Curriculum Development versus Education

GARY A. KLEIN
Wilberforce University, Ohio

INTRODUCTION

The major assertion of this article is that the present curriculum-development approaches to education are limited in the types of tasks they can address and the level of proficiency they can expect from students. Such approaches may be useful as management tools, allowing the systematic management of instructional activities. However, the approaches may interfere with the quality of the educational process.

It seems obvious that one of the goals of teaching reading and mathematics is to facilitate the development of proficiency in these skills. We can contrast mediocre competence with proficient performance of a task. A novice who is trained to achieve mediocre competence can follow rules and procedures with satisfactory levels of speed and accuracy, but has difficulty in applying skills to new situations and in acquiring greater expertise. In contrast, the attainment of proficient performance implies that a person can perform a skill so well and so efficiently that it can be a building block for the acquisition of additional skills, and is easily extended to unfamiliar tasks. The contrast is between young adults who can read 150-200 words per minute, and get most questions right on comprehension tests, and students who read for enjoyment and view libraries as tools for answering questions. The contrast is between students who can generally follow the steps of a mathematical procedure to get an answer right and students who can recognize which type of mathematical procedure is needed in order to attack a given problem. Someone who has reached mediocre competence must still concentrate on performing the task correctly. Someone who has achieved proficiency at a task can focus attention on achieving personal and vocational goals.

The goal of proficiency does not seem to have much influence on current

I thank Ronald Sinclair for his encouragement and suggestions. Helpful comments on earlier drafts were provided by Helen Altman Klein, Julian Weitzenfeld, and Ronald Swartz. Appreciation is also expressed to the staff of the Antioch School, Yellow Springs, Ohio, for demonstrating the craft of effective teaching and furnishing many of the examples used in this article.

Volume 84, Number 4, Summer 1983
0161-4681/83/8404/0821$01.25/0

educational practice. Observation suggests that many teachers are not concerned with the acquisition of expertise, but rather with the training of noticeable increments in skills for all the children in the classroom. The instructional goal is to ensure that almost all the students become at least marginally more competent than they were when they entered the class. This is an important goal in its own right. But the method of instruction a teacher would use in pursuing the goal of marginal improvements may be different from the method used in pursuing the goal of proficiency.

Sometimes the two goals may be incompatible. For example, a competency-based approach to reading seems to be designed for the second goal—small increments in skill for most students. However, the process of breaking complex tasks into "basic" procedures and skills may be a distortion of the proficient performance of those tasks. If a proficient reader does not perform the same procedures and sequences taught to the novice, then the insistence that the novice master those procedures may *interfere* with the development of proficiency. This is especially true if reading is taught only as the deciphering of letters, syllables, and words.

It may be useful to distinguish between procedural and nonprocedural tasks. A procedural task can be broken down into basic elements, steps, or rules; following these rules will accomplish the task. An example would be operating a simple hand calculator to add, subtract, multiply, and divide. The task can be broken down into basic steps,[1] and the student can learn rules for performing these steps. A student who does not know the rules is unable to perform the task. After learning the rules, the student has achieved a mediocre level of competence.

In contrast, other tasks appear to be nonprocedural. We do not know what rules or procedures a person needs to follow in order to perform these tasks. Examples are painting, playing tennis, writing a critique. It is difficult to decompose such tasks into basic steps and rules. Even if there were agreement on a set of rules and higher-level rules, it is not clear that a student who had learned to follow these rules could perform at a satisfactory level.

Instructional methods are often aimed at procedural tasks. Curriculum-development approaches assume that tasks are basically procedural, and can be decomposed into elements such as steps in a flowchart.[2] They assume that concepts can be reduced to component features and elements, and that practice on the elements will yield mastery of the concepts. Competency-based curriculum approaches go further than this, and attempt to measure learning progress by evaluating the learner's knowledge of component rules and elements. In general, the development of a curriculum is an attempt to decompose a knowledge domain into components; the goal is to ensure mastery of the knowledge domain through mastery of the components. This is a reasonable practice for tasks that are procedural. Clearly there would be gains in the management of teachers, students, and materials if all aspects of the educational process could be broken down into manageable elements through the use of curriculum-development procedures.

Curriculum development can also provide a starting point for the teaching of nonprocedural tasks and complex concepts. Some decomposition, however arbitrary, must be made to get the learner started.

However, curriculum-development approaches cannot assure the mastery of nonprocedural tasks. You cannot effectively break tasks down into basic procedures, or break concepts down into basic features, if the proficient performance of the task does not consist of following procedures and the understanding of the concept does not depend on identifying the features. This suggests that curriculum development is a limited tool for many tasks and concepts.

