues explicit. The second and absolute reason why many clues remain unspecifiable is that clues are known only as they are relied on to know something else. A clue can become the object of focal attention; the moment it ceases to function as a clue, however, its appearance and meaning changes. Polanyi observed,

> We cannot attend to a clue as a thing in itself without depriving it of its meaning as a clue and losing sight thereby of the thing to which it served as a clue. . . . Conversely, we can focus on a whole only by reducing our awareness of the particulars to the contribution they make to the whole (Polanyi, 1961:239).

In order to illustrate subsidiary awareness and to show how subsidiarily known clues change both appearance and meaning when they become focal objects, Polanyi used the act of viewing stereoscopic pictures as an example. Each picture when viewed separately may be thought of as a clue to the joint appearance and meaning which emerges when both pictures are viewed together. With regard to viewing

the two images together in a viewer, Polanyi, in Polanyi and Prosch, said,

> . . . we see a stereo image at the focus of our attention and are also aware of the two stereo pictures in some peculiar nonfocal way. We seem to look through these two pictures, or past them, while we look straight at their joint image. We are indeed aware of them only as guides to the image on which we focus our attention (Polanyi and Prosch, 1975:34).

The stereo image which emerges has a depth and quality not present when either picture is viewed separately. The appearance of the two pictures when they are viewed together or holistically is different from their appearance when they are viewed separately or abstractly. Focal awareness and subsidiary awareness are further illustrated by an example of nonverbal communication. Consider how it is possible to know the meaning of a person's nonverbal signaling (for instance the person is flashing anger) without being aware of any of the particular facial expressions or bodily postures. The knower is aware of these particulars (clues) only as they are relied on to attend from them to their joint appearance and meaning, that is, the visage of an angry person. Users of language, similarly, are focally aware of what they intend to say and only subsidiarily aware of the words they use to say it. The individual words derive their meaning from the context (whole) to which they contribute. If an individual word is removed from its context and is thus allowed to become the object of focal attention, the word may assume a different meaning or connotation in the mind of the user. In a sense, the word also changes its appearance when it becomes a focal object. That is, words in context are not normally seen in themselves. Being part

of the background, they tend to blend into it. This phenomenon is known as the transparency of language. (See Polanyi and Prosch, 1975:35.)

"Clearly, the new element I have introduced here into the conception of knowing is the knowing of things by relying on our awareness of them for attending to something else that comprises them" (Polanyi, 1961:241). Borrowing from medical terminology, Polanyi called the objects of subsidiary awareness the proximal term of tacit knowing, and the objects of focal awareness he called the distal term. Polanyi chose this terminology because that which is functioning as a clue is assimilated or "interiorized" into the knower while that which is the object of focal awareness remains external and hence at a distance. Elsewhere he said people "pour" themselves into that which is subsidiarily known. (See Polanyi and Prosch, 1975:36.) Knowing, then, is a process of attending from the proximal term (clues or particulars) to the distal term (focal object). All knowing is personal and tacit and exhibits this from-to functional relationship between the proximal term and the distal term. Polanyi cautioned against mistaking subsidiary awareness for unconscious or preconscious awareness: "What makes an awareness subsidiary is the function it fulfills; it can have any degree of consciousness so long as it functions as a clue to the object of our focal attention" (Polanyi, 1966a:86). Some marginal clues (e.g., clues seen in the periphery of vision) and some subliminal clues (e.g., the muscles controlling the motions of the eyes and the posture of the body) can, with effort, become objects of focal

awareness. Regardless of the level of consciousness, however, all clues remain tacit as long as they continue to function as clues. That is, clues remain tacit as long as they are known by relying on them to know something else.

This study has cited examples from Polanyi relating to both sense perception (stereoscopic vision) and conception (the use of language) in an attempt to establish the credibility of the position that it is possible to be aware in two, intrinsically different ways. Motor skills also exhibit this two-term structure of knowing, one term of which is known subsidiarily and one term of which is known focally.* Polanyi discussed hammering a nail to illustrate subsidiary and focal knowing in motor skills. The person driving the nail is focally attending to the function of the hammer (i.e., the purpose of the act) and is not attending directly to the impressions the shaft of the hammer makes on the palm and fingers. The person is subsidiarily aware of these impressions and uses them to guide the hammer to the nail head with the proper force of impact. In Polanyi's words,

> I am highly alert to the feelings in my palm and fingers holding the hammer. They guide my handling of it effectively, and the degree of attention that I give to the nail is given to these feelings to the same extent, but in a different way. The difference may be stated by saying that these feelings are not watched in themselves but that I watch something else by keeping aware of them. I know the feelings in the palm of my hand by relying on them for attending to the hammer hitting the nail (Polanyi and Prosch, 1975:33).

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*The assertion that motor skills and conceptual knowing have the same epistemological structure should interest educators who argue about differences between training and education.

In a like manner, the person uses awareness of the extensions and contractions of the muscles within the body and all other bodily sensations to help drive the nail. The difference between the kind of awareness persons have for the sensations on their hands and in their body and the kind of awareness they have for the act itself is demonstrated by what happens if the focus of attention is allowed to shift to the sensations: "Any skillful performance is paralyzed by attending focally to its particulars, whether these are the dexterous movements of our body or the tools which we employ" (Polanyi, 1961:240). A baseball player trying too hard to hit a ball by concentrating on the particulars of the act loses the rhythm of the swing. Likewise, focusing on the words of one's language, rather than what one intends to say, by repeating words or phrases over and over strips the words of their meanings and they begin to sound like nonsense. By focusing on the item of attention, performers and knowers remain subsidiarily aware of their body and rely on it to guide their doing and knowing. Polanyi asserted,

> Our body is the ultimate instrument of all our external knowledge, whether intellectual or practical. In all our waking moments we are relying on our awareness of contacts of our body with things outside for attending to these things. Our own body is the only thing in the world which we normally never experience as an object, but experience always in terms of the world to which we are attending from our body (Polanyi, 1966b:15-16).

In the case of many sense perceptions and motor skills, people quite literally interiorize or assimilate clues into their body. They use these clues as tools for knowing something external to themselves. Similarly, when people use actual tools such as

hammers or scalpels, they make these tools extensions of their body by assimilating the clues they provide into their body. For example, the cane of a blind person becomes an extension of the arm. The blind person uses the cane as a tool to "see" obstructions and other hazards by attending from the impressions made on the hand by the butt of the cane (the proximal term) to the joint meaning of these impressions (the distal term) at the cane's tip. (Refer to Polanyi and Prosch, 1975:35-36.)

Bodily participation in the way persons perceive or in the way they perform motor skills is the basis of Polanyi's concept of "indwelling." Indwelling is the name Polanyi has given to the literal and figurative process of taking clues into the body to use them as the proximal term in the act of knowing. He also called this process interiorization, assimilation, expanding one's body, and pouring oneself into. (Americans, in their parlance, speak of becoming absorbed in interesting activity.) He chose this terminology because "to know something by relying on our awareness of it for attending to something else is to have the same kind of knowledge of it that we have of our body by living in it" (Polanyi and Prosch, 1975:36). Thus it may be said that one dwells in clues in order to know something outside the body or self.

Indwelling is not restricted to clues having to do with perceptions and motor skills. It functions in all knowing, including conceptual knowing. People speak meaningful sentences and write provocative books by dwelling in the phonetics, words, grammar, and style which comprise these mentally skillful acts. Students use

textbooks as tools as they dwell in them to know something else. The texts themselves command only subsidiary attention or from-awareness since, ideally, the focus of the attention of students is on that which their textbooks enable them to learn. Students attend from the texts to something else. Becoming absorbed in or giving oneself up to an interesting book by suspending disbelief is an act of conceptual indwelling. By such an act it is said that the book becomes "alive." (See Polanyi and Prosch, 1975:31 and 37.)

According to Polanyi (1961:242 and 245; 1966b:29-31), it is by means of indwelling that human beings become alive in the minds of other persons. That is, by dwelling in another's mind (figuratively of course), one comes to recognize a consciousness behind the facade of behavior and overt response to stimulus which is commensurate with one's own consciousness. Dwelling in and thus knowing the mind of another has the same epistemological structure as perceiving an object with the senses and performing a motor skill. Just as one recognizes a person's face by relying on the particulars of the face to attend from these particulars to their joint meaning (i.e., the recognized face) and just as a person is able to identify the style of a Baryshnikov by attending from the individual movements of the dancer's body across the stage to their comprehensive meaning (i.e., the recognized style), one can recognize the organizing, unifying consciousness behind the combined behaviors of another person. An art critic strives to comprehend an artist's work by dwelling in the mind of the artist. The critic does this in part by surmising function and purpose and organization to the particulars

of an artist's work. Polanyi in discussing the way an apprentice comes to understand the games of a chess master said, "We must surmise that we are faced with some coordinated performance, before we can even try to understand it . . ." (1966b:30). That a person surmises or postulates the existence of another's consciousness and comes to accept the actual existence of this consciousness because of the belief's explanatory value is the same mental process used by a scientist in pursuit of a discovery or a medical doctor seeking a diagnosis or a student in search of new knowledge. (See Polanyi, 1966b:30-32.)

The acceptance of two kinds of awareness and the concept of literal and figurative indwelling introduce a highly personal and tacit fundament to the explication of knowing. That the knower contributes to what is known and how it is known may be in contrast to the objective ideal of science.* Nevertheless, it is important to remember that Polanyi was not speaking of artistic-humanistic

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*Some who read this work and the aspects of it dealing with Polanyi's theory of knowing may choose to interpret personal and tacit as meaning existential or even solipsistic. Such interpretations, if they are made, would be foreign to the philosophy of this study as indeed they are foreign to the highly evolved philosophy of Professor Polanyi. Personal knowing is the active and intelligent participation of the knower in the knowing process. By no means does it preclude persons from seeking after what Einstein called "pre-established harmony." The act of knowing is personal, but that which is known may not be. Or as Polanyi (1966a:92) said, "The search is of our own making, but reality is not." Elsewhere he said, "Our reliance on our awareness of the particulars is the personal; our knowledge of the entity, the objective element of knowing" (1961:244).

knowing only. He was making reference to all knowing. Polanyi, in Polanyi and Prosch, observed,

> We must therefore amend our ideal of science by accrediting skills and connoisseurship as valid, indispensable, and definitive forms of knowledge. This amendment, we shall see, will open the way to a far-reaching relaxation of the tension between science and the nonscientific concerns of man (Polanyi and Prosch, 1975:32-33).

He continued,

> This amendment, we can now see, bridges the gap between the natural sciences and the study of man. Having recognized personal participation as the universal principle of knowing and having determined the structure of this knowing, we are now able to see that the personal participation through which we reach our evaluation of human actions as the actions of sentient, intelligent, and morally responsible beings is a legitimate instance of scientific knowing. It is the way in which we dwell in these particular subjects in achieving our knowledge of them--our understanding of their actions. It is thus not at all "unscientific." All knowing is personal knowing--participation through indwelling (Polanyi and Prosch, 1975:44).

