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ABSTRACT

In this discussion on the development of expertise in teaching, a theory of skill learning is first presented. The characteristics of five stages of skill development in teachers are described: (1) novice; (2) advanced beginner; (3) competent teacher; (4) proficient teacher; and (5) expert teacher. A review of data collected by studies on the subject of teaching expertise points out differences between the novice and the expert teacher in the areas of: (1) interpreting classroom phenomena; (2) discerning the importance of events; (3) using routines; (4) predicting classroom phenomena; (5) judging typical and atypical events; and (6) evaluating performance: responsibility and emotions. The discussion of policy considerations for teacher educators, based upon this developmental theory of skill acquisition, is aimed at helping novices become proficient in classroom techniques while evaluating them in ways approriate for their developmental level. (JD)

THE DEVELOPMENT OF EXPERTISE IN PEDAGOGY

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CHARLES W. HUNT
1880-1973

With a passion for teaching and a love of people, Charles Wesley Hunt helped shape teacher education in America for nearly half a century. His career spanned the range of educational responsibilities—teacher, university dean, president of the State Teachers College at Oneonta, N.Y., and volunteer in national associations for teacher education.

As secretary-treasurer first of the American Association of Teachers Colleges and subsequently the American Association of Colleges for Teacher Education (AACTE), which he helped to create, Dr. Hunt participated directly in the changes sweeping teacher education during the mid-20th century. He worked diligently to develop our national association as the vehicle to stimulate and effect necessary ch ›es in the education of teachers. The tools for change were varied, but of special significance were institutional accreditation, qualitative standards for effective programs, and inclusion of all types of higher education institutions.

When the lecture series honoring him was established in 1960, Dr. Hunt stated:

> In the American Association of Colleges for Teacher Education we have come from our varying stations across the nation to share our experience, to pool our strength, and to play our role in the galaxy of institutional organizations which are very important in our national culture. The gradual assembling of all [collegiate] institutions for the preparation of teachers into one working group is a movement of great significance.

Today is the future that Charlie Hunt could only dream about. It is the future his life's work made possible. While I am sure he would applaud our accomplishments, I am equally sure he would urge us to look beyond our horizon, to anticipate the challenges of the future, and to prepare ourselves to meet that future with understanding and enthusiasm.

Edward C. Pomeroy
Executive Director
emeritus
AACTE

June 1988

THE DEVELOPMENT OF EXPERTISE IN PEDAGOGY

We can learn a good deal from studies about how expert ice skaters, bridge players, radiologists, nurses, mathematicians, and even full-time racetrack handicappers apply their domain-specific knowledge to particular problems they face. In the last few years experts in such diverse fields have been studied and remarkable similarities in the ways they perceive and process information have been shown to exist (Chi, Glaser, & Farr, in press; Berliner, 1986). But the path one travels from novice to expert in these various fields has not yet been well studied, in part because research on expertise is relatively new, and in part because longitudinal studies are needed, and these are among the least likely to receive support. Still, if we had a general theory about the development of expertise in different fields and data about the ways experts and novices perform pedagogical tasks, we might discover that there are policy considerations of interest to the teacher education community. Moreover, some of these policy considerations may not be obvious. Thus, although quite tentative, I would like first to speculate about a general theory of the development of expertise. This theory provides a way to think about the stages one moves through as ignorance is overcome and expertise is achieved in a particular field. Then I will present some interpretations of data my colleagues and I have collected in studies of pedagogical expertise that inform this theory. Finally, I will try to draw out policy considerations for teacher educators as we think about the journey from novice teacher to expert.

A *Theory of Skill Learning*

Let us view the development of expertise in pedagogy as consisting of five stages of skill development, following the general model presented by two Berkeley professors, the philosopher Hubert Dreyfus and his brother, computer scientist Stuart Dreyfus (1986). We begin with *novices*, who, with experience, develop into *advanced beginners*. Most of these individuals then become *competent* teachers. It should be the goal of teacher

education colleges to help prepare the novice and assist the advanced beginner to become a competent teacher. Competence, I believe, should be our goal. Pursuing more or talking of excellence or expertise for all teachers is to pursue a will-o-the-wisp. And to deny that differences in teaching ability exist, as some professional organizations have done, is to perpetuate a fiction. We all know better. Although individual differences abound, I would hypothesize that *novices* are generally student and beginning first-year teachers. *Advanced beginners* are often in the second and third years of their teaching careers, and if they have any talent and motivation whatsoever, about the third or fourth year they may become *competent*. I am convinced that this stage of development can be achieved by the vast majority of graduates of our teacher training colleges. Perhaps around the fifth year a modest number of teachers may move into a further stage of development, that of *proficient*. Some of these proficient teachers will reach the highest stage, achieved by few members of a field, that of *expert*. Each of these stages has some distinguishing characteristics, to which we now turn.