Are tasks such as reading and mathematics procedural or nonprocedural? If procedural, then it is a reasonable approach to decompose them into basic elements and rules, and teach students to follow those rules with greater speed and accuracy. However, if the tasks are nonprocedural—and this is the position taken through the remainder of this article—then reducing them to basic steps, minimal increments, rules and higher-level rules, may be counterproductive to producing proficiency. It may restrict students to the level of mediocre competency described above. The argument hinges on an understanding of proficiency.

A RECOGNITIONAL MODEL OF PROFICIENCY

There are clear novice/proficient differences within educational situations. Compare students who are reading to discover new and exciting ideas with students who are trying to make the sound that best corresponds to a string of letters. Or consider secondary school music students. The good players ignore a mistake in order to maintain the sense of the performance. The lower-level players are disoriented by mistakes because they do not have a sense of the performance, and are just trying to get each note to come out right.

One way to explain the difference between expert and novice is in terms of several types of recognitional capacities: (1) People who are proficient at a task can recognize its similarity to previous experiences, and can use these experiences for guidance; novices lack a base of relevant analogues; (2) experts can recognize the probable outcomes in a situation and can select goals accordingly; novices have little idea of how a situation is likely to wind up, and are preoccupied with figuring out what to do next.

Analogues

In encountering a new situation, people can orient themselves by recognizing it as similar to an analogous situation; the analogue can then be used to direct their attention to important features, to suggest reactions, and to help them anticipate consequences (Klein and Weitzenfeld 1982). The analogue is a concrete experience that a person has had or has observed—in contrast to an abstract rule for how to behave. Because of their wide range of experience, experts have available a repertoire of analogues to guide performance. They can perceive a current task as being similar to a previous situation, and they can use what they know about that situation to predict outcomes, identify plans, and determine what is relevant. Thus, proficiency is based on going from the abstract to the concrete—from the rules used by novices to the analogues used by experts.

When a person identifies a current task in terms of a previous, concrete, analogous task, there is often a recognition of what action to take—the action that was successful before. Thus, people who are proficient have a strong sense of what is typical. They need only to spend attentional resources on the exceptional cases. In contrast, the novice rarely knows what is typical, and needs to figure out reactions for most situations (Bainbridge 1978).

For example, a nursery school child playing with blocks is acquiring analogues for later use. A teacher using a recognitional model might attempt to help the child notice ways in which the blocks fit together, so that the block domain becomes more vivid and well understood. Such a domain may later be useful for studying mathematics, but it also can have value for areas such as art, deductive thinking, and even storytelling.

Goals

Experts appear to be able to recognize plausible long-range goals in situations. Their examination of a situation is framed in terms of outcomes worth striving for. The expert then can use long-range goals to structure short-range goals and plans. Thus, the performance of the expert appears smooth and coordinated because actions are generally occurring within a context of overall goals. By contrast, novice performance is jerky, because novices are usually reacting to local conditions and to immediate pressures. There are no long-range goals to integrate their performance.

Children learning soccer spend a lot of time running after the player with the ball. With experience, they learn to anticipate where the play is likely to move, so there is less inefficient running around. They learn the types of positions that are likely to produce a shot at the goal, so they can begin to work toward producing those positions.

As children become proficient, they are gaining the ability to recognize the probable outcomes of their behavior. Their familiarity with outcomes helps them to select outcomes they prefer. It allows them to plan. We can see this in an activity as simple as drawing a picture. With enough experiences of running out of room and crunching essential figures in at the bottom or along the sides, children learn to select the right scale for the initial figures drawn. They have learned to anticipate the effect of scale size of initial figures on space available for the remaining figures. Their overall plans and goals for the picture allow them to present a coordinated and balanced arrangement.

How are analogues identified and outcomes recognized? There are models of direct recognition that do not involve rules and calculations. One example is template matching. Our biological immune systems use a template matching process to remember which foreign bodies to respond to. Another example is the technology of holographic memory systems, which rely on the interference patterns of light waves to produce instantaneous recognition of complex figures.[5] These examples are cited to demonstrate that similarity can be recognized without having to go through calculations of formal elements.

In conclusion, we can describe skilled performance in a way that emphasizes recognition, rather than calculation, and highlights the importance of experience for perceptual learning, analogical reasoning, and the use of long-range goals.