Knowing is a tacit act on two counts. First, the clues which are combined to attend from them to their joint meaning are known subsidiarily when they are functioning as clues and hence are not fully specifiable. The knower is aware of them only by relying on them to know something else. Letting some of the clues become the foci of attention not only alters or even destroys the original focal object, it also changes the appearance and meaning of the clues as well. Second, knowing is a tacit act because the process of gathering and combining clues and attending from them to their joint meaning may not be an explicit operation. The details of this process, termed "integration," may not be specifiable because of

its nature. Regarding integration Polanyi said,

> The very process of tacit integration, which we have found so ubiquitous, is, when we turn our attention directly upon it, as we have been attempting to do in this work, also indeterminate, unspecifiable. . . . Our dwelling in the particulars, the subsidiary clues, results in their synthesis into a focal object only by means of an act of our imagination--a leap of a logical gap; this does not come about by means of specifiable, explicit, logically operative steps. The depth <u>seen</u> through a stereoscope is a new phenomenal experience, not <u>deducible</u> in its unique phenomenological character from the clues that the process of tacit integration integrates, just as the heliocentric concept of the planets "seen" by Copernicus was a new conceptual experience <u>not</u> deducible from his available data. We can only point to the existence of tacit integration in our experience. We must be forever unable to give it an explicit specification (Polanyi and Prosch, 1975:61-62).

Polanyi (1966a:88-91; 1966b:21-25; Polanyi and Prosch, 1975: 57-63 and 96-97) described the substance of the pursuit of scientific discovery. He considered scientific discovery to be the paradigm of all forms of scientific knowing. It is a suggestion of this study that scientific discovery may be the paradigm for the acquisition and utilization of knowledge in art and more ordinary endeavors as well as in science. Understanding how scientists begin to envision a problem and pursue the problem to its solution may help educators understand how students, and all people, learn something they did not know before.

An important argument against the belief that knowing is totally objective and explicit and hence explainable in terms of a formal process stems from the realization that people are able to perceive or conceptualize a problem, broadly at first, without being able to say fully what they know or how they know it. Dewey (1931:100) said that such an ability functions in all thought: "It

is the first stage in the development of explicit distinctions. All thought in every subject begins with just such an unanalyzed whole." (Refer to the explanatory note regarding Dewey at the bottom of page 9.) He said that to have a feeling, impression, or hunch about something is to perceive it as a problem "before there is recognition of what the problem is." He continued,

> The problem is had or experienced before it can be stated or set forth; but it is had as an immediate quality of the whole situation. The sense of something problematic, of something perplexing and to be resolved, marks the presence of something pervading all elements and considerations (Dewey, 1931:100).

Were it not for the ability to perceive a problem and possible solutions first in broad terms and only later with more definition, the knower would be impaled on one horn or the other of Meno's dilemma. That is, a person either does not know how or where to look for something new because it is new, or if the person does know, then the object of the search must not be new in the truest sense. Polanyi's explanation of discovery, which utilizes the concept of tacit knowing, is an answer to the dilemma expressed in the Meno that asks how people can come to know something which they do not already know. Polanyi's insight may also be an explanation of how artists create and of how all persons acquire and use knowledge.

According to Polanyi, in Polanyi and Prosch (1975:57-62 and 96-97), inquiries are initiated and carried out by acts of "intuition" and "imagination." It is through the power and trainable skill of the intuition that scientists and students sense or anticipate coherence behind seemingly disparate phenomena. It is the intuition

which furnishes the heuristic surmise (see page 33) regarding the meaning of phenomena. This ability to anticipate the presence and meaning of an as yet unknown coherence or the capacity for an "active foreknowledge of an unknown reality" (Polanyi, 1961:243) also serves to guide the pursuit of the knower striving to know. Though Butterfield was perhaps guilty of understating the mental rigor required of Newton as he proceeded toward his grand synthesis, he did indicate the importance of intuition to the success of the pursuit:

> The situation had become so ripe that one youth who made a comprehensive survey of the field and possessed great elasticity of mind, could shake the pieces into the proper pattern with the help of a few intuitions (Butterfield, 1966:163).

At work with intuition, the imagination furnishes, indiscriminately, the clues or raw materials which feed the inquiry. The imagination must be free to roam, picking clues here, choosing there. The intuition enables one to see the problem, indefinitely at first, and with materials furnished by the imagination, it selects clues which are presumed relevant to the comprehension of the problem and its solution.

Polanyi, in Polanyi and Prosch (1975:60), cited Poincaré as having described two stages of scientific problem solving. One stage, which owes its potency to the imagination, consists of (in Polanyi's words) "successive sallies of the imagination" or efforts of "racking one's brains." The other stage belongs to the intuition and is a "spontaneous process of integration." (Interestingly, the "pain" of discovery, creativity, and learning might be associated

with the imaginative stage.) Poincaré noted that spontaneous integration may take place many hours and quite unexpectedly after imaginative efforts have ceased. The information and ideas activated by the imagination are integrated, spontaneously, by the intuition which also serves to guide the pursuit of problem resolution.* Dewey (1931:102) believed that the consummative exclamations of both scientists and artists on comprehending coherence and perceiving beauty represented a simple but legitimate summing up and integration of "previous experience and training and bring [consequently] to a unified head the results of severe and consecutive reflection." Dewey (1934:72) quoted Van Gough's observation regarding the "fullness of emotion and spontaneity of utterance" coming from those who have "steeped themselves in experiences of objective situations." And he thought that statements by William James about religious experience

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*There may be physiological justification for separating mental processes into categories. For example, research suggests that the two hemispheres of the brain are specialized in their functions, each more or less controlling its own form of knowing. The left hemisphere seems to be the seat of analytic thinking. It processes information sequentially or linearly in verbal and logical fashion. The functions of the "left-brain" may correspond to Polanyi's imaginative stage of knowing. The "right-brain," on the other hand, seems to be responsible for spatial orientation, awareness of the body, and ability to recognize faces. The right-brain apparently processes information spontaneously or simultaneously, rather than sequentially. Its functions may correspond to Polanyi's intuitive stage.

The list of related articles which follows represents only a small sample of the number and variety of articles which are available: Robert E. Ornstein, "Right and Left Thinking," Psychology Today, No. 12 (May 1973), pp. 86-92; Colin Martindale, "What Makes Creative People Different," Psychology Today, No. 2 (July 1975), pp. 44-50; Roger W. Sperry, "Left-Brain, Right-Brain," Saturday Review, No. 23 (August 9, 1975), pp. 30-33; Madeline Hunter, "Right-Brained Kids in Left-Brained Schools," Today's Education, No. 4 (November-December 1976), pp. 45-48; Bob Samples, "Mind Cycles and Learning," Phi Delta Kappan, No. 9 (May 1977), pp. 688-692.

were also descriptive of the internal processes preceding expression. According to James, in Dewey,

> A man's conscious wit and will are aiming at something only dimly and inaccurately imagined. Yet all the while the forces of mere organic ripening within him are going on to their own prefigured result . . . (Dewey, 1934:72).

As noted in Chapter II, determinations of relevancy and coherency are personal acts. There are no explicit rules by which a person groping to learn can know whether the coherence being pursued is mere illusion and whether the method of pursuit will ever culminate in anything of substance. Furthermore, there is nothing mechanical in the process which would automatically carry an inquiry to logically necessary conclusions once it had reached a certain stage. (Pages 38-39 of Chapter II contain a discussion on logically necessary conclusions.) The accuracy of this assertion is demonstrated in Darwin's Century, a detailed account by Eiseley (1961) of events leading up to the discovery and formulation of the theory of organic evolution. Numerous individuals, both predecessors and contemporaries of Darwin, came close to making the discovery. In speaking of one who pursued the "elusive shadow," Eiseley said,

> The lonely and embittered American royalist had come within a hairsbreadth of the greatest discovery of the age. The fact is revelatory of the endless flux of ideas which, in the social mind, await their moment of crystallization (Eiseley, 1961:125).

It was Darwin who bridged the final gap, perhaps by intuition and imagination, and effected the crystallization.

With respect to the process of discovery, Polanyi observed,

> Formal processes of inference cannot thrust toward the truth. . . . All explicit forms of reasoning, whether deductive or inductive,

> are impotent in themselves; they can operate only as the intellectual tools of man's tacit powers reaching toward the hidden meaning of things (Polanyi, 1961:242-243).

In discussing the convictions of Keats, Dewey (1934:33-34) said Keats believed that formal reasoning was limited in its power to approach truth. He quoted Keats as saying that he "never yet has been able to perceive how anything can be known for truth by consecutive reasoning . . . ." Keats, according to Dewey, believed that reasoning which did not also include intuition and imagination could not reach truth. Keats felt that because the world is one of surmise and uncertainty, reasoning, without imagination, must fail.

In the view of knowing-learning presented in this study, a person strives to know by first anticipating and then focusing on an indefinitely known item by means of gathering and combining an array of subsidiary clues which are presumed to bear on the focus of attention. Clearly, knowing may be a purposive, deliberate activity far removed from any portrayal of it as passive sense reception and response to stimuli. Moreover, most of what is known by an individual may never be known completely. Through an inexhaustible combination of clues which the knower contributes to the act of knowing, ideas and objects of knowing have the continuing capacity to reveal additional aspects and meanings as they shift into and out of the focus of the mind's gaze. (Knowledge may also be incomplete in the sense that what is known cannot be fully specified by virtue of the knower's reliance on tacitly known clues and the tacit integration of those clues.) This study equates knowing and learning because to know most things is never to exhaust the potential to learn more

about them and their applications. Polanyi has explained,

> The dynamic impulse by which we acquire understanding is only reduced and never lost when we hold knowledge acquired and established by this impulse. The same impulse sustains our conviction for dwelling in this knowledge and for developing our thoughts within its framework. Live knowledge is a perpetual source of new surmises, an inexhaustible mine of still hidden implications (Polanyi, 1961:244).*

An important aspect of tacit knowing may be its capacity for explaining how new and different entities can emerge from the parts which comprise them. (A statement on page 10 of this study, by Smuts, having to do with the emergence of the whole from its parts is relevant.) Consider the presence of the expression on a face which is apart from and in addition to the separate features on the same face. Even though the expression on a face and its features occupy virtually the same locus in space, the two entities are distinct. The blind person using a cane "sees" with the joint meaning of the sense impressions at the cane's tip, not the individual impressions made by the butt of the cane on the palm and fingers. (These are Polanyi's examples. See 1966b:12-13.) A medical doctor making a diagnosis attends from individual symptoms to their joint meaning. Surely the doctor would believe that the entity (i.e., the diagnosis) toward which the efforts are directed is qualitatively different from the symptoms which comprise it. To say that there is no difference would be to reduce the skill of the doctor by equating the observation of symptoms with diagnostics. Polanyi, in

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*This quotation also appears on page 8 of the study.

Polanyi and Prosch (1975:29 and 140-143), cautioned against trying to explain living phenomena by studying only their parts. If one has a question about primroses, the answer must be in terms of primroses and not, for example, in terms of the positions and velocities of atomic particles. Hein (1976:2-7) pointed out that disputes between the analytic tradition and the holistic tradition are widespread in biology as well as in other fields of study. Such disputes concern methodological questions as well as questions about the nature of reality. Representing the holistic position, Sinnott (1966:51 and 57) said, "An organism is not simply a mixture of compounds but a living architecture, no part of which can be understood except with reference to the whole." Sinnott believed that organisms are not simple aggregates of parts, they are integrates. Commoner expressed a similar notion when he said,

> The simple sum of the separate molecular events is insufficient to represent the living whole. . . . No matter how many ingredients they may contain, the biochemist's test-tube mixtures are dead; but these same ingredients, organized by the subtle structure of the cell, comprise a system which is alive (Commoner, 1966:41).

The preceding examples are presented to help show that holistic entities which are distinct and qualitatively different from the parts which comprise them may indeed emerge from their parts. Illustrations of perceptual-conceptual emergence as well as the emergence of living organisms from the nonliving are given. In the language of tacit knowing, it is misleading to characterize an entity as being an aggregate of certain parts since knowledge is never complete and therefore all the constituent parts are not

specifiable. Furthermore, the process of combining parts which results in the emergence of new entities is a tacit and therefore unspecifiable act of integration, not simple addition or aggregate accumulation.