'The behavior of the novice is rational, relatively inflexible, and tends to conform to whatever rules and procedures they were told to follow.'

Stage 1: Novice. Here the commonplaces must be discerned. The elements of the tasks to be performed need to be labeled and learned, and one learns a set of context-free rules to guide behavior. For example, in learning to drive an automobile the novice is taught the meaning of highway signs, lane markings, safety regulations, etiquette at stop signs, and other elements of the task. Novices are taught to shift at about 12 miles per hour, a rule that is virtually context free, to be followed on upgrades and downgrades, in good weather or bad, in slow-moving traffic or on empty streets. In learning to teach, the novice is taught the meaning of terms like higher-order questions, reinforcement, and learning disabled. Novices are taught context-free rules such as "give praise for right answers," "wait at least three seconds after asking a higher-order question," "never criticize a student," and that old stand by, "never smile until Christmas." Identifying the context-free elements and rules is needed in order to begin to teach. The behavior of the novice is rational, relatively inflexible, and tends to conform to whatever rules and procedures they were told to follow. Only marginal performance is really expected. This is

a stage for learning the objective facts and features of situations. It is a stage for gaining experience. And it is the stage at which real-world experience appears to be far more important than verbal information, as generations of student teachers have informed us.

Stage 2: Advanced beginner. Here experience can become melded with verbal knowledge, similarities across contexts are recognized, and episodic knowledge is built up. Strategic knowledge—when to ignore or break rules and when to follow them—is developed as context begins to guide behavior. For example, when driving on ice you need the torque generated in second gear and so it might be neccessary to stay in that gear longer. In teaching, you learn that praise does not always have the desired effect, such as when a low-ability child interprets it as communicating low expectations. And you learn that criticism of a usually good student after a bad performance can be quite motivating. Experience is affecting behavior, but the advanced beginner still has no sense of what is important. Benner (1984, p. 23-24) makes this point in comparing novices and advanced beginners with competent nurses.

> I give instructions to the new graduate, very detailed and explicit instructions: When you come in and first see the baby, you take the baby's vital signs and make the physical examination, and you check the I. V. sites, and the ventilator and make sure that it works, and you check the monitors and alarms. When I would say this to them, they would do exactly what I told them to do, no matter what else was going on...They couldn't choose one to leave out. They couldn't choose which was the most important...They couldn't do for one baby the things that were most important and then go on to the other baby and do the things that were most important, and leave the things that weren't as important until later on... If I said, you have to do these eight things...they did those things, and they didn't care if their other kid was screaming its head off. When they did realize, they would be like a mule between two piles of hay.

The novice and the advanced beginner, though intensely involved in the learning process, may also lack a certain responsibility for their actions. This occurs because they are labeling and describing events, follow-

ing rules, recognizing and classifying contexts, but not actively determining through personal action what is happening. The acceptance of personal responsibility for classroom instruction occurs when personal decision making, willfully choosing what to do, takes place. This occurs in the next stage of development.

Stage 3: Competent. Competent performers of a skill have two distinguishing characteristics. First, they make conscious choices about what they are going to do. They set priorities and decide on plans. They have rational goals and choose sensible means for reaching them. In addition, while enacting their skill, they can determine what is and what is not important. From their experience they know what to attend to and what to ignore. In driving, this is the stage where one can shorten time in going to the airport by changing lanes, speeding up, and committing minor infractions of the law, but always under conscious control and with knowledge of what is safe and what is not. In teaching, this is the stage where one learns not to make timing and targeting errors, because one has learned through experience what to attend to and what to ignore. And this is when teachers learn to make curriculum and instruction decisions, such as when to stay with a topic and when to move on.

'Competent performers . . . have rational goals and choose sensible means for reaching them [and] they can determine what is and what is not important.'