The model of proficient performance we have been discussing is summarized in Figure 1. On being faced with a new situation, an expert is able to draw on a repertoire of experiences and recognize the situation as similar to some previous experience. There may be a specific analogue involved, or a prototype derived from several analogues. The recognition is sensitive to relevant features of environmental context, as well as to the person's goals. Since the analogue will not be entirely similar to the new situation, some adjustment will be necessary in order to translate the prior experience(s) into a guide for what is relevant in the current situation, options available for action, expectations about consequences of action, general anticipations. In this way,

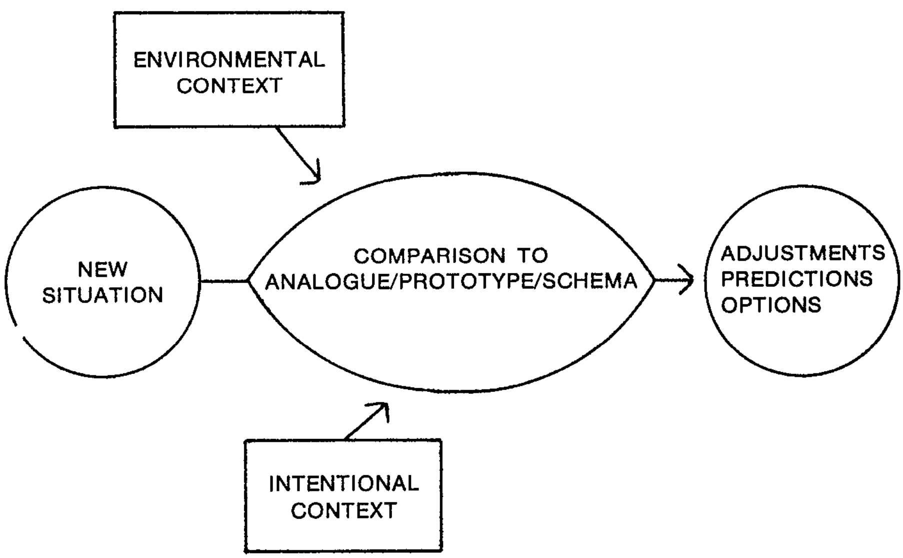

Figure 1

the expert is able to have an understanding of the new situation and a feel for what is going on, and what must be done and why.

The recognitional model cautions against an overemphasis on the mastery of rules and procedures. Certainly, some rule learning may be needed for initial instruction of most skills. Rote memory for procedures, rules, and facts may sometimes be an essential prerequisite for nonprocedural skills. For example, a student trying to learn a statistics formula will be handicapped by weaknesses in multiplying and dividing. If a formula calls out the term 82/2 and the student has to stop and work that out on a hand calculator to obtain 41, then the continuity of the process is broken. So I am not claiming that all learning should be experiential. There is a need for rote memory of facts and letter identification and arithmetic skills. However, once perceptual learning and recognitional capacities have developed to the point where they can replace rule-following, the proficient person no longer needs to depend on rules. Forcing reliance on rules and procedures will interfere with recognitional abilities. Excessive drill on rules and procedures can then inhibit the development of recognitional capacities.

Consider the dysfunctions of students drilled on word recognitional skills, using oral reading and other methods, to the point where they become uncomfortable skimming over any word. One elementary school teacher confessed that it took her two weeks to read *Love Story* because she is unable to skip any word, even when reading to herself.

A PROCEDURAL MODEL OF PROFICIENCY

The procedural model assumes that all tasks consist of procedures; mastery of these procedures will lead to mastery of the tasks. Novices and experts are both seen as performing procedures and following rules; experts are just faster and more accurate, and have learned higher-level rules. Procedures and rules can be thought of as instructions: If X occurs, do Y until Z occurs.

The procedural model differs from the recognitional model in several ways. It places emphasis on learning rules, rather than on perceptual learning. Judgments are formed via computations on basic elements, rather than by the use of analogous experiences. Similarities and goals are calculated, rather than recognized. Under this view, the expert has learned the basic steps so well that they can be performed automatically, whereas the recognitional model suggests that the expert has learned to recognize and perceive, and no longer has to perform calculations or follow procedures.

The procedural approach to expertise is attractive to educators for several reasons. It is compatible with the scientific goals of reducing and decomposing complex phenomena to basic elements. It promises that instructional problems are inherently tractable, if only we can find the right basic elements and the optimal set of rules and higher-level rules. The procedural approach is also related to the associationist tradition in American psychology, as represented by behaviorism and by information-processing models. For these and other reasons, the procedural approach is dominant in psychology and education. It provides the rationale for competency-based and mastery-learning approaches to curriculum development (e.g., Bloom 1976).