Polanyi's tacit knowing suggests a dynamic interaction between the two terms of awareness and the knower, who causes the subsidiary or proximal term to bear on the focal or distal term. The subsidiary term, the focal term, and the knower form a triad the changing shape of which determines the acuity of perceptions, the skillfulness of behavioral acts, and the lucidity of conceptions. Polanyi, in Polanyi and Prosch, depicted the fragileness of the triad when he said,

> [T]he knower can dissolve the triad by his own specific action: by merely looking differently at the subsidiaries. The triad will disappear if the knower shifts his focal attention away from the focus of the triad and fixes it on the subsidiaries (Polanyi and Prosch, 1975:38).

The inexhaustible combinations of clues and focal objects, the facility with which clues can become focal objects, and the ease with which clues wax and wane in importance in the mind of the knower all begin to suggest what daily experience teaches regarding the limitless and changing variations of perceptions, skills, and conceptions both within solitary individuals and between numbers of them.

Commoner (1966:33 and 41-43) reported that classical biology was grounded in the study of intact living organisms, not in the analysis of their parts. Hein (1976) noted the substantial contributions which holistic methods of inquiry have made and are making in biology and called for the development and use of similar methods

in education in order to understand better such complex phenomena as learning and teaching. One of the purposes of this study is the conceptualization of a holistic technique for the evaluation of educational classrooms. The classroom is a comprehensive entity which emerges out of the individual behaviors, intentions, and emotions of the teacher and students which comprise it. It exists as an integrate, not an aggregate, of these constituent parts and is identifiable as distinct and qualitatively different from these parts. Methods of evaluation which focus exclusively on the particulars (e.g., communication patterns, the uses and types of educational objectives, and test scores) which help to comprise the entity designated the classroom may not be able to perceive and describe the entity in terms of these particularistic abstractions. More complete or holistic observations which seek to gather and integrate a host of clues (some of which are specifiable and some of which are not) into their joint meaning which is the classroom may be necessary before judgments regarding degrees of goodness and badness can be made.

Polanyi's inquiries into the nature of knowing have led to a kind of unified-field theory of knowing. He has postulated the same epistemological structure for sensory perceptions, motor skills, and mental conceptions. He has speculated that the same impulse which helps people acquire knowledge also functions as they hold that knowledge and seek to apply it. And he has asserted that a correspondence exists between the structure of knowing and the structure of

that which is known.* It may be that as a scientist much of the impetus for Polanyi's epistemological speculations came from his interest in scientists' pursuit of discovery. He has not, however, restricted the concept of tacit knowing to science alone. The accuracy of this statement is suggested by the broad variety of sources from which Polanyi has drawn examples of instances of tacit knowing. Furthermore, his most recent extended work, Meaning (1975), was the culminant attempt to show how tacit knowing functions in the creation and enjoyment of works of literature, painting, sculpture, and stagecraft as well as in science. He has employed the explanatory power of tacit knowing to answer questions regarding the authoritative acceptance of mythical, religious, and moral beliefs in addition to those beliefs having to do with science. Indeed, the very breadth of his applications of the concept of tacit knowing lends ample support to a suggestion made throughout this study that Polanyi's explanation of the process of scientific inquiry and discovery may also explain the way artists proceed and the way all persons acquire and use knowledge.

Such a suggestion would seem to apply especially to those educational settings in which students pursue expressive and Type III objectives. That students learn by means of a process which is essentially similar to the way scientists pursue discovery and artists create may also apply, though to a lesser extent, to the

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*Although this last assertion is not discussed here because it lies outside the scope of this study, refer to Polanyi, 1966b: 29-52.

pursuit of simple educational objectives. If the way students learn is a personal and tacit act of creative discovery and imaginative problem solving, then it seems inappropriate and self-defeating to restrict students to the explicit instructional prescriptions of preordained, simple objectives. Moreover, evaluation methods which assess the success or failure of educational activity in terms of simple objectives may be relying on outcomes of educational activities which are secondary to and different from essential aspects of the learning and teaching process. (For a similar argument, see Broudy, 1972; Macdonald, 1974.)

Polanyi, in Polanyi and Prosch (1975:98-99), likened the creation of art to the pursuit of discovery and problem resolution in science. The artist and the scientist seek to synthesize, what may seem to some, disparate and incompatible ideas and pieces of information by virtue of their ability to anticipate as yet only vaguely recognized meaning and coherence and to gather clues presumed to bear on this meaning and coherence. The object of focal attention is the potential work of art or scientific discovery. The focal object gradually assumes greater definition and clarity as subsidiary clues are gathered and caused to bear on it. By the same token, the clues change their appearance and meaning as the focal object changes its appearance and meaning. The dynamic interaction between subsidiary and focal objects which occurs when the artist or scientist causes the subsidiary to bear on the focal is the same interaction (see page 119) which occurs among all knowers striving to know. Like scientists, Polanyi said, "The poet starts with a problem that is

largely indeterminate at both ends: it is open in its aim as much as in the means it uses for achieving it" (Polanyi and Prosch, 1975:98). H. W. Janson, in Polanyi and Prosch, described the process more fully:

> . . . the creative process consists of a long series of leaps of the imagination and the artist's attempts to give them form by shaping the material accordingly. The hand tries to carry out the commands of the imagination and hopefully puts down a brush stroke, but the result may not be quite what had been expected, partly because all matter resists the human will, partly because the image in the artist's mind is constantly shifting and changing, so that the commands of the imagination cannot be very precise. . . . In this way, by a constant flow of impulses back and forth between his mind and the partly shaped material before him, he gradually defines more and more of the image, until at last all of it has been given visible form (Polanyi and Prosch, 1975:98-99).

The interaction which occurs between the subsidiary and focal terms of knowers, scientists, and artists as they cause the subsidiary to bear on the focal may be the same interaction which occurs between the developing educational aims and strategies of good teachers. (A discussion on the interplay that takes place between aims and strategies appears in Chapter I on page 11.) Indeed, Polanyi, in Polanyi and Prosch, saw a kinship between the process of discovery and creativity in science and art and the natural growth of a child. He said,

> They [science and art] search for means of solving a problem . . . and they pursue this quest while continuing to shape the problem so that it will better fit the means for solving it. The way a child grows to a higher level of physical maturity provides us with an illustration of how this kind of creative process, involving a continuous interaction of both means and ends, operates (Polanyi and Prosch, 1975:99).

The similarity between the process involved in science, art, and ordinary knowing and the processes involved in educational endeavors

which feature expressive and Type III objectives seems particularly striking.* Students groping or stretching themselves toward objectives and solutions to objectives which are initially only vaguely seen closely resemble scientists and artists amidst their pursuits. Teachers are probably able to see objectives and potential solutions with somewhat more clarity than students, at least initially. However, this is not to exclude teachers from the process of groping and stretching. On the contrary, docemur docendo--we are taught by teaching. Furthermore, Eisner (1969:16; 1972:582) said that the substance of outcome evaluations of expressive and Type III objectives must occur after the fact since these kinds of objectives put a premium on the unique and unexpected and cannot be preordained. (See page 92.) That Janson, in Polanyi and Prosch, perceived a similar situation regarding artistic creation substantiates further the suggestion that some educational processes are similar to the process of knowing employed by scientists, artists, and ordinary persons. Janson said,

> It [the making of a work of art] is a strange and risky business in which the maker never quite knows what he is making until he has actually made it; or to put it another way, it is a game of find-and-seek in which the seeker is not sure what he is looking for until he has found it (Polanyi and Prosch, 1975:98).

The prospect of explaining some teaching activities in terms of a knowing-learning activity was raised at the beginning of this

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*Eisner (1969:16) expressed the belief that expressive educational objectives are generally used more frequently by teachers than are simple instructional objectives.

study. (See pages 7 and 12.) If tacit knowing can explain the process of artistic creation and if some teaching is an artistic process, then tacit knowing may be able to explain some teaching. If it can be shown that some teaching is substantively similar to knowing-learning, that is, if they can be shown to have the same epistemological structure, then an evaluation technique which also has this structure may have substantial explanatory power and utility for those engaged in teaching and the study of teaching. In addition, if it is "good" teaching which is patterned after learning (and the assumption expressed on page 6 of this study is that it is), then such a technique may even be able to help explicate good teaching.

Greer (1974) argued that teaching is an artistic process, and he identified several artistic aspects of teaching. However, his descriptive statements sometimes lack substance and do not always represent explanations. Polanyi's concept of tacit knowing may have the capability of explaining artistic aspects of teaching and of thus establishing a similarity between knowing-learning and teaching. Greer described teaching as an artistic process of discovery and problem resolution. (See, for example, Greer, 1974:18-21 and 50-55.) In order to understand discovery, Greer said that the inside stance or personal mode of knowing must be understood, yet he did not attempt to explain such knowing. It may be that inside or personal knowing can be explained in terms of Polanyi's knowing through indwelling.

The inside stance or personal mode of knowing occurs when teachers interiorize or assimilate clues which are subsidiarily known

into themselves and attend from them to objects or activities of focal attention. Being "in tune with this preverbal stream" (see page 95) is the same as Polanyi's awareness by relying on (clues) which is distinct from awareness by attending to (focal objects). Greer was correct when he recognized that the inside stance or personal mode of knowing could not be made fully explicit and could not be reconstructed in a mechanistic or formal scheme. However, he may have been in error when he attributed the personal mode of knowing to preverbal or preconscious levels of awareness. As noted on pages 104 and 105 of this study, all clues are only tacitly known, regardless of their actual or potential level of consciousness, as long as they are known by relying on them to know something else. That is, clues are not explicit, not because they belong to some level of consciousness, but because they function as clues.

Tacit knowing and Polanyi's concept of subsidiary awareness may have the capacity for explaining how it is possible for teaching to be an atheoretical process. (See Greer, 1974:11 and 42.) Teachers do not teach by focusing on a specified set of theories, beliefs, and skills any more than knowers, scientists, and artists must have definite, articulated material in mind before and as they proceed. Such explicit rules and dicta for behaving and thinking function as background information in actual situations, guiding but not directing teaching and other forms of knowing. Polanyi's (1965:14-15) observation that rules of phonetics, grammar, and style condition but do not determine the contents of speech is a good example of the way rules and theories function in knowing and applications of

knowledge without being explicitly identified by their users and without controlling their own use.

Greer (1974:50-55) said that teaching is a process of problem resolution, but he did not explain the process. He derived from Ecker a definition of teaching as "qualitative problem solving."* Regarding this process, Greer said,

> It is the controlled process of instituting qualitative relationships among the commonplaces of teaching as a means to the achievement of modifications in the learner judged in qualitative terms as characteristic of a whole (Greer, 1974:55).

He said that teachers "order their educational means and ends," "think in a kind of qualitative way," "try to work within the thought processes of their pupils," and "proceed on the basis of a general feeling." He continued by saying that formal laws of logic do not seem "directly applicable" to qualitative thought processes, and he likened the feeling which accompanies teachers as they devise educational ends and means to the feeling which accompanies artists engaged in the creation of art. Greer suggested that this feeling has an "amorphous beginning, rises to a peak, and finally achieves resolution."

