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Perspectives and Imperatives

TEACHING: RULES, RESEARCH, BEAUTY, AND CREATION

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During the last two decades, much research has been conducted in an effort to identify effective ways of teaching. This research includes process-product, correlational studies[1] and theory testing, experimental studies.[2] The findings of these and related studies are consistent. Together, they suggest a now familiar set of teacher behaviors: asking recall questions, structuring content so that student error rates are low, presenting and demonstrating by the teacher, providing adequate practice monitored by the teacher, giving students feedback on their progress, providing periodic reviews, getting students ready to receive instruction, teaching the total class as a group, and others.

Because these findings represent an important success in establishing stable, effective teaching behaviors, they are beginning to be seen as a science

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[1]For example, Jere E. Brophy and Carolyn M. Evertson, "Process-Product Correlations in the Texas Teacher Effectiveness Study: Final Report" (Austin: University of Texas, R & D Center for Teacher Education) (ERIC document reproduction service No. ED 091 094); Jane Stallings and David H. Kaskowitz, "Follow-through Classroom Observation Evaluation, 1972–73" (Menlo Park, Calif.: SRI International, 1974); Robert S. Soar, "Follow Through Classroom Process Measurement and Pupil Growth (1970–1971): Final Report" (Gainesville: University of Florida, 1973); Charles W. Fisher, Nikola N. Filby, Richard N. Marliave, Leonard S. Cahen, Marilyn M. Dishaw, Jeffrey E. Moore, and David C. Berliner, "Beginning Teacher Evaluation Study, Technical Report Series" (San Francisco: Far West Regional Laboratory of Educational Research and Development, 1978); Homer Coker, Jeffrey L. Lorentz, and Joan G. Coker, "Teacher Behavior and Student Outcomes in the Georgia Study" (paper presented at the Annual Meeting of the American Educational Research Association, Boston, April 1980).

[2]For example, Thomas L. Good and Douglas A. Grouws, "Process-Product Relationships in Fourth Grade Mathematics Classrooms, Final Report" (Columbia: University of Missouri, College of Education, 1975); Carolyn M. Evertson, Edmund T. Emmer, Julie P. Sanford, and Barbara S. Clements, "Improving Classroom Management: An Experimental Study in Elementary Classrooms," *Elementary School Journal* 84 (November 1983). 172–188; Wesley C. Becker, "Teaching Reading and Language to the Disadvantaged—What We Have Learned from Field Research," *Harvard Educational Review* 47 (November 1977): 518–543; Christopher M. Clark, Thomas R. Guskey, and Jacques S. Benninga, "The Effectiveness of Mastery Learning Strategies in Undergraduate Education Courses," *Journal of Educational Research* 76 (March/April 1983). 210–214; Frederick J. McDonald, "Mastery Learning Evaluation Project: Interim Report" (New York: New York City Board of Education, 1982)

of teaching, and teachers are being urged to make their teaching more scientific. While this movement is still in its early stages, a counter movement is gaining strength. Teachers are also being urged to be more artistic in their teaching. This paper is an attempt to explore teaching as science and teaching as art. Teachers need to sort out their beliefs about these two metaphors that are being applied to teaching. Their beliefs will influence their decisions about how to teach.

Although most scholars in the area of teaching would reject the notion that teaching is exclusively science or exclusively art, it is possible to categorize positions as being basically science or basically art. These two views of teaching will be examined in turn, followed by an analysis of them and a proposal for teachers.

TEACHING AS SCIENCE

As might be expected, most teaching researchers see teaching as a science; however, some see it as more of a science than others. Rosenshine and Stevens[3] and Berliner[4] believe the research has yielded considerable knowledge about teaching that teachers can and should use. According to Berliner, although research has not answered all the questions about the relationship of teacher behavior to student learning, there are now "well documented ways for teachers to make sensible choices about how they should go about teaching."[5] In a thoughtful analysis, he goes on to identify pre-instructional, during-instructional, climate, and post-instructional factors associated with student achievement. Berliner implies that the relationships that have been found between teaching and learning are so strong that they are an imperative for classroom action.