At the current time, there are no clear data favoring one type of approach over the other. The recognitional approach is not as amenable to scientific investigation as the procedural approach, since it claims that there are limits to how far we can analyze a task into components and basic elements.[4]

However, there are theoretical reasons for distrusting the procedural approach. The introductory section presented the assertion that a procedural approach to education is too restrictive. In this section, we shall examine some specific problems. What can be attacked are the assumptions that all tasks and concepts can be described in terms of steps or rules and that novices are performing the steps and rules slowly and inaccurately. The assumptions are basic to information-processing theories of cognitive psychology; they have been criticized by Dreyfus (1972), Haugeland (1978), and Klein (1978).

First, can complex tasks and concepts be analyzed into simple, discrete procedures? This approach is basically a form of logical atomism, in that it assumes that complex issues can be decomposed into basic elements. The problem is that such elements have not been found. Elements may exist only in the context of the overall task and the goals of the person performing it. Logical atomism has been abandoned within the field of philosophy. Yet it lingers in education to provide the framework for atomistic approaches.[5]

Step-by-step descriptions are adequate for some tasks (e.g., operating a hand calculator), but run into trouble on other tasks (reading a story, interpreting a homework assignment, riding a bicycle). How would you develop a flowchart of discrete steps for riding a bicycle? You might break it into stages: "Get on the bicycle," "Start riding," "Continue riding," "Stop," "Get off." But this does not say anything about the skills involved.[6] In practice, it has proven to be almost impossible to get experts to agree on the criteria for complex tasks.

Procedural approaches may still be valuable in certain situations, such as designing rehabilitation programs for brain-damaged clients. In such cases the goal of proficient performance is abandoned. The limitations of procedural descriptions no longer matter.

Second, when should procedures and rules be applied? If complex tasks could be analyzed into procedures, of the form "if X occurs, do Y until Z occurs," how will a novice recognize when X has occurred, so it is time to begin, or Z has occurred, so it is time to stop? The procedural approach attempts to use the concept of higher-level rules to explain how someone "recognizes" when to apply a lower-level rule.[7] However, Achinstein (1968) and Fodor et al. (1980) have shown that attempts to describe the conditions for initiating rule-like commands have failed. Their work suggests that even if experts were following rules, we would not be able to define the conditions for initiating the rule-following actions. If we cannot tell people when they should and should not follow a rule, a procedural approach will not be very useful.

Instead of trying to explain recognitional capacities in terms of rule hierarchies, we can argue that rule-following *depends* on recognitional capacities. Processes such as analogical reasoning are important even in a rule-governed domain. Consider students learning forms of deductive inference and the use of Venn diagrams. Typically, they have no trouble with the procedures for setting up a Venn diagram; their difficulty is in recognizing which type of diagram or syllogism to use for a new situation. When they get to the point where they can recognize analogues, can see the similarity to a familiar classroom problem or homework exercise, they know how to proceed. The ability to follow rules depends on the ability to recognize when the rule is relevant.

Third, we cannot trust the verbal reports of subject matter experts on how they perform tasks. Our questions about what they are doing often seem to be attempts to discover the rules they are following, so they may try to imagine plausible rules to satisfy us.

Fourth, are we following rules unconsciously? We are not aware of following rules, so some people claim that we have learned those rules so well we can do them without conscious awareness. This is debatable.

Again consider bicycling. Making a turn on a bicycle involves a consistent ability to select the angle of turn as a function of speed, steepness of grade, wind direction and velocity, sharpness of turn desired, and nature of road surface. A hypothetical set of steps and contingencies describing such performance would be difficult if not impossible to understand. Therefore, it is hard to see how a set of equations and contingencies that you could not understand on the conscious level can be performed automatically at the unconscious level.

You might want to argue that what you perform automatically is not a series of equations and contingencies. But that is the point. Why teach steps when competent performance does not consist of following steps? And even if we did know the equations and contingencies for making a turn on a bicycle, and even if the trainee had a Ph.D. in mathematics, would we want to begin by teaching the equations and contingencies?

Furthermore, if we could identify steps and contingencies, and asked a proficient cyclist to try to follow those steps, it seems likely that performance would be decreased. This raises the dilemma of having to instruct novices about rules and procedures that should only be used unconsciously.

For these reasons, proficient performance may not consist of following procedures. The reverse is also true: Procedural tasks do not seem to lend themselves to highly proficient levels of performance. You would not say that someone was a real expert at starting a car under standard conditions. Of course, if we are talking about *your* car, and getting it started on cold winter mornings when you have to listen to its gasps and sputters and know just how much to tease it with the choke or accelerator, then we are dealing with complex recognitional capacity, and expertise is possible.