That Greer and Polanyi are in agreement seems likely, yet Polanyi's conceptualizations are perhaps more substantive and satisfying. In the language of tacit knowing, teachers anticipate educational ends (aims) and means (strategies) broadly at first. As a result of gathering and integrating clues presumed to bear on

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*David W. Ecker is the author of "The Artistic Process as Qualitative Problem Solving" reprinted in Readings in Art Education, Elliot Eisner and David Ecker, (Eds.), Waltham, Massachusetts: Blaisdell Publishing, 1966, pp. 57-68.

the aims and strategies, these two entities are perceived with increasing clarity. It is the teacher who causes the clues to bear on their joint meanings (aims and strategies) and a dynamic, three-cornered interaction among the teacher, clues, and focal objects (aims and strategies) results. Moreover, a similar triadic interaction takes place among the teacher, the aims, and the strategies. (See page 11.) That is, as a teacher pursues aims it may be necessary to change strategies, and as strategies are changed aims may have to be adjusted. The process is thus open at both ends. The process is made complete by teachers seeking to dwell in individual students and groups of students in order to know students as beings having a consciousness commensurate with their own and in order to develop appropriate aims and strategies for the students.

A final aspect of teaching as a process of discovery, as it is described by Greer, may lend itself to explication by means of Polanyi's concepts. As teachers seek to establish and control qualitative relationships among the commonplaces of education, what furnishes the nucleus around which aims and strategies can form; around what does the amorphous feeling which accompanies teachers condense; what is the whole against which modifications in the learner are judged? In Greer's words, that which gives "impetus and direction" to the effort to establish qualitative relationships is the guiding yet distant, vague, and shifting image of a whole person or an educated man. He likened this visionary commitment by teachers to the commitment of artists for potential and materializing paintings, symphonies, and dramas (Greer, 1974:37). Polanyi's solution to Meno's

dilemma and his explanation of scientific discovery seek to establish the ability of knowers to anticipate meaning and coherence or to have an active foreknowledge of an unknown reality. Polanyi argued that knowers have a tacit awareness of a problem and a solution without being explicitly aware of either. Eiseley, writing as a scientist and an historian, regarded the ability to anticipate as having been essential to the discovery of the theory of organic evolution:

> As a young man somewhere in the high-starred Andean night, or perhaps drinking alone at an island spring where wild birds who had never learned to fear man came down upon his shoulder, Charles Darwin saw a vision. It was one of the most tremendous insights a living being ever had. . . . None of his forerunners has left such a message; none saw, in a similar manner, the whole vista of life with quite such sweeping vision (Eiseley, 1961:351-352).

It is this anticipatory ability, born of the intuition, which allows knowers to acquire new knowledge, scientists to discover, and artists to create. It may be this same ability which enables teachers to sense the beckoning image of a whole person or an educated, sensitive human being and thus to guide their imaginative development of aims and strategies.

Broudy's (1972) attempt may represent the most informed effort to date to apply Polanyi's concept of tacit knowing to education. Broudy, like Macdonald (see pages 62 and 63), observed that educational goals have in effect been miniaturized in order to make them measurable. Both men agreed that tests used in outcome measurement misrepresent the nature of knowledge and its uses in nonschool activities. Broudy (1972:221-222) posited five separate, though not mutually exclusive,

"life uses" of schooling. These are replicative, interpretive, appreciative, associative, and applicative uses. Replication is the simplest use of school learning and merely entails the recall and duplication outside of school of information learned in school. There is no alteration in or transformation of the information between its acquisition and use in school settings and its use in nonschool settings. Replication is what students refer to when they say they are "regurgitating" information back to a teacher. (Interestingly, it is rare that one hears others remark that they are regurgitating information out into the working world.) Broudy suggested that the ability to replicate information, both in principle and in fact, has become the sole, or at least major, criterion for determining what should be taught and what has been learned in schools (1972:220-221). It may be that replicative uses of information predominate in schools but no where else.

Rather than replication, Broudy argued that interpretation is the most important and "central" life use of schooling. Persons are using information interpretively when they evince their understanding of a situation by being able to classify it within a larger category, hypothesize regarding its causes and effects, and recognize it as being subsumed by a law or doctrine (1972:221). Broudy said that replication is probably not the major life use of schooling because 1) people forget, in a rather short time, much of the material they learned in school and 2) nonschool tasks are rarely the same as school tasks (1972:228). The questions arise, if much of what is learned in school is forgotten and if learning must be transformed

before it can be applied outside of school, how is learning utilized and is formal schooling of any use? The answer to the second question is obvious (else dismiss the schools and with them the democracy), and for the answer to the first question, Broudy invoked Polanyi's concept of tacit knowing.

Tacit knowing may be an explanation of how information can function in nonschool uses in spite of forgetfulness and in ways which are different from the way in which it was learned. Broudy (1972:228-232) noted that Polanyi posited two distinctly different kinds of awareness, focal and subsidiary. He noted that it is the function which clues perform in the act of knowing which renders them clues and that information functions as clues regardless of its level of consciousness. What was learned in school was learned focally; it was the object of attention. It can still be the focal object in nonschool situations, but chances are it will not be. In nonschool activities, these focal objects most probably become clues to knowing something else. Hence they are known subsidiarily and can still be utilized even though they are not or cannot be explicitly recalled. In short, tacit knowing provides for the normal phenomenon of forgetting without rendering what is no longer explicit lost and unusable.

Tacit knowing also accomodates the universally recognized discrepancy between the setting and context of school learning and the setting and context of out-of-school applications of school

learning.* Clues are known by relying on them to know something else. When focal objects become clues their appearance and meaning changes. Clues to knowing something else are themselves known in terms of or in the context of the objects of focal attention. (Refer to the statement on page 106 with regard to knowing the body in terms of the objects to which one attends from the body. Also see Polanyi, 1966b:16.) As settings and contexts are transformed, that which is known is also transformed in appearance and meaning. Meaning is not lost, it is merely changed. Moreover, it is the knower who causes the subsidiary to bear on the focal. As the knower changes, over time, so does the appearance and meaning of what is known. Polanyi's concept of tacit knowing may have the capacity to explain the continued usefulness of information even though much of it has been forgotten. Tacit knowing may also have the ability to explain the transformation of information so the information is applicable in novel and changing situations.

A recent effort to apply the concepts of Polanyi to education was made by Lorimer (1977). He asserted that a thorough understanding of tacit knowing "can found a revolutionary pedagogy" (1977:564). Essentially, Lorimer's approach was to draw attention to the dynamic part which subsidiary awareness plays in knowing and the constructive

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*Even in vocational training programs which try to replicate job situations, school machinery and equipment soon become outmoded, clients are more like patrons than real, independent-minded customers, and the profit motive does not underlie rules and procedures. In short, mighty efforts notwithstanding, there remains a gap between the world of school and the world of work.

part which it can play in education. Such an approach is in accordance with the two-term structure of knowing, which suggests that subsidiary awareness or awareness by relying on supplies the underlying foundation for focal awareness. Lorimer drew attention to the size, variety, and importance of subsidiary information which each child brings to the classroom. Since children and all persons rely on the subsidiary to attend from it to the focal and since the subsidiary aspect of knowing is continually affecting the perceptions and thoughts of children anyway, teachers should learn to capitalize on it and make use of it.

According to Lorimer (1977:565-566), teachers should make use of subsidiary awareness by "grounding" instruction and the classroom environment in the backgrounds and experiences of their students. Grounding education in the experiences of students depends on bringing some subsidiary aspects of experience into focal attention. Lorimer said that for teachers to become focally aware of what some of these subsidiary aspects are they must engage in "sensory thinking." Reminiscent of Eisner (1977:349-354), Lorimer (1977:566-567) recommended that teachers be attentive to verbal, nonverbal, physical, social, and cultural constituents of experience which influence and color perception and thinking. A focal awareness by teachers on these normally subsidiary aspects of experience is necessary if teachers are to improve the pedagogical process and if students are to learn to think critically about subsidiaries. In the first instance, teachers help themselves by viewing their efforts and the classroom through the eyes of their students, and in the second, students

learn to focus a vivid and discerning awareness on the foundations of thinking, foundations which are too often taken for granted and accepted placidly.

CHAPTER V

CONCLUSIONS AND A CONCEPTUAL MODEL

> If we have erred, let them be errors of youth and excess and not those of age and loss of nerve.
>
> A young man

The purposes of this study are to explore the similarity between knowing in science and knowing in the arts and to conceptualize a technique for the evaluation of educational classrooms based on this similarity. It is not the purpose of this study to say what "good" teaching is. Rather, the goal is to devise a technique of evaluation which might be used to help discover what it is. The model enunciated here can perhaps be used to expand the knowledge base regarding teaching and to add to both the science and the art of teaching.

It is perhaps misleading to talk about good teaching as if there is an Aristotelian essence to it which, when discovered, can serve as a universal rule or style or method of teaching. On the contrary, this study does not postulate such an essence, and indeed it suggests that science itself, the paradigm of knowing and knowledge, may not be able to make claims of universality regarding either its methods or the information which it generates. If science cannot make such claims, then the implication for practitioners in other fields is that they ought to cast a dubious eye whenever claims of universality are made. What this study does seek is an evaluation technique that is sensitive to a broad range of data which can be

apprehended under a variety of conditions. In this way, perhaps good teaching can be comprehended as both a product of and a contributor to the unique setting and context in which it occurs.

Conclusions

This study has explored the bases of scientific and artistic knowing in search of a shared foundation between them. Moreover, it has argued that knowing and learning represent different states in a single epistemology. If the apparent extremes of human cognition (i.e., knowing in science and knowing in the arts) could be shown to be fundamentally similar by virtue of a single underlying structure common to both and if knowing and learning could be shown to represent a single epistemology having the same structure as science and art, then it might be possible and helpful to explain the acquisition of all knowledge in terms of this versatile structure or process. Polanyi's efforts to bridge the real or apparent gap between science and art have been invoked. Specifically, Polanyi's concept of tacit knowing, an example of the cognitive school of learning theory, has been employed to try to explain the acquisition and utilization of knowledge by students.

The following conclusions from Chapter II were reached: 1) Hypothesis formation in science proceeds on the basis of imagination and skillful judgment. 2) In science, methods for determining relevancy and coherence (including simplicity) are essentially personal. 3) Knowing in science relies on elements which are more judgmental than logically compelling; hence knowing in science, though admittedly

rigorous, lacks the fundamental objectivity, exactitude, and certainty popularly ascribed to it. 4) The process of discovery in science resembles the process of creation in art. The implication of these conclusions for students and educators is that the same personal, judgmental, and imaginative process which helps scientists and artists perceive problems, apprehend relationships, and devise solutions may function in ordinary acquisitions and utilizations of knowledge.

Tacit knowing is the concept which has been used in this study to establish not just a resemblance but a substantive similarity between knowing in science and knowing in the arts. If the same epistemological process or structure could be found underlying and pervading science and the arts, then the same or a closely related structure might also underlie less extreme and more ordinary instances of knowing, especially if the structure were pervasive. Among these less extreme instances of knowing are the acquisition and utilization of knowledge by students. This study has suggested that knowing-learning is a fundamentally personal and tacit process which functions in all instances of knowing, whether perceptual, conceptual, or physical and whether scientific, artistic, or otherwise. It is a purposive and imaginative act of anticipating meaning among perplexing but seemingly disparate bits of information and of integrating these bits into understandable wholes.

Multiple conclusions were derived from the contents of Chapter IV. Because of the complexity of human cognition, these conclusions should be regarded as primitive and therefore tentative; 1) Discovery in science, which Polanyi called the paradigm of

scientific knowing, and creation in art both proceed by means of the process of purposive and imaginative anticipation followed by integration of parts into wholes. That discovery and creation manifest the same epistemological structure establishes a substantive similarity between them. 2) The process of knowing-learning which explains discovery in science and creation in art also explains the ordinary acquisition and utilization of knowledge by students. This is especially apparent among those students in pursuit of expressive and Type III objectives. It is less clear with regard to students and simple educational objectives. 3) The process of knowing-learning used by scientists, artists, and learners is also used by some teachers to teach. That knowing-learning and some teaching manifest the same epistemological structure also establishes a substantive similarity between them. The implication of these conclusions for educational evaluators is that a technique of evaluation utilizing the same versatile structure of epistemology may have substantial explanatory power for those engaged in teaching and the study of teaching.