Because they are more personally in control of the events around them, following their own plans, and responding only to the information that they choose to, teachers at this stage tend to feel more responsibility for what happens. They are not detached. Thus, they often feel emotional about success and failure in a different and more intense way than do novices or advanced beginners. And they have more vivid memories of their successes and failures as well. But competent performers are not yet fast, fluid, or flexible in their behavior. These are characteristics of the last two stages in the development of expertise.

Stage 4: Proficient. This is the stage at which intuition or know-how becomes prominent. Nothing mysterious is meant by these terms. Think of the microadjustments made in riding a bicycle. At some point in learning to ride a bike you no longer think about these adjustments. You have an "intuitive" sense of the situation. Further, from the wealth of experience that the proficient individual has accumulated comes a holistic

recognition of similarities. For example, it is the stage when a teacher notices, without conscious effort, that today's mathematics lesson is bogging down for the same reason that last week's spelling lesson bombed. At some higher level of categorization the similarities between disparate events is understood. This holistic similarity recognition allows proficient individuals to predict events more precisely because they see more things as alike and, therefore, as having been experienced before. Chess masters, bridge masters, air traffic controllers, and radiologists rely upon this ability. The proficient performer, however, while intuitive in pattern recognition and in ways of knowing, is still analytic and deliberative in deciding what to do. An example of this distinction may be found by considering a proficient automobile driver approaching a curve on a rainy day. It is by intuition developed through accumulated experience that the driver simply "knows" when the car is going too fast. An *analysis* of options then occurs and the driver *decides* whether to brake, let up on the gas, or down shift. Most tournament chess and bridge players are at this proficient stage. But the grand masters are those few who move to a stage higher, to the expert level.

Stage 5: Expert. If novices, advanced beginners, and competent performers are rational, and proficient performers are intuitive, we might categorize experts as "arational." They have an intuitive grasp of a situation and seem to sense in nonanalytic, nondeliberative ways the appropriate response to make. They show fluid performance, as we all do when we no longer have to choose our words when speaking or think about where to place our feet when walking. We simply talk and walk in an apparently effortless manner. The expert safety in football, the expert martial artist in combat, the expert chess master, and the expert teacher in classroom recitations all seem to know where to be or what to do at the right time. They engage in their performance in a qualitatively different way than do novices or competent performers. The pilots who no longer fly the plane but believe they are personally flying, the race car drivers who talk of "becoming one with the machine," and the air traffic controllers who see airplanes rather than blips on the screen are involved in their tasks in qualitatively different ways than are others. They are not con-

sciously choosing what to attend to and what to do. They are acting effortlessly and fluidly, behaving in ways that are not easily described as deductive or analytic. Though beyond the usual meaning of rational, because neither calculation nor deliberative thought is involved, the behavior of the expert is certainly not irrational. The writings of Schon 1983) about knowledge-in-action characterizes the behavior of the expert practitioner.

'. . . when things are going smoothly, experts rarely appear to be reflective about their performance.'

Experts do things that usually work, and thus when things are proceeding without a hitch, experts are not solving problems or making decisions in the usual sense of those terms. They "go with the flow," as they say in California. When anomalies occur, when things do not work out as planned or something atypical is noted, deliberate analytic processes are used in the situation. But when things are going smoothly, experts rarely appear to be reflective about their performance.

Summary. This general stage theory about the development of expertise is derived from speculations about how expert systems in the field of artificial intelligence can be created. Its application to pedagogy is still unknown. Certainly, like all stage theories, the duration of time spent in a stage can be expected to vary widely. The more important question is whether the stages make sense, rather than whether the trip from novice to expert takes two years or five. In addition, we should note that a person who is typically at one stage of development may, in particular situations, show characteristics of individuals who are at another stage of development. Also, expertise is considered to be highly contextualized. It may not transfer from situation to situation very well. This theory is presented because I believe it is supported by data my colleagues and I have collected during the last few years, and because I believe it has heuristic value for teacher education. Let us examine the supporting data before we discuss implications for policy.