Rosenshine and Stevens contend that research has revealed effective teaching behaviors that are applicable to well-structured content areas such as a body of knowledge or a skill taught step-by-step. The behaviors or fundamental teaching functions that emerged from their careful synthesis of the research are daily review, presentation, guided practice, correctives and feedback, independent practice, and weekly reviews. According to Rosenshine and Stevens, "All teachers use some of these behaviors some of the time, but the most effective teachers use most of them almost all the time."[6] They conclude that the major functions or components of systematic instruction are known.

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[3]Barak Rosenshine and Robert Stevens, "Teaching Functions," in *Handbook of Research on Teaching*, 3rd ed., edited by Merlin C. Wittrock (New York: Macmillan, 1986), pp 376–391.

[4]David C Berliner, "The Half-filled Glass. A Review of Research on Teaching," in *Using What We Know About Teaching*, edited by Philip L. Hosford (Alexandria, Va Association for Supervision and Curriculum Development, 1984), pp. 51–77.

[5]Ibid., p. 52.

[6]Barak Rosenshine and Robert Stevens, "Teaching Functions," in *Handbook of Research on Teaching*, 3rd ed., edited by Merlin C Wittrock (New York: Macmillan, 1986), p 377

But Berliner and Rosenshine and Stevens do not specifically mention how to conceptualize and deal with those aspects of effective instruction that are now known. Gage,[7] Hosford,[8] and Hunter,[9] while strong supporters of research on teaching, draw on art to fill in the gaps.

Hunter claims that both learning and teaching research have provided us with a scientific foundation of teaching, with the basic skills of teaching: anticipatory set, objective, instructional input, modeling, checking for understanding, guided practice, and independent practice. Teaching, however, is not a science; according to Hunter, it is "an art based on science,"[10] just as music, painting, and medicine are arts based on science. Art enters teaching as the teacher creatively applies the fundamental rules of teaching. Providing perceptive examples, tailoring to the needs of students, and adjusting or embellishing the basic skills of teaching constitute the art of teaching.

Gage's position is similar to Hunter's, but he does not believe that research has yielded firm rules or principles of teaching that lead to predictability and control. Rather, Gage believes that research has produced weak generalizations about teaching that must be adapted as teachers attempt to implement them in real classrooms with real students. This application of generalizations about teaching-learning relationships requires artistry, according to Gage. It requires intuition, insight, and creativity. Science, then, can and has provided useful knowledge about teaching, but the complexity of the classroom limits the utility of the knowledge. It can serve as a powerful basis for the art of teaching; it cannot serve as a set of prescriptions.

Hosford's position is, perhaps, somewhere between Hunter's basic skills of teaching and Gage's weak generalizations. Hosford believes that process-product research has produced much useful knowledge about effective teaching. He summarizes it into five categories: time-on-task, teacher expectations, monitoring, assigning of work, and organization. However, the prescriptions that are arranged in these categories pertain mostly to the explicit curriculum. Hosford believes that the silent curriculum—or attention to student motivation, student self-concept, respect for others, and similar personal-social goals—also influences the explicit curriculum and is a crucial aspect of any educational program. Creating a desirable silent curriculum as one attempts to apply the science of teaching requires artistry, Hosford says. Art, therefore, is the application of principles of teaching through the silent curriculum.

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[7] Nathaniel L. Gage, *Hard Gains in the Soft Sciences. The Case for Pedagogy* (Bloomington, Ind.: Phi Delta Kappa, 1985).

[8] Philip L. Hosford, "The Art of Applying the Science of Education," in *Using What We Know About Teaching*, edited by Philip L. Hosford (Alexandria, Va. Association for Supervision and Curriculum Development, 1984), pp. 141–161.

[9] Madeline Hunter, *Mastery Teaching* (El Segunda, Calif. TIP Publications, 1982)

[10] Ibid., p. 1.