Chapter III of this study has examined the character and status of conventional and unconventional methods of educational evaluation. The following historical kinds of conclusions were gleaned from this examination: 1) The field, or discipline, of educational evaluation is unsettled. Practitioners are in disagreement regarding, among other things, the purposes of educational evaluation, its underlying assumptions, its language, and its methodologies. 2) The variety of acceptable methodologies has grown during the past decade.

Conventional approaches are less associated today with approaches of convenience than they once were. 3) New approaches often incorporate personal judgment by evaluators as an intentional and legitimate part of their process. Some practitioners recognize that the acknowledgment and utilization of judgment does not render a method less scientific. These new approaches do less to try to determine and control teaching and learning and more to indicate how teaching and learning actually occur. 4) There is a need to identify and specify standards against which the merits of educational activity are judged, beyond mere personal preference and subjectivism. However, these standards do not need to be universal, fixed, and permanent. The implication of these conclusions for education and educational evaluators is that a variety of methodologies accepting a variety of types of data may lead to less rigidification of concepts and practices.

A Conceptual Model

The model of evaluation devised in this study is a holistic, as opposed to an analytic, technique. Rather than assay out a few, critical variables, this technique seeks more complete perspectives on educational activities and renders judgments according to these perspectives. A holistic model is appropriate for the use proposed for it in this study: observation of classrooms in order to add to the knowledge base of education by trying to discover what good teaching is instead of imposing a definition of what it may be. By examining isolated kinds of information, analytic techniques imply

that some kinds of information are more important than some others and that good teaching is definable prior to and even in the absence of observations of actual instances of educational activity. It might be premature for educators to restrict their vision in this manner. Moreover, good teaching may emerge from a variety of variables interacting together rather than from a limited few which have been separated for the purpose of facilitating the observation of them.

In this study, the object of educational evaluators' scrutiny is the classroom. The classroom is an emergent and comprehensive entity which results from the integration of an indefinite number of variables or clues. The idea of the dynamic emergence of a classroom group from the variables which compose it is in harmony with ideas expressed by Getzels and Thelen (1960:65-82). Though classrooms are dynamic and fluid, they nevertheless have an abiding quality to them. Eisner (1977:355) noted that despite their fluidness, classrooms have pervasive and enduring characteristics which can be observed over time. Thus there is support for the belief that this quality or atmosphere or emergent entity termed the classroom persists and is recognizable despite rapid and short-term fluctuations and deviations.

The classroom represents an integration of impressions by evaluators. Evaluators and evaluations refer to the classroom in the same way that words refer to their meanings. That is, meanings of words are apart from and in addition to the words themselves. The classroom is apart from and in addition to the parts which comprise it. To perceive the classroom at all, to perceive it with fidelity,

and to begin to explain it, evaluators must view intact classrooms. As Grene (1969a:17)* observed, some phenomena have resisted analytical explanation; understanding comes only from reference to wholes. She said that in other instances, no matter how pronounced a person's analytical propensity might be, ". . . we must often examine the whole in order to find the part-determined explanation we seek."

Lastly, holism suggests coordination and interrelation between and among the parts comprising an entity. (See Eiseley, 1961:86, 91, and 334-336.) Instead of being separate from each other and in disaccord, parts are connected and entwined. A change in one brings changes in the others. Thus to be perceived and comprehended, a holistic entity such as the classroom must itself be perceived more completely or holistically.

Naturalistic investigation is appropriate for the pursuit of discovery. By means of natural observation, it may be possible to describe and judge teaching and eventually to discover some of those elements and conditions which help comprise good teaching. The evaluation technique of this study is meant to capture students and teachers in the process of learning and teaching. On the assumption that a process cannot be comprehended by stopping it or by otherwise altering it drastically, evaluators using this technique should try to blend into the normal classroom activity, becoming as unobtrusive as possible. Evaluators using this technique would not engage in

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*Though cited only this one time, Anatomy of Knowledge, which was edited by Grene, contains several papers directly pertaining to the arguments and beliefs expressed in this study.

practices designed to control or induce change in the activity being scrutinized.

Blending into classroom activity requires ample time. Evaluators sometimes attempt to record and evaluate educational activities in remarkably short periods of time. The technique developed in this study seeks to capitalize on that kind of understanding which may only come with intimate familiarity. Hence the technique may consume several hours a day for several weeks. In a word, the technique seeks those teaching methods which endure, and it is itself long-lasting. Moreover, just as Stake (1967a:528) saw fit to consider classroom "antecedents," this technique recommends that evaluators familiarize themselves with the history of a class so they can describe, judge, and come to understand its present condition. The historical search may include, among other things, examination of student and class records, the administration of questionnaires, and personal interviews. However, it does include experiential information gleaned by evaluators from their (alert) presence in a class.

The principle of eolithism, discussed on pages 66 and 67, leaves open the possibility of the gradual evolution of <u>educational aims</u> and <u>strategies</u> by teachers to fit the unique needs of students and groups of students. Intimately familiar evaluators are able to perceive and follow such an evolutionary process of instruction, whereas the process might be too subtle for and lie below the sensitivity threshold of less time-consuming approaches. A long-lasting technique also allows evaluators to observe students as they "stretch"

themselves toward objectives which guide but do not direct and which condition but do not determine. Such a technique affords evaluators the opportunity to observe spontaneous and evolving classroom developments as well as preordained outcomes. Reminiscent of Stake (1967a:532; 1975:15), evaluators using the technique described in this study have the opportunity to investigate their own hunches and to follow up that which their observations suggest; they are not restricted to planned and stated objectives. Rather, they are only restricted by their ability to ask probing questions, to perceive with acuity, and to uncover answers.

This study has criticized conventional evaluation for doing too much to determine how teaching occurs instead of being patterned after learning and teaching. Specifically, many conventional methods merely assume that students learn by some form of stimulus-response, and they require teachers to preordain objectives and outcomes. Under such a scheme, teaching is concerned with providing the proper stimulus or series of stimuli in order to evoke planned responses, and evaluating is a matter of measuring responses. That a method of evaluation has its roots in a learning theory is probably not a fault but a virtue <u>if</u> the evaluation identifies the learning theory on which it is based and <u>if</u> the credibility of the learning theory has been or is established. Importantly, even if the explanation of human cognition offered in this study is not deemed acceptable, future theorists should perhaps continue to seek ways of grounding methods of evaluation in theories of learning. Macdonald is cited on pages 63 and 64 of this study as suggesting that models of evaluation

be based on learning models. Advocacy of a particular theory of learning should also affect choices of teaching methods. Berliner and Gage (1976) chronicled various classes of theories of learning and discussed how these theories relate to teaching. Gagné (1976) emphasized the essentialness of maintaining a close and supporting connection between learning and teaching. With regard to providing instruction which is successful, Gagné said, "The essential task of the teacher is to arrange the conditions of the learner's environment so that the processes of learning will be activated, supported, enhanced, and maintained" (1976:42).

The model of evaluation devised in this study rests on a cognitive theory of learning, and arguments for the theory are presented in Chapters II and IV. According to the study, knowing and learning by students and all other persons are epitomized by the process which scientists and artists use to make discoveries and creations. As a consequence of this belief, the study advocates the normal and extensive use in classrooms of the kinds of objectives which Eisner called expressive and Type III. (A discussion of these kinds of educational objectives appears on pages 90-93 in Chapter III.) In describing the way educational activities ought to be, Eisner noted the lasting value of those activities in which learners have to "muddle through" an inquiry, clarifying the goals and means of achieving the goals as they proceed. Persons on the cutting edge of knowledge must muddle through because, quite obviously, no one knows the final answers. Yet Eisner argued that such inquiry need

not be restricted to adults and to those persons working near the frontiers of knowledge:

> Inquiry can be contextually defined so that the youngster can be at the cutting edge of inquiry for him. I would like to see us provide situations in a school where that cutting edge experience can be undergone . . . (Eisner, 1969:28).

Even if the teacher knows the answers to an assignment fully or at least in part, the learning situation can be contrived so that students have to investigate those answers.

It is sometimes said by teachers that such experiences bring a welcomed change from normal classroom activities, providing fun and diversity for students as well as the teacher. "Besides," they say, "students need to learn to use their imaginations; they need to learn how to think." The need to furnish such experiences may go deeper than the usual justifications however. Indeed, the study has tentatively concluded that imaginative and active knowing-learning, such as found in discovery, creation, problem solving, and inquiry, may underlie and pervade the acquisition and utilization of knowledge by students. Nor is it clear that the acquisition and utilization of factual information (i.e., that information which normally lends itself to transmission by the use of simple educational objectives) should be excluded from the process of knowing-learning. Rather than letting students "learn" to use their imaginations, education may itself need to learn how to allow students to use a largely stifled and innate ability which is fundamental in the process of knowing and learning.

The model of educational evaluation presented in this study

is bifurcated into description and judgment. Description is meant to be complete or holistic; it represents impressions made on evaluators as they envision an entity termed the classroom; and evaluators are to be natural observers who pattern their method of observation after the methods of learners and some teachers. But what about judgment? On what basis do evaluators judge the merits of educational activity? By what standards are some endeavors deemed better than others? The question of standards is indeed "sticky." To say that evaluation requires standards is unnecessary because the requirement is obvious. Standards are essential. Yet asking for standards is like asking for a definition of good teaching: if standards could be specified, then good teaching could also be specified, at least in principle.

Teaching is not like running a footrace. If it were, evaluators could simply use their stopwatches to measure how well a particular teacher does and compare that performance to the performances of other teachers by means of an absolute standard such as a world's record or by means of the best performance ever reported by a teacher in the same category. In the first place, this study offers an alternative to quantitative methods of evaluation. "Stopwatches" of evaluation may yield too narrow a view of educational endeavors. Like medicine two centuries ago (see pages 84-85), education ought to strive for careful, thorough, and more complete observations. To do this, educational evaluation should record qualitative information as well as quantitative. Some evaluation should rely on the depiction in words of classrooms by recognized experts who use their own

judgment in deciding what to record, how to describe it, and what value to place on it.

In the second place, while the model enunciated in this study incorporates judgment unmasked by quantification and presented baldly in words, it does not try to set standards. On the contrary, the model is to be used to discover standards so that a definition of good teaching can be developed, not imposed arbitrarily or otherwise. Until now, specification of standards in advance has seemed essential in order to conduct evaluations. The decision to hold the specification of standards in abeyance is based on three beliefs: 1) Acceptable and satisfying standards have not been specified by anyone to date and therefore cannot be invoked. 2) Valid evaluations can be conducted with tacitly known standards held by recognized experts who are themselves performing the evaluation. 3) Fixing standards in advance has led and will continue to lead to observations which are incomplete because they are biased in the direction of the standards. By relying on experts who possess an intimacy with education far deeper than even they can tell or make explicit (e.g., educational connoisseurs), education may be able to evolve a definition of good teaching and to discover and specify the standards on which it is based.

Most evaluators and efforts of evaluation have assumed the explicit identification of standards in advance of the evaluation to be an essential step in the process. The tendency to assume that standards are either known and therefore identifiable or to assume that they are not known at all denies a third possibility which is that standards can be known tacitly and because of their tacitness

they are not identified. Evaluation without standards is not evaluation. However, it is not necessary for standards to be specified in order for them to function legitimately and validly in the process of evaluation any more than it is necessary for clues to be specified in order for them to contribute to the act of knowing a focal object. Polanyi's concepts explain how tacitly known information functions in the knowing of focal or explicit information. The eventual goal of educational evaluation may be to specify standards, but the means to that goal may be to utilize standards which are not now explicitly known.