Studies of Expertise

Many of our studies have used three groups of subjects: Expert, novice and postulant teachers[1]. *Expert* mathematics and science teachers at the secondary level were identified through nomination and chosen after classroom observations were made. *Novice* teachers were first-year teachers who had excellent evaluations when they were student teachers. *Postulant* teachers were those who worked in industry as engineers, computer specialists, and scientists who wanted to teach but were not interested in going though the regular teacher education program. These were individuals with subject matter expertise but no pedagogical knowledge or training. They are the equivalent to those in many states who enter classroom teaching through an alternative certification route, bypassing colleges and schools of education. The equivalent stage of development of these individuals, in terms of the developmental theory just discussed, is that of completely unprepared novice. These are the greenest of green, the rawest of raw recruits. They anchor the bottom of a continuum going from ignorant to expert in a particular field. The teachers whom we call novices in our studies would probably span the categories of novice and advanced beginner in terms of the theory of development just presented. In a number of areas our data support the assertions made in the general theory, though we worked without any knowledge of that theory. Let us now examine the data.

'Postulant teachers . . . with subject matter expertise but no pedagogical knowledge or training . . . anchor the bottom of a continuum going from ignorant to expert . . .'

Interpreting classroom phenomena. Because of a lack of experience, the novice is predicted to have trouble in interpreting events. Until episodic knowledge is built up and similarities can be recognized across contexts, we can expect confusion to characterize the novices' interpretations of classroom phenomena when compared with the interpretations of experts. We obtained data like that in a study where experts, novices, and postulants watched three television screens showing the same lesson simultaneously (Sabers, Cushing, & Berliner, 1988). The center screen

[1] Funding for these studies was provided by the Spencer Foundation, to whom we are grateful. My colleagues at the University of Arizona included K. Carter, P. B. Claridge, K. Cushing, J. George, S. Pinnegar, D. Sabers, & P. Stein.

showed a teacher instructing, taped from the back of the class. Only the middle group of students was visible. The screen on the right showed only the students on the right of the room and the screen on the left showed only the students on the left of the room. When played simultaneously, a complex auditory and visual environment was created. Our subjects talked aloud during part of the time and answered some directed questions as well. Differences were found among the three groups. For example, the novices often made contradictory statements about what they had observed, especially when they were asked about instructional or management events within the classroom. The novices experienced difficulty in making sense of their classroom observations and in providing plausible explanations about what was occurring within the classroom. For example, when novices were asked to describe the learning environment in the classroom we heard:

> **Novice:** It looked. . .I wouldn't call it terribly motivating. It was, well, not bored, but not enthusiastic.
>
> **Novice:** Very positive as well as relaxed. Very positive. . .it's good to be able to focus [student] energy into a group situation, yet at the same time, accomplishing the work that they need to do for the class and also lending to the relaxed feeling of the classroom.

Such contradictory interpretations were common. Even more discrepancy was noted when participants were asked to describe the students' attitudes toward this class. For example:

> **Novice:** It didn't look like it was a favorite class for most of them. One boy looked kind of like, "Oh no, it's not this class again." They didn't look overwhelmingly enthusiastic to be there.
>
> **Novice:** They seemed pretty excited about the class, excited to learn, and a lot of times it's hard to get students excited about science, but this teacher seems to have them so that they are excited about it. They're willing to work and they want to learn.

As a group, novices seemed unable to make much sense of what they saw. They experienced difficulty monitoring all three video screens simultaneously. Thus, they often reported contradictory observations and appeared confused about what they were observing and about the interpretations that could be made of their observations.

Postulants are even less familiar with classroom events than novices. Perhaps that is why they appeared even more overwhelmed than the novices. Many of the postulants expressed difficulty or an inability to monitor all three video screens simultaneously. Generally, they appeared able to focus on and make sense of only one video screen. Because this limited their observations, they also made errors and contradictory statements when they were asked about specific events.

'. . . novices . . . often reported contradictory observations and appeared confused . . . Experts, however, . . . responded effortlessly and fluidly.'

Experts, however, did not demonstrate any confusion or difficulty in making sense of the classroom (video) observations. They responded effortlessly and fluidly. They not only made more comments about what was happening (experts averaged 27.4 comments during this segment of the task; novices, 20.5 comments; postulants. 23.2 comments), but their comments were more detailed and descriptive than those of the other two groups. The experts appeared comfortable both describing what they observed and interpreting events in terms of classroom instruction and management. For example, during a second viewing where the experts talked aloud, one commented:

> **Expert:** Left monitor again. . .I haven't heard a bell, but the students are already at their desks and seem to be doing purposeful activity, and this is about the time that I decided they must be an accelerated group because they came into the room and started something rather than just sitting down or socializing.

In fact, just as this expert inferred, we had recorded an accelerated group of students. It was a science classroom for students identified as GATE (Gifted and Talented Education) students.