TEACHING AS ART

Three scholars who view teaching as an art or as more of an art than a science are Eisner,[11] Tom,[12] and Rubin.[13] Eisner's thoughtful position is that science can provide rules of thumb about teaching that "make interpretation and judgment more acute,"[14] but science cannot provide a prescriptive science of education. It cannot provide a prescriptive science, Eisner holds, because teachers and students are active, experiencing, unique human beings who make predetermined structures useless and because teaching involves much more than applying a set of discrete skills. According to Eisner, art and craft are much better metaphors for teaching because they are sensitive to the dynamic nature of teaching. Analyzing a situation, thinking on one's feet to choose a course of action, and using one's imagination are all qualities of the artist and the craftsperson. While the craftsperson relies on established routines to solve classroom problems, the artist creates new practices.

Tom is equally critical of the science approach to teaching. He claims that research on teaching is flawed conceptually and therefore has not been and cannot be productive. The research that has been conducted ignores mediating variables such as student motivation to learn, overlooks the fact that teaching has goals or purposes, and neglects the situational features of teaching, Tom suggests. His proposal is that teaching be viewed as a moral craft, "as a reflective, diligent, and skillful approach toward the pursuit of desirable ends."[15] He outlines specific craft features of teaching: mechanical skills, analytic knowledge, and the ability to apply analytic knowledge to specific situations.

Rubin is not as critical of a science of teaching as Tom or Eisner. He believes that research has not provided a formula for classroom action but that it is helpful. He would present the findings of research on teaching to teachers as a way to stimulate the development of a personalized style of teaching. According to Rubin, "Each teacher must, in one way or another, develop a collection of devices which work."[16] Artistic teachers are those who know the subject and students, choose objectives of worth, use imagination and innovation to achieve objectives, pursue goals with skill and dexterity, and make many decisions intuitively, Rubin says.

CRITIQUING THE METAPHORS

Before the utility of these two positions on teaching can be evaluated, it is necessary to analyze and critique the positions. As illustrated in Figure 1,

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[11]Elliot W. Eisner, "The Art and Craft of Teaching," *Educational Leadership* 40 (January 1983) 5–13.

[12]Alan R. Tom, *Teaching as a Moral Craft* (New York: Longman, 1984).

[13]Louis J. Rubin, *Artistry in Teaching* (New York: Random House, 1985).

[14]Elliot W. Eisner, "The Art and Craft of Teaching," *Educational Leadership* 40 (January 1983): 9.

[15]Alan R. Tom, *Teaching as a Moral Craft* (New York: Longman, 1984), p. 127

[16]Louis J. Rubin, *Artistry in Teaching* (New York: Random House, 1985), p. 5

Figure 1. Science and Art Teaching Metaphors

	Science		Art	
Process	Hypothesizing Data gathering Data analysis Concluding	Rational, reflective acts	Inspiration Creation Production/ Performance	Insightful, creative acts
Product	Generalizations, laws, principles, relationships	Understanding, cognitive ends	Things of beauty, aesthetics, taste	Emotional, affective ends

science can be viewed in two ways. It can be thought of as the "accumulated knowledge synthesized and formulated with reference to the discovery of general truths and the operation of general laws."[17] That is, it can be conceptualized as a product of research. It can, however, also be conceptualized as a process, as that which scientists do as they attempt to establish generalizations. Science as a process includes hypothesizing, observing, classifying, measuring, analyzing, judging, generalizing, and other activities.

Similarly, art can be viewed as both a product and a process, although in some forms of art product and process are inseparable. Edman states, for example, that "in the arts, it is impossible to divide means from ends, to divorce motives from actions, or what is said, from the way in which it is said."[18] To the extent that it can be separated, art in the sense of product is an aesthetic thing, a thing of beauty. "Works of art are purely perceptible forms that seem to embody some sort of feeling," Langer states.[19] An emotional or affective response is invoked by art in those who experience it. The process of art consists of inspiration, creation, and insight, and completion of a performance as in dance or theater or a product as in painting or sculpting.

Both science and art, then, have both a process and a product. The process of science emphasizes rationality and reflection, while the process of art stresses intuition and invention. The product of science is knowledge or understanding; it is cognitive in orientation. The product of art is feeling and emotion; it is affective in orientation. This is not to say that art cannot make contributions to the intellect. It can, as Taylor ably points out.[20] Art's primary focus, however, is emotion.