An approach to evaluation which forthrightly relies on the judgments of recognized experts is open to charges of obvious bias and personal preference. On the other hand, a less obvious kind of bias is already at work among approaches which specify standards of teaching in advance. The specification may be arbitrary, and even if it is not, specification tends to fix the vision of evaluators and prohibit perception of the unexpected and the novel. (See Eisner, 1977:355.) Recall that the proposed use of this evaluation technique is not to decide whether a teacher should be rehired or whether a project should be refunded. This technique is used to add to the knowledge base of education. It is a technique from which educators can glean information. Eventually, when some of those conditions and components which add to the comprehension of teaching have been discovered and made explicit, this technique can be used to educate second-generation experts who can, in turn, apply the concepts locally for local needs. In the meantime, educators of the highest repute,

whether they are known primarily as evaluators or not, should bring their expertise and good judgment to bear on the phenomena occurring at the interface between teachers and students.

The study does not address itself in depth to a description of professional and personal characteristics of educational experts. It does suggest the need for persons who are at once schooled in the appreciation of teaching, yet who are naive in the sense that they exude a readiness to meet the unexpected and the surprising. They are persons whose knowledge about teaching approaches limits of the knowledge about teaching, yet who are acutely aware of these (and their) limitations.

As a mode of description and a basis for judgment, the adaptations of Eisner and his students of art criticism to educational criticism appear rich in creative potential. The work of one of these students, Greer (1974), is discussed in Chapters III and IV of this study. Greer argued that teaching is an artistic process whose nuances can be uncovered by applying the language of art criticism to contemporary school activities. Eisner's use of art criticism in educational evaluation may complement or round out conventional approaches. (Refer to Eisner, 1972; 1975; 1977. Also see pages 86-88 of this study.) Educational critics attempt to reveal that which educational connoisseurs have learned to appreciate. The language of critics is that of suggestion and implication, rather than translation. They rely on simile, metaphor, and analogy as they describe, interpret, and evaluate teaching and learning endeavors. Achilles (1977) said that connoisseurs rely on past experience as a

means of making current and critical judgments. Stake (1976) also put a premium on the experiential basis of understanding. His arguments for the use of case studies in social investigation are capable of opening doors and removing some traditional fixations. (Also see Stake, 1975.)

An evaluation scheme designed to remove fixations has been devised by Parlett and Hamilton (1976). They recommended a switch away from the conventional, "agricultural-botany" paradigm of evaluation to a "social-anthropology" paradigm. Parlett and Hamilton concluded that such a switch would result not only in changes of methodologies but in changes of basic suppositions, concepts, and terminology as well. They chose to discuss some of the personal attributes required of evaluators using approaches such as theirs. (See 1976:151.) Many of the changes in educational evaluation which Parlett and Hamilton said should occur are also embodied in the model developed in this study. That these changes or recommended solutions to problems were arrived at independently offers support to both the work of Parlett and Hamilton and the concepts of this study. The flowering of educational evaluation may be awaiting the maturation of these and methods like them, whether they are adapted from art, anthropology, history, journalism, philosophy, or some other field as much at ease with holism as it is with analysis.

Much has been said in this study about the need for an evaluation technique with the malleability to pattern itself after learning and teaching. Such a capacity would seem to be a fundamental

necessity for a technique which is used to try to make discoveries about teaching. The study concluded that knowing-learning and some teaching share the same epistemological structure, and it suggested that an evaluation model utilizing this epistemology might have substantive explanatory power for teachers and others who study teaching. Diagrams of this structure follow. While these diagrams are a product of this study and are unique to it because they have developed from the arguments of the study, the idea to diagram knowing, teaching, and evaluating came, in part, from Polanyi and Prosch (1975), especially Chapter 4, "From Perception to Metaphor," and Chapter 5, "Works of Art."

The epistemological process employed by scientists in pursuit of discovery, artists engaged in creation, and students absorbed in inquiry can be diagramed, basically, as in Figure 1:

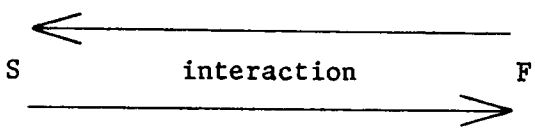


Figure 1

Knowing-Learning (Basic)

Figure 1 shows the process to be one of interaction between the Subsidiary and the Focal terms of awareness.* That which is known

*Subsidiary and focal are Polanyi's terms. They are explained in Polanyi (1961:239-242). A discussion of them also appears on pages 101-106 of this study. Page 119 of the study contains a discussion of the process of interaction between the two terms of knowing and the knower.

is a product of this interaction. The process is a purposive activity initiated by persons as they attempt to discover, create, or inquire into that which perplexes them and as they attempt to resolve the perplexity. Knower-learners grope or stretch themselves toward objects and ideas only vaguely seen at first. They do this by anticipating and focusing on an indefinitely known item by means of gathering and integrating an array of subsidiarily known clues which are presumed to bear on the focus of attention. This initial integration of clues causes the focal item to assume a tentative appearance and meaning. The tentative appearance-meaning of the focal item causes the clues to be seen and understood differently because clues are known in terms of focal objects. (See Polanyi's statement on page 106 of this study and also Polanyi, 1966b:16.) A shift in the appearance-meaning of clues results in a similar shift in the appearance-meaning of the focal item and so on. Furthermore, clues are added to and subtracted from their original array and subsequent arrays causing additional changes in the perception and understanding of the focal object, and these changes have their own repercussions for the way clues are seen and understood.

The full process is portrayed in Figure 2, an expanded version of Figure 1. The process of knowing-learning is an interaction between the focal and subsidiary terms of awareness in which a shift in the appearance and meaning of one of the terms causes a corresponding shift in the other. In a figurative sense (and perhaps in a literal sense as well) as the object of focal attention

becomes progressively more definite, the subsidiary clues and the focal object are brought closer together. Subsequent arrays of clues and subsequent generations of focal objects are Evolved terms of awareness as is noted in Figure 2:

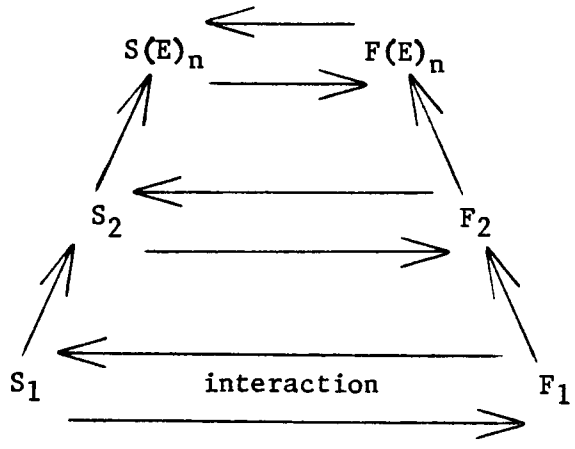


Figure 2

Knowing-Learning (Expanded)

Anytime the process is stopped, the terms "solidify" and the evolved subsidiary and focal terms are what is said to be known.

The same structure can also be used to depict the interaction between educational aims and strategies which occurs in some teaching. (A discussion of such interaction appears on pages 11 and 127-128 of this study.) In a spirit of eolithism, some teachers devise educational experiences which fit students and groups of students.

The process used by these teachers matches the way students learn. The process is depicted in Figure 3:

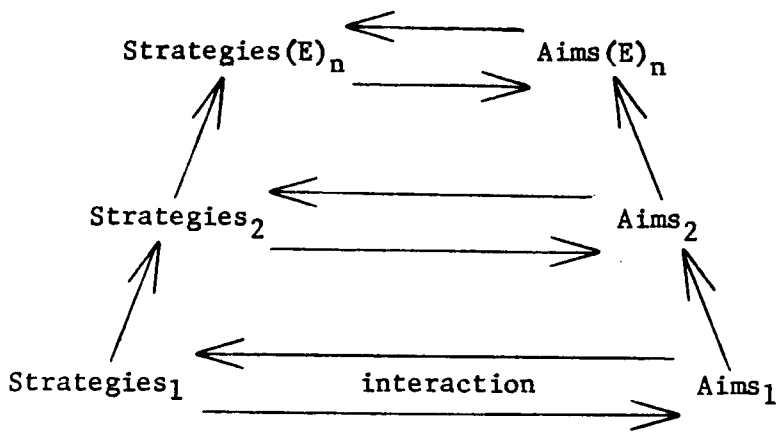


Figure 3

Teaching

In Figure 3, teachers initially perceive aims and strategies only vaguely. As they come to know their students (or, like artists, as they come to know the material with which they work in accordance with the ideas of Hawkins), teachers gradually evolve appropriate aims and strategies by causing the two to interact and grow closer together. The description by H. W. Janson, in Polanyi and Prosch, of artistic creation is a most satisfactory rendering of the spirit in which some teachers may teach:

> The hand tries to carry out the commands of the imagination and hopefully puts down a brush stroke, but the result may not be quite what had been expected, partly because all

> matter resists the human will, partly because the image in the artist's mind is constantly shifting and changing, so that the commands of the imagination cannot be very precise. . . . In this way, by a constant flow of impulses back and forth between his mind and the partly shaped material before him, he gradually defines more and more of the image . . . (Polanyi and Prosch, 1975:98-99).*

Evaluators trying to discover and comprehend those conditions and components which help constitute good teaching may find a similar approach to be a powerful tool. Just as some teachers "feel their way" in the development of appropriate aims and strategies and just as knower-learners gradually define what they know and the basis on which they know it, so may evaluators proceed as they attempt to perceive and then describe and judge the classroom. Evaluation is first a matter of description, and description depends on accurate perception, the method of which is shown in Figure 4:

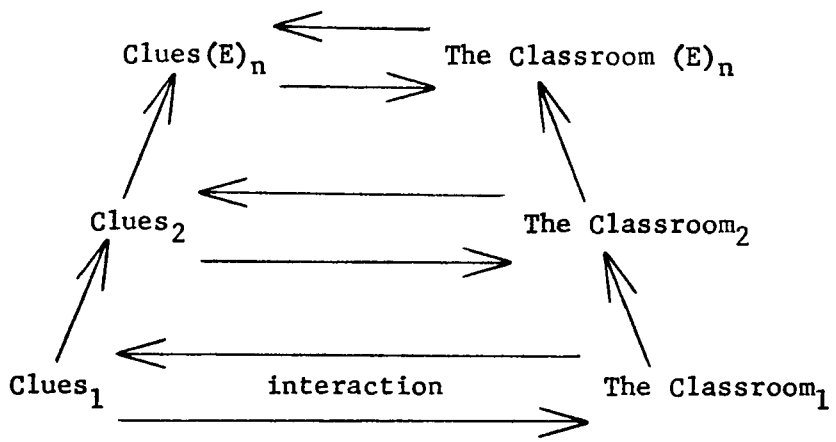


Figure 4

Evaluating (Description)

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*This quotation also appears on page 123 of the study.

Figure 4 indicates that evaluators initially perceive vaguely the holistic entity which this study has termed the classroom. By gathering and integrating an indefinite number of subsidiarily known clues, evaluators begin to focus the image of the classroom. By means of interaction between the object of perception and the clues which compose it, the classroom is perceived and made describable.