In addition, experts were able to monitor the sounds from both the teacher and students more accurately than did novices or postulants.

Given their ability to monitor three video screens simultaneously for both visual and auditory cues, experts seemed less confused than either the novices or the postulants and thus were better able to interpret classroom events.

We were particularly impressed with how effortlessly experts could interpret and evaluate events and behaviors in real time. For example:

> **Expert:** In the monitor in the middle, it might have been a good idea to start out class with measuring the height of these plants that they're growing while roll is being taken, so that you're not wasting or having a bunch of dead time at the end of the class.
>
> **Expert:** Again, viewing the middle monitor, I think there is an indication here of the type of structure of this classroom. It's pretty loose. The kids come in and go out without checking with the teacher.
>
> **Expert:** I'm looking at the left monitor. . .I think that this is a part of a continuing activity from the day before probably, because they know exactly what they're doing without any instructions from the teacher.
>
> **Expert:** On the left monitor, the students' notetaking indicates that they have seen sheets like this and have had presentations like this before; it's fairly efficient at this point because they're used to the format they are using.

In contrast, postulants and novices usually gave a step-by-step account of what was happening, as though they were announcing what they were viewing to someone who could not see the screen. In this respect they were reminiscent of radio announcers reporting an athletic event. The comments of postulants and novices indicated that perhaps they had difficulty in interpreting events and behaviors. Their discussions lacked the inferences, conclusions, evaluations, and suggestions that appeared with frequency in the protocols of the experts.

Another of our studies also showed this difference in interpretive competency between experts and novices (Carter, Cushing, Sabers, Stein, & Berliner, 1988). In this study we had our subjects look at a series of slides depicting science or mathematics instruction during a class period in a high school. The subjects held a remote control and were told to view about 50 slides at their own pace, stopping to comment on any they found interesting. Novices and postulants seemed to show no particular pattern in what they stopped to comment on, and they showed the same kinds of contradictions in their interpretations that we found in the study using videotapes. For example, one novice might say, "Everything looks fine, they're all paying attention," and another novice might say, "It looks like they're starting to go off task, they're starting to drift." A pattern was noted among the experts that was quite different. The experts, more often than the subjects in the other groups, found the *same* slides worth commenting about and had the *same* kinds of comments to make. For example:

Expert: [Slide 5] It's a good shot of both people being involved and something happening.

Expert: [Slide 5] Everybody seems to be interested in what they're doing at their lab stations.

Expert: [Slide 5] Everybody working. A positive environment.

Expert: [Slide 51] More students with their books closed, their purses on their desks, hands folded, ready to go.

Expert: [Slide 51] Must be the end of class and everybody is getting ready for the bell to ring.

This reduction in variance by the experts is particularly noteworthy. It means they have learned to pay attention to some of the same things and to interpret visual stimuli in the same way. This similarity in *what* is attended to and *how* it is interpreted is what we want when we visit an expert ophthalmologist or an expert tennis player for advice. Postulants,

novices, advanced beginners—anyone in the early stages of skill acquisition—simply will not have acquired enough experience for that.

Discerning the importance of events. Related to the problem of interpreting classroom phenomena is the problem of discerning in complex environments what is important to attend to. The theory discussed suggests that this is one of the marks of novices, distinguishing them from those at higher levels of development . We have evidence for that from our study of visual processing of classroom information. We showed a slide of a classroom scene very rapidly—for under 1 second—and asked our subjects what they saw. The responses of the postulants and novices were clearly descriptive and usually quite accurate.

> **Postulant:** A blond-haired boy at the table, looking at papers. Girl to his left reaching in front of him for something.
>
> **Novice:** [It's] a classroom. Student with back to camera working at a table.
>
> **Novice:** A room full of students sitting at tables.

In contrast to these literal descriptions, typical of novices and postulants, some of our expert teachers gave more than mere descriptions and their viewing was more organized.

> **Expert:** It's a hands-on activity of some type. Group work with a male and female of maybe late junior high school age.
>
> **Expert:** It's a group of students maybe doing small group discussion on a project as the seats are not in rows.

For experts, the information that was often deemed important was that with instructional significance, such as the age of the students or the teaching/learning activity in which they were engaged. Blond hair and posture were simply not important. In this sense, our experts were acting

like experts in other fields do, responding not to the literal characteristics of a situation but only to those aspects that are important.