Now, let us return to the positions that have been reviewed concerning science and art as applied to teaching. Of course, the science position that is

[17]Philip L. Hosford, "The Art of Applying the Science of Education," in *Using What We Know About Teaching*, edited by Philip L. Hosford (Alexandria, Va.: Association for Supervision and Curriculum Development, 1984), p. 143.

[18]Irwin Edman, *Arts and the Man: A Short Introduction to Aesthetics* (New York: W. W. Norton, 1939), pp. 130–131.

[19]Suzanne K. Langer, *Philosophical Sketches* (Baltimore: Johns Hopkins University Press, 1962), p. 78.

[20]Harold Taylor, *Art and the Intellect* (New York: Museum of Modern Art, 1960).

being advocated in the literature is a science-as-product position. Berliner, Rosenshine and Stevens, Hunter, Gage, and Hosford are interested in rules, generalizations, laws, relationships, and the like. When they say that teaching is or should be like a science, they mean that researchers have produced useful knowledge through the scientific process and teachers should use it in some form. They do not advocate a science-as-process position in which teachers are researchers in their own classrooms. That is, they see teachers as users of someone else's science process rather than as hypothesizers, data gatherers, data analyzers, and action deciders for themselves.

The art position that is being proposed in the literature is the reverse. Eisner, Tom, and Rubin are proposing art in the art-as-process sense. They are urging teachers to be more creative and inventive in their teaching. They do not, for the most part, advocate art as product. If they did, their proposals would contain more references to beauty, harmony, and aesthetic qualities of the classroom and school. Their ends are science ends. They are advocating the process of art as a way to reach the ends of science. They are saying that if teachers are more creative and sensitive they will be able to increase students' understanding and cognition What has been emphasized, in summary, is science as a product and art as a process, but with science ends. The question that arises is what position should be emphasized, what position on science and art is the most useful.

Teaching-as-art-product. The strength of this position is that it calls attention to aspects of teaching that are often overlooked. To think of schools, classrooms, materials, and actions as aesthetic things is refreshing and generative. Being surrounded by beauty can lift the spirit and satisfy the senses. Unfortunately, teaching cannot be conceptualized as an art product because the goals of art are insufficient for teaching. School buildings with interesting designs, educational materials that are visually pleasing, teachers with graceful movements, activities with balance and fluidity, although important, cannot be the central purpose or goal of education Student learning must be the central purpose. When student learning is the main purpose, the goal is primarily cognitive and therefore a science goal.

Teaching-as-science-product. This conception's strength lies in its potential to simplify the complex act of teaching. If laws of teaching existed that teachers could use to solve classroom problems, teaching would indeed be simple. Of course, no such laws exist. As supportable as teaching-as-science-product is in the theoretical, it is not supportable in the practical. Research has not produced enough principles or even weak relationships that are appropriate for the range of goals, settings, and students that exist. Many of the laws apply mainly to well-structured information and skill teaching, often at the elementary level. This is not to criticize the contributions of Berliner, Gage, and others. As they indicate, either explicitly or implicitly, much remains to be known about effective teaching. Also, the most useful form in which the research findings can be conveyed to teachers has not been clarified. Fenstermacher suggests that schemata and evidence might be better than rules as bridges to practice, but research on this matter is lacking.[21] At present, then, the teaching-as-science-product metaphor is too undeveloped to be useful.

But teaching-as-science-product is also a deficient metaphor because of its view of the teacher. Teaching-as-science-product implies that teachers are incapable of developing their own practices, that their proper role is a dependent one whereby they acquire the teaching skills that research produces and use them with a minimum of alteration. In short, teachers are technicians rather than scientists. Technicians apply known techniques, while scientists deal with the unknown, according to Zukav.[22] Useful conceptions of teaching must contain a view of the teacher as the active, reflective, able person that the complex nature of teaching requires.