Evaluation is also a matter of judgment, and judgment depends on standards. Just as clues to knowing an object of focal attention function in knowing, although they are only tacitly known, standards can function in judging even though only tacitly known. Indeed, there may be no other way to begin to comprehend standards because the evolution of standards (and judgments as well) imbues and enriches them with additional meanings. By specifying and fixing standards in advance (i.e., by making them explicit in advance), evaluators may be depriving standards of the enhancement of their meanings. It may be that evaluation can end with a definition of good teaching and with some degree of faithful specification of standards; but it may not be possible to begin with a truly accurate specification of standards because the act of judging adds to the meaning of the standards on which the judgments are based. The answer lies in understanding the now familiar epistemological dynamic, which can be used to portray judgment of the classroom as well

as description. Figure 5 diagrams this dynamic:

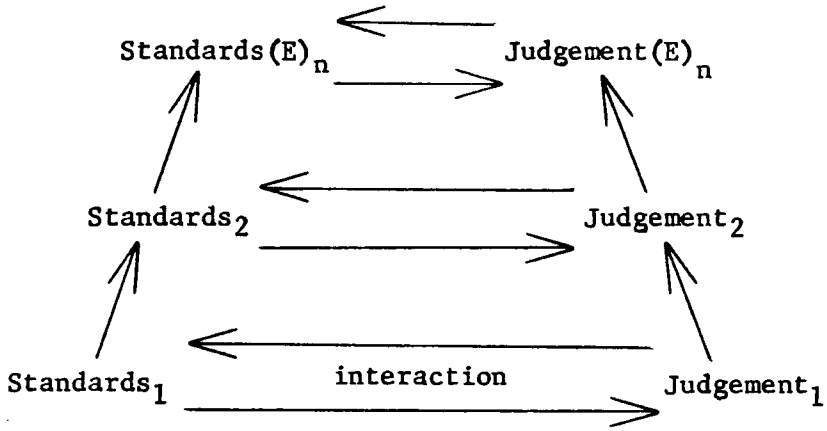


Figure 5

Evaluating (Judgement)

In Figure 5, standards which experts use to make judgments about the classroom both compose judgment and are composed by judgment. That is, judgment emerges out of the integration of the standards used to make it. And, standards derive their appearance and meaning from, or are known in terms of, the judgment. Hence until judgment moves to an evolved state (depicted by E_n), standards are imbued with lesser degrees of meaning. The gradual interaction between standards tacitly held by experts and judgments by these experts ends in improved judgment and more meaningful standards. Evaluators discover evolved standards and judgments by the same process that Meno discovered that which he did not already know: by having tacit awareness prior to explicit awareness. With evolved comprehension by those persons making evaluations may come an increased ability to specify what they knew but could not tell.

All that remains is to explain the dynamic which keeps the interaction between standards and judgments going. That judgments emerge from standards accounts for the left-right action in Figure 5, and that standards derive their appearance and meaning from judgments explains the right-left action. The upward movement occurs because a shift in the appearance and meaning of judgments, for example, results in a corresponding shift in standards which affects judgments and so on. Figure 6 is presented as a summary of the process of knowing-learning, some teaching, and evaluating. The position in the Figure of each representative of the process with respect to the position of the other representatives indicates that teaching should accommodate learning and that evaluating should directly accommodate teaching and thus indirectly learning.

This study has sought to develop a technique of evaluation which utilizes the skillful judgment of experts. It has argued that all knowledge is grounded in personalness and tacitness and that such a technique of evaluation merely legitimizes processes which are constantly occurring in so-called objective methods anyway. Yet the study has opposed mere subjectivism and personal preference. Glass, in Starkman and Bellis, succinctly stated an essential argument and position of this study:

> The hobgoblin of "subjectivity" can still be invoked to threaten the lay audience, even though it has been a dead issue in the philosophy of science for decades. . . . Every act of measurement, experimental design, hypothesis formulation, or data interpretation in scientific inquiry involves human judgment; indeed they may even involve aesthetic and, particularly, value judgments. In this

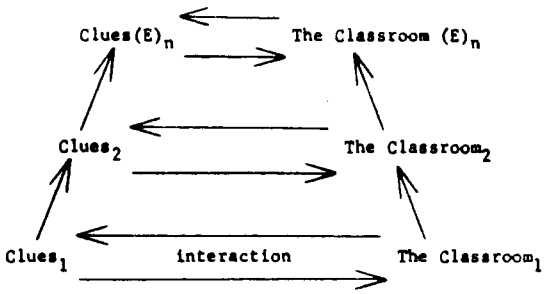


Figure 4

Evaluating (Description)

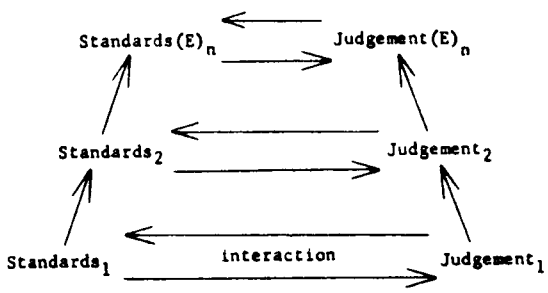


Figure 5

Evaluating (Judgement)

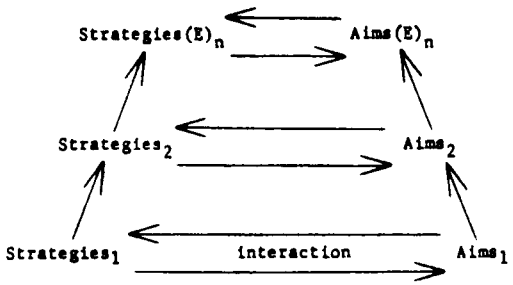


Figure 3

Teaching

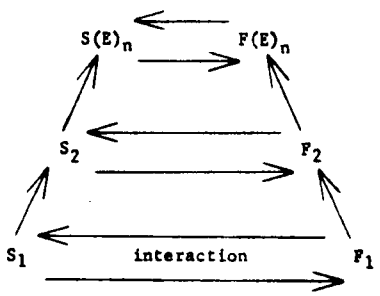


Figure 2

Knowing-Learning (Expanded)

Figure 6

Summary of Figures 2 through 5

> sense, all science is subjective. The only "subjectivity" one need fear--both in science and in educational evaluation--is capricious and unsubstantiated opining (Starkman and Bellis, 1977:330).

How can the technique of this study avoid capricious and unsubstantiated opining? On what authority can the judgments of experts be based other than that of their own expertise? And perhaps most difficult of all, how can a judgment which is in actuality valid be recognized as such? Eisner (1975:16-19; 1977:354-356) asked whether his approach to educational evaluation, and unconventional approaches in general, could be trusted; Greer (1974:91-93) ruminated about how the validity of his method could be increased; and Stake (1975:22) recommended the use of multiple observers to improve the reliability of responsive evaluations.

Eisner and Greer discussed two kinds of corroboration, both of which may be useful: structural and multiplicative. Structural corroboration is the systematic gathering of numerous clues and pieces of information which point toward and support a conclusion. All the evidence supports the plausibility and validity of a conclusion. After it has been substantiated structurally, a conclusion can be maintained within a reasonable degree of doubt. Systems of science and jurisprudence utilize structural corroboration. In science, speculations and proposed explanations must be in harmony with laws and accepted theories. Explanations which violate or contradict accepted views of the universe are suspect and probably due for rejection. Multiplicative corroboration, in contrast, is the confirmation of a belief as a result of multiple observations, whose

outcomes are the same, of a single phenomenon or set of phenomena. When the scientific community requires replication of experiments and when justice demands the concurrence of twelve jurors, they are relying on multiplicative corroboration.

The key to replication and confirmation by multiple observation is control of conditions, and the model of evaluation presented in this study seeks to partake of the process of teaching and learning without controlling or even altering the process. Such a delimitation may reduce or prevent the possibility of multiplicative corroboration. On the other hand, if the classroom is an abiding entity and a useful concept, then it may be possible for an evaluator or a group of evaluators working independently of each other to observe and recognize it again and again over time. That an entity can be observed reliably manifests what Eisner (1975:18-19; 1977:354-355) called "referential adequacy." In this case, multiplicative corroboration is a test of the adequacy of both the object of the observation and the observation itself. The classroom and its constituents are empirical objects.

The need to structurally corroborate descriptions of and judgments about the classroom would seem to represent fewer intrinsic problems because the entity and the judgments are themselves integrations of clues and standards which bear on the entity and the judgments. The entity termed the classroom and judgments about it emerge from the clues and standards which compose them much as conclusions and verdicts emerge from the evidence which bears on and composes them.

It is with this synthesis of ideas that the study has completed

its purpose of conceptualizing a model of educational evaluation. That the model was to be based on a similarity between knowing in science and knowing in the arts and that evaluation should perhaps be influenced by teaching and learning suggested an epistemological model. Such has been the nature of the model devised in the study.

CHAPTER VI

SUMMARY AND RECOMMENDATIONS

> On with it then, and finish the job! Be as eager as you were to plan it and do it with whatever you have.
>
> St. Paul

Summary

This was a conceptual study about educational evaluation. Its purpose was twofold: 1) to explore the similarity between knowing in science and knowing in the arts and 2) to conceptualize a technique for the evaluation of classrooms based on this similarity. It was suggested that educational activities ought to be grounded in how students know and learn. It was maintained that some teaching methods are epistemologically similar to learning methods. And it was argued that a technique of evaluation which is capable of patterning itself after such learning and teaching might have substantial explanatory power for those who study teaching. The works of Polanyi furnished the necessary and versatile theory of learning.

Chapter II utilized the philosophy of science to explore likenesses between discovery in science and creativity in art. Four conclusions were gleaned from Chapter II: 1) Hypothesis formation in science proceeds on the basis of imagination and skillful judgment. 2) In science, methods for determining relevancy and coherence (including simplicity) are essentially personal. 3) Knowing in

science relies on elements which are more judgmental than logically compelling; hence knowing in science, though admittedly rigorous, lacks the fundamental objectivity, exactitude, and certainty popularly ascribed to it. 4) The process of discovery in science resembles the process of creation in art. A similarity between cognitive processes in science and art was considered encouraging but inadequate to suggest a comprehensive theory of learning which might have the capacity to explain how students acquire and utilize knowledge. Further speculation in this area was reserved for Chapter IV.

Vital to the development of a model of evaluation was an examination of current methods in the field. Chapter III critiqued some approaches to educational evaluation, and it reviewed a number of recently conceived approaches which are designed to broaden the types of data collected and to capitalize on the skillful judgment of evaluators. As a result of the critique and review, Chapter III yielded four historical conclusions: 1) The field, or discipline, of educational evaluation is unsettled. Practitioners are in disagreement regarding, among other things, the purposes of educational evaluation, its underlying assumptions, its language, and its methodologies. 2) The variety of acceptable methodologies has grown during the past decade. Conventional approaches are less associated today with approaches of convenience than they once were. 3) New approaches often incorporate personal judgment by evaluators as an intentional and legitimate part of their process. Some practitioners recognize that the acknowledgment and utilization of judgment does not render a method less scientific. These new approaches do less

to try to determine and control teaching and learning and more to indicate how teaching and learning actually occur. 4) There is a need to identify and specify standards against which the merits of educational activity are judged, beyond mere personal preference and subjectivism. However, these standards do not need to be universal, fixed, and permanent.