The differences between a recognitional model of proficiency and a procedural model have implications for education at three different organizational levels. There are implications for students, for teachers, and for administrators.

THE PROFICIENT STUDENT

Helping students achieve proficiency is an educational goal, but our understanding of this goal varies according to which model of proficiency we use, recognitional or procedural. Similarly, the methods used to reach the goal will be different.

A competency-based approach has a number of advantages, including the opportunity to develop a logical sequence of instruction and the opportunity to set minimal standards. There is an attempt to specify what a student needs to learn at one level in order to move on to the next level. The instructional program can emphasize these necessary elements, and reduce the amount of time spent on topics that are not necessary. If successful, this approach can produce an increase in efficiency, as well as in effectiveness.

However, the procedural model may teach students that learning occurs by accumulating the answers to many trivial problems. The flowchart can become a paradigm of knowledge, and the ideal of the educated person may be a well-programmed computer. Unfortunately, Dreyfus (1972) and Searle (1980) have pointed out that computers simply perform computations on sets of independent, isolated facts. The process does not involve understanding, only engineering. This is a grim ideal to place before students.

If we use the perspective of a recognitional model of proficiency, we can identify potential drawbacks to curriculum-development approaches.

First, students may be less able to develop recognitional capacities and proficiency. Resnick (1976) has shown that most students learning to add two digits do not use the methods presented by teachers; they evolve more efficient approaches (e.g., starting with the larger number and just counting off the increments for the smaller number). These approaches are rarely taught, students usually just learn them. Yet a rigid curriculum that demanded that each student perform the "ideal" procedure for the first grade (e.g., starting each problem at zero and incrementing both of the numbers to be added) might inhibit the development of more proficient approaches in students ready to improve their skills.

Reber and Allen (1978) have shown that trying to analyze some tasks actually seems to weaken subjects' ability to learn perceptual discriminations.

Second, some tasks are not easily handled by a procedural approach. With regard to curriculum development, we would expect that more attention would be given to more procedural tasks, and that these types of tasks should make up a disproportionately large amount of such programs. Skills such as problem solving and decision making, which are not amenable to analysis into basic elements, would be expected to play a minimal role in the curriculum. If their absence is noted, the remedy may be to add them as additional atomistic skills to be mastered (see Klein and Weitzenfeld 1978 for a critique of such approaches).

Third, attempts to apply a procedural approach to recognitional capacities can become unwieldy because of the problem of representing context.

Contextual understanding allows experts to resolve ambiguity. But curriculum approaches cannot assume that their users have an adequate contextual understanding (if the users did, they would not need the training). So ambiguity is resolved through more rules and procedures. But context is not just more rules or pieces of information. It is the framework within which the task is performed, and within which it must be understood. A practical barrier is encountered in trying to handle contextual frameworks by additional rules and procedures. This barrier is the need for voluminous amounts of information, which are still deemed insufficient.

A concrete example is the guidance provided for Instructional Systems Development (ISD) personnel in government and industry. ISD is a task analysis of how to do a task analysis. It presents the steps needed to break down complex tasks into simpler steps. Montemerlo and Harris (1978) have documented the growth of ISD manuals from fair-sized single volumes in the late 1960s to the massive multivolume models of the mid-1970s. But no one can apply massive multivolume models (which are still criticized as having insufficient detail). According to Montemerlo and Harris, ISD is a "judgmental" task (i.e., dependent on recognitional capacities) and thus not amenable to its own methods of task analysis.

Fourth, there is the idea of homogeneous students. Curriculum designs have the virtue of standardization. They have the potential for helping students who would never be expected to gain proficiency, and for whom rule-following represents a higher level of performance than would otherwise be expected. This gain is offset by the losses to students capable of becoming highly proficient, but who are prevented from moving beyond rules, steps, and procedures.

Fifth, a last problem concerns the importance of failures. Swartz, Perkinson, and Edgerton (1980) have discussed the importance of failures in education. From the perspective of a recognitional approach, it is important for students to see what happens when inappropriate analogues fail and have to be rejected and replaced. It is important for students to learn how to use failure as a cue that overall goals have been misunderstood, so it is time to reidentify the problem. If students learn to feel threatened by even a potential for failure, they have diminished their ability to use failures and to achieve proficiency.

However, instructional programs that emphasize the successful performance of procedures can extract penalties for failures, and discourage experimentation. Emphasis is placed on successful performance, according to standards of competence. Error-free learning is the goal. The rewards are for the result, not the adventure. Learning is what you do if you do not already know; it is a penalty for ignorance.