Teaching-as-art-process. This position is an appealing one because of its inherent faith in the ability of individual teachers to solve their own problems. It says to teachers that they are perceptive, intuitive, creative, and responsible. Ultimately, however, this conception is not supportable because it is too vague. Teaching-as-art-process needs greater clarity before it can have meaning for teachers. Behaviors and examples that build on the pioneering frameworks prepared by Eisner, Tom, and others are needed. In addition, the concept is troublesome because, in art, process and product are often inextricably bound together; therefore, the concept's goal is unsuitable as the main objective of teaching.

Teaching-as-science-process. The strength of this position is that it leads to science ends. That is, it focuses on cognition, the school's main goal, but not by prescribing laws with limited utility. It expresses faith in teachers to decide for themselves what is best for their settings. It says that teachers are able, independent, thoughtful persons. Further, the elements of the process of science are sufficiently specific to indicate to teachers what they are to do as they engage in the process of science as a way of teaching. Perhaps a weakness of this conception is the deliberate, rational approach to teaching that it suggests. Teaching is often reflexive and nondeliberative because of its speed and the unpredictability of classroom events.

A PROPOSED CONCEPTION FOR TEACHING

Art as a metaphor for teaching has much to offer, but it cannot be the conception for teaching in either the process or product form. The process

[21]Gary D. Fenstermacher, "On Learning to Teach Effectively from Research on Teaching Effectiveness," in *Time to Learn,* edited by Carolyn Denham and Ann Lieberman (Washington, D.C.: National Institute of Education, 1980), pp. 127–137.

[22]Gary Zukav, *The Dancing Wu Li Masters. An Overview of the New Physics* (New York. Bantam, 1979).

form is too vague, at present, and it inevitably leads to the art ends of aesthetics, beauty, taste, and so on. These ends are unsuitable as the main product for teaching. Science in the product form is also unsuitable, but for different reasons. Its deficiency lies in its present lack of robustness. There simply is not enough of it to be of much use. The best alternative is science in process form. That is, the best metaphor for teaching is the science process or teacher as scientist. It is both specific and oriented toward the appropriate goal, but it also characterizes the type of teacher that realities of the classroom demand.

The teacher as scientist or researcher is the continual seeker of truth, the active, self-sufficient, growing professional. As illustrated in Table 1, the teacher-scientist hypothesizes or identifies possible courses of action for the teaching setting, collects evidence through observation and with the aid of instruments about the effects of the action, analyzes and reflects on the evidence, and makes a judgment about whether to continue, discard, or modify the action. Although the process appears to be linear, it need not be. Observing and analyzing students, activities, and behaviors takes place constantly. New behaviors or actions to be tried can emerge at any time. Further, the process can be less deliberate and rational than it seems. Surely one skilled in the process could use it during the actual teaching act as well as before and after teaching.

When teaching is viewed as a science process, science as a product and art as a process or product are not ignored. These conceptions are still possible, but they are subsumed and altered by the major conception. The laws or relationships that emerge from the science-as-product conception cannot, of course, be accepted as laws and relationships, but they can be accepted as hypotheses to be tested. For example, the finding that recall questions facilitate student achievement cannot be accepted as truth. Instead, the finding can be accepted provisionally until the teacher tries the behavior and reflects on its utility. However, findings issued by the research community are only one source of hypotheses about classroom action. Hypotheses can also come from experts, models, introspection, and other sources

Table 1. Teaching-as-Science-Process

Hypothesizing: What can be tried?
Identifying teaching behaviors that might be effective in relation to setting, students, and objectives. (Sources of behaviors are research results, experts' advice, the behavior of others, intuition, etc.)

Data gathering: What does it do?
Using the teaching behaviors and collecting evidence about their efficacy. (Techniques for data gathering are field notes, diaries, student questionnaires, student test results, etc)

Data analysis: What does it mean?
Examining the collected data to determine the effectiveness of the teaching behaviors

Concluding: What can be used?
Deciding which behaviors to continue to use and which to discontinue

Similarly, an art process directed at art ends cannot be accepted, but an art process as it informs a problem statement and solution is appropriate. In fact, many researchers, when describing their research processes, liken them to art. Zukav, for example, sees the discoveries of scientists as an act of creation. He states, "The distinction between scientists, poets, painters, and writers is not clear."[23] According to Dixon: "Numerous episodes in the history of science compel one to believe that at times scientific discovery is comparable with artistic creativity. Time and time again, scientists have written about their work in terms of intuition or sudden, unexpected insight."[24] As long as it is secondary, art as a product does not conflict with science as a process. All other things being equal, it undoubtedly is more productive to function in an emotionally pleasing environment than in a dull or dissonant one.