Chapter IV was a detailed explanation of Polanyi's concept of tacit knowing. Belief in the simple premise that people know more than they can tell and confidence that "knowing by relying on" not only exists but underlies "knowing by attending to" suggested that Polanyi's concepts have the capacity to unite the separated modes of scientific knowing and artistic knowing. That the unification was the result of a powerful and pervasive process indicated that Polanyi's concepts are able to explain the ordinary acquisition and utilization of knowledge by students. Three conclusions were derived from Chapter IV. Because of the complexity of human cognition, these conclusions are primitive and therefore tentative: 1) Discovery in science, which Polanyi called the paradigm of scientific knowing, and creation in art both proceed by means of the process of purposive and imaginative anticipation followed by integration of parts into wholes. That discovery and creation manifest the same epistemological structure establishes a substantive similarity between them. 2) The process of knowing-learning which explains discovery in science and creation in art also explains the ordinary acquisition and utilization of knowledge by students. This is especially apparent among those students in pursuit of what Eisner called expressive and Type III

objectives. It is less clear with regard to students and simple educational objectives. 3) The process of knowing-learning used by scientists, artists, and learners is also used by some teachers to teach. That knowing-learning and some teaching manifest the same epistemological structure also establishes a substantive similarity between them.

Chapter III offered a view of teaching as an artistic process. Tacit knowing, because it helps to explain creativity in art, was used in Chapter IV to explain artistic aspects of teaching. By thus explaining some teaching in terms of a knowing-learning process, the study completed a major step in the conceptualization of an educational evaluation model based on a substantive similarity between knowing in science and knowing in the arts. All that remained was to argue that the proposed model ought to make use of this shared epistemology and to explain the dynamics of the epistemology. Chapter V diagramed the dynamics and cast the model in a methodology appropriate to the model's use.

Recommendations

Predictably, it is recommended that the model developed in this study be implemented. Implementation could have a number of desirable outcomes.

First, utilization of the model might result in realization of the purpose proposed for it: increased comprehension of the interface between students and teachers engaged in learning activities. Realization of this purpose would be limited, in part, by the level

of expertise evaluators were able to bring to bear on the classroom. To the extent that evaluators were chosen because they were handy and available or to the extent that they possessed a vested interest in the evaluation other than as acceptably neutral professionals, the worth of the evaluation would probably be compromised. Second, a serious implementation of the model could accommodate an associated effort to train evaluators. Because the experts doing the actual describing and judging would be relying on knowledge which they knew but could not tell (in a manner identical to the way an artisan or any competent person performs a skillful act without attending to the particulars of the act), evaluator trainees would need to observe firsthand the experts in the process of evaluating. The training would rely on the ability of novices to perceive and assimilate the skills possessed by experts. Third, implementation of the model of evaluation could also meaningfully support teacher training. As noted in the study, advocacy of a learning theory may have implications for instructional theory. If the process of teaching deemed "good" by evaluators using this model allows students to muddle through and inquire into their lessons, then apprentice teachers, like apprentice evaluators, could improve their teaching skills by the same process by trying to observe teaching through the eyes of experts.

Since this study represents an early application of the concept of tacit knowing to education and educational evaluation, work still needs to be done to establish tacit knowing's credibility and to comprehend its ramifications.

For example, does tacit knowing function in some subject

areas more than in others? Can cutting-edge curricula be designed in history as well as in obviously creative endeavors such as art and some levels of science? Do students learn elementary mathematics or even spelling by attending from the proximal or subsidiary term of awareness to the distal or focal term? As a tentative answer to the last question, that tacit knowing may explain sensory perception (Polanyi called perception the most "impoverished" form of tacit knowing) at least suggests that it can also explain the lowest levels of knowledge acquisition and utilization. The structure of such low-level learning can be diagramed as shown in Figure 7:

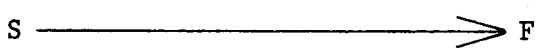


Figure 7

Simple Knowing and Learning

Figure 7 indicates that in instances of simple learning where there is no need or desire to try to discover and identify the basis of focal knowledge, no right-left interaction takes place between the focal and subsidiary terms. Moreover, since there is no interaction, there is also no upward evolution of the terms to more definite states. In this case, the focal object is perceived or understood with sufficient clarity as a result of a single integration.

Other questions, these having to do with the age-relatedness of tacit knowing, might also be raised. Is tacit knowing a skill the development of which is dependent on the physiological and psychological development of the knower? Is Piaget correct regarding

his developmental stages? Again, tacit knowing's apparent ability to explain a basic process such as sensory perception suggests that it functions even in infants and that perhaps Piaget has overlooked the most basic denominator of knowing. Furthermore, is Bloom's hierarchical classification of cognitive functions representative of the actualities of knowing? Even a cursory examination of the classification suggests that tacit knowing may underlie "comprehension," "application," "analysis," "synthesis," and "evaluation," which are all the levels except the first one, "knowledge." If tacit knowing does underlie these levels, then Bloom may not have reached the fundaments of cognition.

That tacit knowing applies as easily to sensory perception and physical skills as it does to conception would seem to indicate that distinctions between education and training are artificial rather than natural. Perhaps vocational education and general education do share the relatedness for which Dewey argued. Finally, the concept of tacit knowing may be able to reduce the power of the concept of the unconscious. When mental functions are divided into the conscious and the unconscious, knowledge has a tendency to assume an either-or status. Knowledge either belongs to the conscious or it belongs to the unconscious; as such, it is either known consciously or it is not known (consciously) at all. Tacit knowing offers a third kind of awareness which seems to claim for its own some of the characteristics attributed until now to the unconscious. Perhaps continued research into the "split brain" (see page 114) can shed light in this area.

In the initial chapter of the study, Hawkins was quoted as saying that one of the criteria by which theorization ought to be judged is fruitfulness. The concept of tacit knowing seems to meet this standard. Perhaps this study satisfies it as well.

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APPENDIX

GLOSSARY

Analysis. A method of inquiry which seeks part-determined explanations. This method must of necessity alter drastically the phenomena under investigation.

Clues. The particulars out of which focal objects and joint meanings emerge. According to Polanyi, clues to knowing are known tacitly as long as they are relied on to know the object or joint meaning which they comprise. As long as they function as clues, they are known in terms of this object or joint meaning. Clues can come from all levels of consciousness.

Conventional Educational Evaluation. The predominant variety of educational evaluation. Conventional evaluation has been devoted, almost exclusively, to student-gain-by-testing, outcomes in comparison with fixed objectives, reliance on quantification, and the rules of experimental research.

Educational Aim. That which a teacher pursues in the course of conducting educational activities. The teacher orchestrates numerous aims simultaneously as well as sequentially. Some aims are generalized and global, applying to a variety of students over an extended period of time. Others are specific and short-term.

Educational Evaluation. Observation of the actual and uncontrived day-to-day operations of a school classroom. The observation results in description of what is happening and judgment as to the value of what is happening. The method of investigation is naturalistic.

Eolithism, Principle of. A term coined by engineer-novelist Hans Otto Storm. He used it to describe the skillful fashioning of material objects. It implies craft, flexibility, and adaptability. The principle of eolithism is in contrast to the principle of design which suggests fixity of goals and homogeneity and lack of variety in the means and materials used to reach those goals. Hawkins used the two principles to characterize the contrasting starting points from which curriculum designers and other educators can approach their tasks.

Epistemology. The systematic study of knowing. It is one of three major divisions of philosophy, the other two being metaphysics and axiology.

Experimental Investigation. An approach to scientific information-gathering which is in contrast to naturalistic investigation. Investigators using this approach seek to control variables, establish conditions, and institute treatments in efforts to isolate causes and generalize results.

Expressive Educational Objectives. A term coined by Eisner and a concept developed by him. These educational objectives specify neither the problem with which a student will deal nor its solution. Such objectives do identify activities in which learners are to be engaged, but they do not specify in advance what the student will learn or what the outcomes (behavioral or otherwise) will be. Eisner also called them "encounters."

Focal Awareness. A concept used by Polanyi to identify "knowing by attending to." Focal awareness designates the kind of awareness persons have for an entity to which they attend from the particulars which comprise it. It is the kind of awareness about which persons normally refer, and it is devoid of connotations of peripheralness, subliminalness, and unconsciousness. It is in contrast to subsidiary awareness.

Holism. A method of inquiry which permits phenomena to remain intact and natural. Holism seeks explanations in terms of wholes and emergent entities. The method is sensitive to the coordination and interrelation between and among the parts comprising an entity.

Indwelling. A term used by Polanyi to designate the literal and figurative process of taking clues into the body to use them as the subsidiary term in acts of knowing. Other characterizations of this process are interiorization, assimilation, expanding one's body, and pouring oneself into. Polanyi said that the joint meaning of particulars is not known by looking at the particulars themselves but by dwelling in them.

Knowing-Learning. An activity initiated by persons as they attempt to discover or create that which is perplexing them and as they attempt to resolve the perplexity. It is a purposive and imaginative act of anticipating meaning among perplexing and seemingly disparate pieces of information and of integrating these pieces into understandable wholes. The term was derived from Polanyi's concept of tacit knowing.

Naturalistic Investigation. A flexible approach to scientific information-gathering which is in contrast to experimental investigation. Naturalistic investigation is rooted less in what is planned for and expected and more in what occurs without intrusion by investigators. It is less sensitive

to design and more sensitive to the unique and unexpected. Investigators using this approach do what Hein called "watch and wonder."

Simple Educational Objectives. Those objectives which lend themselves particularly well to the transmission of factual kinds of information. They often represent preordained and fixed educational goals and standardized means to those goals. They are often accompanied by descriptions of behavioral displays which are said to indicate achievement of the objectives.

Strategy. The overlying plan or means by which a teacher pursues educational aims. Strategies overlie a teacher's behavior, give the behavior consistency, and help make it explicable. A teacher employs numerous strategies simultaneously.

Subsidiary Awareness. A concept used by Polanyi to identify "knowing by relying on." Subsidiary awareness designates the kind of awareness persons have for particulars or clues from which they attend in order to know something else. Polanyi also called it "from-awareness." It is not to be confused with preconscious or unconscious awareness. Objects of which a knower is subsidiarily aware are not known in themselves but are known as they are relied on to know an object of focal attention.

The Classroom. A comprehensive entity which emerges out of the myriad of parts which comprise it. Among those parts are the individual and collective behaviors, intentions, and emotions of students and their teacher. The classroom is the object under scrutiny by evaluators using the model of evaluation developed in this study.

Type III Educational Objectives. A term and a concept by Eisner. These educational objectives specify problems with which students will deal, but they do not attempt to identify solutions. Students are encouraged to seek creative answers to specific problems.

Unconventional Educational Evaluation. That genre of approaches which allow investigators to be naturalistic observers concerned with pursuing areas of inquiry suggested by their own efforts as well as with pursuing outcomes of stated objectives. Unconventional approaches enable investigators to collect qualitative data exclusively or in addition to quantitative data. They put a premium on the utilization of judgment and insight by evaluators. For the most part, unconventional evaluation has developed since the middle of the nineteen sixties.

VITA

Michael Lowell Crist was born in Little Rock, Arkansas, on December 16, 1945. He attended the Little Rock public schools until his graduation in 1963. He received his Bachelor of Arts degree from the University of Arkansas at Little Rock in 1968. He moved with his wife to Nashville, Tennessee, and in 1969 began his employment with the Metropolitan-Nashville Public Schools. Granted a professional development leave from the system in 1974, he became a full-time resident student in the Department of Educational Administration and Supervision at the University of Tennessee, Knoxville. He received his Specialist in Education degree in 1975. After returning to his position in Nashville for the 1975-1976 school year, he again became a full-time student in the Department of Educational Administration and Supervision at the University of Tennessee. He received the Doctor of Education degree in 1977.

Mr. Crist is listed in Who's Who Among Students in American Colleges and Universities. He is a member of the honor societies of Phi Kappa Phi and Phi Delta Kappa. Among his pastimes are astronomy, photography, and aviation. He lives with his wife the former Jane Finger, daughter Amanda Leah, and collie dogs Ladybug Thyme and Gandalf Stormcrow outside Burns, Tennessee.