THE PROFICIENT TEACHER

Our analysis of proficiency applies to teachers as well as to students. Perceptual learning and recognitional capacities are no less important at this level. Proficient teachers can recognize when students understand something, are interested, are troubled. They have a wide array of well-understood analogues for perceiving new situations. They have sufficient familiarity with outcomes to work within a firm, goal-oriented context. In such a context, they can use serendipity by recognizing how something unexpected can assist in the pursuit of a goal. They can recognize when difficulties need to be dealt with immediately, and when there will be later opportunities for resolution. For example, if students make some mistakes, one response is to immediately correct those mistakes. Another response is to wait for a subsequent opportunity for the students to realize the mistakes and correct them without outside help. The experienced teacher, who has learned what to expect, can wait.

Unfortunately, there are many pressures within educational organizations that interfere with teacher proficiency and prevent its development. Many teachers do not develop proficiency, even with years of experience. Some will never become proficient, and new teachers may lack the necessary experience. To ensure minimal competency on the part of all teachers, one safe strategy is to use a curriculum-development approach emphasizing behavioral objectives, to structure the performance of teachers (Barber 1979; Council on Teacher Education 1976; Kaufman, Knight, and Watson 1980). This is an effective solution in a bureaucratic environment. It ensures quality control by treating staff as interchangeable. Once lesson plans have been created, staff can be shifted around, and substitute teachers employed with minimal disruption. Teachers can be assigned the job of teaching the elements of concepts and the procedures for performing tasks, but they do not have to be responsible for teaching the concepts or the tasks themselves. These are some of the goals motivating the search for an ideal curriculum analysis. Although no one has claimed to come close to the ideal, it would seem that these goals were involved in the development of the K–12 scope and sequence analysis, specifying individual tasks to be taught and the sequence of instruction.

What would happen if an ideal curriculum analysis were completed and applied? Such an approach treats teacher performance as a sequence of rules and procedures to be mastered and mandated. It can interfere with the development of proficiency by eliminating the need for developing recognitional capacities. Teachers no longer have to be trusted to recognize when a student understands anything. They need only to follow lesson plans, administer tests, require remedial work from predefined options according to predefined criteria. Such an environment does not have much room for the exercise of proficiency. If reading scores show at least a marginal improvement from the year before, progress has occurred, and the problem can be passed on to the next teacher.

This should not imply that teachers have stopped trying to become proficient, to understand, to recognize. It is only meant to describe why current educational approaches may pose barriers to effective teaching.

It would be foolish to argue that teachers should not plan, develop exercises, or use standardized instructional materials with students. Instead, the recognitional model of proficiency would criticize an approach in which standardized materials were presented to students according to predetermined plans (a curriculum) and modified only on the basis of standardized evaluation results showing inadequate or excessive progress. We do not want to prevent teachers from planning, but we do not want to enslave teachers to plans or restrict freedom to depart from plans.

THE PROFICIENT ADMINISTRATOR

The procedural approach has been applied to the area of management in the form of rational models. Such models may consist of such steps or procedures as: identify each step of the process being managed, identify the individual(s) responsible for each step, develop evaluation criteria to determine when each step has been successfully accomplished, develop milestone timetables to ensure that each step is accomplished at the proper time, and apply the evaluation methods to be certain that everything is being done when it should be and by the person responsible. Deviations from the milestone schedule can be identified as early as possible so that corrective action can be initiated in a timely manner.

If the process being managed is education, and a procedural approach is being used, it is likely that a curriculum-development approach will satisfy management needs. Teachers can develop lesson plans in advance, present instructional packets at the appropriate time, and evaluate students to ensure that skill increments have occurred on time and to the proper, predetermined level.

It can be argued that the purpose of education is *not* effective management; the purpose of management is effective education. Yet we must recognize that principals are hired to manage the educational process. The performance of principals will be gauged by their apparent effectiveness as managers.[8] Therefore, we can expect most principals to visibly apply systematic management techniques, regardless of the consequences for education. Those who do not appear to be dynamic managers will be replaced by others who are. Eventually, educational output will be managed using the same principles by which automobile output is managed. In such a system, curriculum approaches that break education down into "manageable" pieces seem inevitable.

Another consideration is the competency of teachers. With tenure practices as they currently are, there is much greater pressure for administration/management personnel (such as principals) to appear competent than there is for teachers to appear competent. Principals can be replaced more easily than teachers. Therefore, there are lower expectations of teacher competence than there are of principal competence. If you have little faith in your front-line teachers, then it makes good sense to restrict the scope of their activities. You can minimize your concerns about their competence and training if you can reduce education to specific competencies to be trained in sequence, to predetermined criteria. Once such a system is installed, the principal is able to assume the role of manager of the educational process.