Teaching-as-science-process, then, is a powerful conception of teaching. It provides a specific, appropriate model for teaching. But it is no better than the other models unless it is embedded in a personal ideology or a set of values that specifies desirable ends and acceptable means. Neutral technologies as teaching-as-science-product has become and as teaching-as-science-process could become are inappropriate models for teaching because of their unwavering focus on effectiveness, regardless of other considerations. Teachers should engage in the science process in their classrooms, but they should do so in relation to a consistent, thoughtful set of beliefs about what learnings are of most worth and what classroom actions are morally justifiable that is developed before the use of the scientific process. That is, they should carefully build a view of ideal teaching and then continually use the science process to discover the most proficient way of implementing the ideal. Thus, the teacher will come to employ the most effective behaviors, but the behaviors will be consistent, compatible, and justifiable. Teaching-as-science-process within an ideal can lead to classroom practices that work—they produce desired results in students—and that are right—they treat students and knowledge in supportable ways.

As potent as the science-as-process metaphor for teaching is, it is probably not the appropriate model for the teacher in training or the new teacher. The scientific process is for experienced teachers who are confident in their ability to manage classrooms and organize lessons. It is for those who have reached the point where self-analysis and self-reflection are possible.

Further, teaching-as-science-process is also not for teachers who have not been adequately prepared to use it. For the model to have success, teachers must possess research skills suitable for studying their own teaching. Minimally, they must know how to formulate questions or hypotheses, how to gather evidence, how to analyze findings, and how to make action decisions.

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[23] Ibid., p. 10.

[24] Bernard Dixon, *What Is Science For?* (New York: Harper & Row, 1973), pp. 24–25.

Teaching-as-science-process presents a considerable challenge to supervisors. In addition to helping teachers acquire research skills, the supervisor may need to engage in the research process with the teacher. The supervisor can be a source of behaviors to be tried, an assistant in data gathering and interpretation, and a sounding board during the decision phase. Also, the supervisor can play a major role in helping teachers clarify their ideal teaching

Becoming a classroom scientist or researcher may be a difficult and lengthy process, but the teaching-as-science-process metaphor appears to have a better chance for improving teaching than seeing teaching as a matter of following rules discovered by others; as developing an environment of beauty; or as painting, dance, or other acts of creation.

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Tye, Kenneth A., and Arthur L. Costa, compilers. *Better Teaching through Instructional Supervision: Policy and Practice* Sacramento: California School Boards Association, 1986, 44 pp. $6.50.

This booklet is written for school board members who wish to establish policies that will lead to improved supervision of instruction. A clear distinction is drawn between evaluation and supervision. Various approaches to supervision are described briefly, and collegial efforts to improve schools are recommended

Hameyer, Uwe, Karl Frey, Henning Haft, and Freidrich Kuebart, eds *Curriculum Research in Europe.* Strasbourg. The Council of Europe, 1986, 240 pp

This book provides state-of-the-art depictions of recent developments in curriculum research by prominent educational scholars in Europe, including Ulf Lundgren, Karl Frey, and Philip H. Taylor Countries represented are Austria, Belgium, the Federal Republic of Germany, France, Luxemburg, the German Democratic Republic, Greece, Italy, the Netherlands, Nordic countries, Spain, Switzerland, the United Kingdom, and Yugoslavia. This volume, which presents a range of research conceptions, is a valuable resource for making international comparisons of curriculum. Sponsored by the Institute for Science Education at the University of Kiel, the volume builds on the *Handbook of Curriculum Research,* edited by Hameyer, Frey, and Haft (Weinheim: Beltz Verlag, 1983).