Therefore, a competency-based curriculum offers advantages in terms of management of instruction, and management of teachers' activities. A product—education—can be defined and produced on schedule.

Of course, the same criticisms can be made of rational management techniques used for competency-based curriculum development and behavioral objectives. Management newsletters continue to emphasize rational-deductive approaches, and offer procedural guidelines—basic steps to becoming an effective manager. Nevertheless, it has been recognized for several decades that rational-deductive approaches do not accurately describe managerial performance. Simon (1945) described the information-processing limitations that prevent administrators from pursuing a formal analysis of decisions. Braybrooke and Lindblom (1963) have also described the inherent limitations of a rational-deductive model (e.g., incompatibility with human problem-solving capacities, inability to handle situations with inadequate information, costliness of analysis, limited applicability to ill-defined problems).

We would hypothesize that the proficient manager (administrator, principal) is not following rules and procedures. Mintzberg (1973) has shown that executives prefer concrete, current information, even gossip, speculation, and hearsay, to the abstracted summary information contained in the routine reports flooding their desks. This makes sense in terms of the opportunity for using analogical reasoning with concrete data sources, and the ability to take advantage of experience-based recognitional capacities. Reports of abstract data offer little opportunity for recognitional capacities. There is not much to be done with tables and graphs except interpret them according to standard analytical techniques.

It is not surprising that proficient principals occasionally complain that they are forced to spend so much time on paperwork that they cannot get into the classrooms to see what is going on. The rigorous management approach makes sense only if managerial proficiency is viewed from a procedural perspective. If good managers decompose tasks into elements, treat each element separately, and so forth, and if this is all that their skill consists of, then by requiring all managers to follow these steps it is possible to mandate proficiency.

What we have is a cycle in which managers are pressured to rely on technology rather than on proficiency. Since their technology is procedure-based and atomistic, they force teachers to use curriculum approaches rather than the teacher's own expertise. The output of such a process is a population of students who have learned that they can progress through the educational system by maintaining a mediocre level of competence.

CONCLUSION

A recognitional model of proficiency has been presented and used to show how a procedural approach may place restrictions on the development and exercise of proficiency of students, teachers, and principals.

The argument has been advanced as follows: Proficiency does not depend on following rules and procedures. Approaches that emphasize rules and procedures may help novices, but may interfere with the eventual development of proficiency. Curriculum-development approaches emphasize rules and procedures; therefore, they will be of questionable value in helping students become proficient. However, there are strong management concerns that are best served by competency-based curriculum approaches. Despite alternative means for developing proficiency in students, we should anticipate that procedural approaches will continue to flourish.

This is a pessimistic conclusion. It is based on the assumptions that principals are expected to assume dynamic manager roles and that procedural curriculum approaches are most compatible with such roles. The pressure on principals to appear to be dynamic managers of education seems to be ongoing, and can only be served by attempts to break the educational process into manageable pieces. For these reasons, efforts will undoubtedly continue to analyze complex skills into their "basic" elements, and to teach these elements to novices as a means of upgrading skills. Whatever the phrases or slogans, the process will be the same, and will be driven by management needs.

If the goal of managing education continues to take precedence over the goal of education, we can predict that fewer students will attain proficiency in school-related skills. The majority of children should attain minimal but adequate levels of competence during the course of their schooling, and they should show no appreciable improvement in skills following the completion of their formal education.

Notes

1 Basic steps assume the existence of a shared culture. A step such as "press the green switch" is not really basic if you do not know how to press a switch or recognize green. Nor can you be instructed in more basic steps—no one can tell you how to move your finger, and informing you that green consists of light with a dominant wavelength of 525 millimicrons would not be helpful. Thus, as Wittgenstein (1953) has argued, there are no basic steps outside of a culture of shared practices. This causes difficulties for computer scientists attempting to model human knowledge. Nevertheless, the concept of basic steps can still be used if too much weight is not put on it, and if it is applied only to situations where there is a set of common practices.

2 Industry makes use of comparable methods such as Instructional Systems Development (ISD), which has been successfully applied to tasks such as starting a jet engine.

3 Digital computer programs may model such events by calculating Fourier transforms, but no one has suggested that holograms themselves are formed when laser beams perform Fourier analyses, and on the basis of their calculations derive an output consisting of an interference pattern.

4 Nevertheless, the recognitional model is specific enough to generate research, and work has begun in the areas of grand-master chess performance, paramedic cardiopulmonary resuscitation skills, computer programming skills, and parenting skills.

5 There is some neurophysiological speculation that complex scenes are perceived by breaking them down into basic elements. Specialized feature detectors are hypothesized to respond to lines at different angles, etc. These simple cells for detecting features would then feed into complex visual cortex cells for building up scenes. However, such a tidy scheme has been questioned by John & Schwartz (1978), who cite contrary evidence in that the simple cells in the cortex of the cat sometimes take *longer* to respond to stimuli than the complex cells do.

6 Polanyi (1958) has stated a rule for riding a bicycle: At any given angle of unbalance, the rider should turn the front wheel to the degree inversely proportional to the square of the speed. But Polanyi pointed out that no one could actually use such a rule to ride a bicycle (the reader is invited to try) and that additional contextual factors interact with this rule so that the rule is insufficient to maintain adequate performance.

7 It is not clear where such a hierarchy would end; there may be a problem here of an infinite regress of higher-level rules.

8. Principals are also responsible for tasks such as ordering equipment and maintaining insurance. These responsibilities are of less relevance to the concerns of this article. Instead, the emphasis is on the responsibility of managing the performance of teachers to maximize the delivery of educational services.

References

Achinstein, P. 1968. *Concepts of science.* Maryland: Johns Hopkins University Press.

Bainbridge, L. 1978. Forgotten alternatives: Skill and work-load. *Ergonomics* 21:169–85.

Barber, C. 1979. Training principals and teachers for mastery learning. *Educational Leadership* 37: 126–27.

Bloom, B. 1976. *Human characteristics and school learning.* New York: McGraw-Hill.

Braybrooke, D., and Lindblom, C. E. 1963. *A strategy of decision.* New York: The Free Press of Glencoe.

Council on Teacher Education. 1976. *Guidelines for planning and conducting essential competency studies.* Tallahassee, Fla.: Florida Department of Education.

Dreyfus, H. L. 1972. *What computers can't do: The limits of artifical intelligence.* New York: Harper & Row.

Fodor, J. A., et al. 1980. Against definitions. *Cognition* 8: 263–367.

Haugeland, J. 1978. The nature and plausibility of cognitivism. *The Behavioral and Brain Sciences* 2: 215–60.

John, E. R., and Schwartz, E. L. 1978. The neurophysiology of information processing and cognition. In *Annual Review of Psychology*, vol. 2a, ed. M. R. Rosenweig and L. W. Porter. Palo Alto, Calif.: Annual Reviews, Inc.

Kaufman, R., Knight, M., and Watson, K. 1980. *Competency-based vocational education system: A comprehensive model for planning and delivering successful vocational education.* Tallahassee, Fla.: The Center for Needs Assessment and Planning.

Klein, G. A. 1978. Phenomenological vs. behavioral objectives for training skilled performance. *Journal of Phenomenological Psychology.* Fall, pp. 139-56.

Klein, G. A., and Weitzenfeld, J. 1978. Improvement of skills for solving ill-defined problems. *Educational Psychologist* 13: 31-41.

———. 1982. The use of analogues in comparability analysis. *Applied Ergonomics* 13: 99-104.

Kuhn T. 1970. *The structure of scientific revolutions.* 2nd ed. Chicago: University of Chicago Press.

Mintzberg, H. 1973. *The nature of managerial work.* New York: Harper & Row.

Montemerlo, M. D., and Harris, W. A. 1978. Angels, pinheads and task analysis. Paper presented at the American Psychological Association meetings, Toronto.

Polanyi, M. 1958. *Personal knowledge: Towards a post-critical philosophy.* Chicago: University of Chicago Press.

Reber, A. S., and Allen R. 1978. Analogic and abstraction strategies in synthetic grammar learning: A functionalist interpretation. *Cognition* 6: 189-221.

Resnick, L. 1976. Task analysis and instruction design. In *Cognition and Instruction*, ed. D. Klahr. Hillsdale, N.J.: Erlbaum.

Searle, J. R. 1980. Minds, brains and programs. *The Behavioral and Brain Sciences* 3: 417-57.

Simon, H. A. 1945. *Administrative behavior.* New York: The Free Press.

Swartz, R. M., Perkinson, H. J., and Edgerton, S. G. 1980. *Knowledge and fallibism: Essays on improving education.* New York: New York University Press.

Wittgenstein, L. 1953. *Philosophical investigations.* Oxford, England: Basil Blackwell.