Experts seemed to have organizing frameworks for viewing. One such framework was around the concept of work. They commented on "students *working* at the blackboard," "students *working* independently," "teacher looking over a person *working* in lab," etc. Work appeared to be a salient, organizing concept for the experts as they viewed these slides.

For the most part, postulants' descriptions were characterized by greater detail about the more static features of the classroom environment. Students were one aspect of the environment, but in contrast to experts, students and their work-related actions were not the prominent features of their descriptions. In fact, students and their work involvement appeared to be no more salient to postulants than did the physical surroundings of the classroom, the equipment, the windows and desks, and the charts on the wall. Apparently, *all* the visual stimuli presented had equal informational value. The postulants were not able to distinguish what was important from what was not in the booming, buzzing confusion of life in classrooms. This inability to sort out the forest from the trees is a characteristic of those in early stages of skill development (Lesgold, 1984).

'The postulants were not able to distinguish what was important from what was not in the booming, buzzing confusion of life in classrooms.'

Using routines. In part, the apparently effortless and fluid performance of the experts is because of their use of routines that make classrooms appear to function smoothly. Leinhardt and Greeno (1986), for example, in studying elementary school mathematics lessons, compared an expert's opening homework review with that of a novice. The expert teacher was found to be quite brief, taking about one-third less time than the novice. This expert was able to pick up information about attendance and who did or did not do the homework. She was also able to identify who would need help later in the lesson. She elicited mostly correct answers throughout the activity and managed to get all the homework corrected. Moreover, she did so at a brisk pace and never lost any control of the lesson. She had routines to record attendance, to handle choral responding during the homework checks, and for hand raising to get attention. This expert also used clear signals to start and finish the lesson

segments. In contrast, when the novice was enacting an opening homework review as part of a mathematics lesson, she was unable to determine who did and did not do the homework, had problems with taking attendance, and asked ambiguous questions that led to her misunderstanding the difficulty the homework. At one time the novice lost control of the pace. She never learned which students would have difficulty later in the lesson. Of importance is that the novice showed lack of familiarity with well-practiced routines. She seemed not to have habitual ways to act. Students, therefore, were unsure of their roles in the class.

In one of our studies (Berliner, 1988), we had experts, novices, and postulants teach a short lesson on probability to about 15 high school students. The experts were unhappy about their participation in this task, in part, because the students they had to teach were not the ones they taught regularly. Their own students were trained in routines to make the classroom run smoothly. One expert, reflecting on what was wrong with the task, said:

> **Expert 5:** My expectations when a kid comes into my classroom for math is that he has pencil and paper ready at all times because I make them take notes, just as you do in social studies. They have practice problems. And this is kind of tough 'cause I don't know what was the routine these kids were used to, you know? . . . You know, with the kids that are used to your routine, you can stand up and talk for 15 or 20 minutes, and by your questioning techniques and by having them work with guided practice at their desks [you keep them working]. But these kids didn't know me, and they didn't know the way that I operate, that all are supposed to participate, and why, and that they're all supposed to be on task [constantly].

The well-practiced routines of expert surgeons, ice skaters, tennis players, and concert pianists (Bloom, 1985), no less than expert teachers, are what give the appearance of fluidity and effortlessness to their perfor-

mance. What looks to be so easy for the expert and so clumsy for the novice is the result of thousands of hours of experience and reflection.

'What looks to be so easy for the expert and so clumsy for the novice is the result of thousands of hours of experience and reflection.'

Predicting classroom phenomena. The general theory of skill development also suggests that experience should provide experts more capability for making better assumptions and hypotheses about classroom phenomena and student behavior, assumptions and hypotheses that are not obvious to novices. Because experience leads to recognition of similarities, the expert learns the probability that certain events or stimuli are associated with certain other events or stimuli.

We have some data that pertain to this issue from the study where expert, novice, and postulant teachers looked at slides and reported what they saw. Experts made many more assumptions, hypotheses, and predictions than did the others. They reported, for example:

> **Expert:** Students were not seated in the traditional type of seating arrangement—one that would normally be used for a lecture-type style of teaching. So from the seating arrangement, I *assumed* that they must have been involved in some activity other than a traditional type of a lecture.
>
> **Expert:** . . .there aren't a whole lot of humorous math problems, so I *assumed* a couple of the students must have been talking—from their facial expressions—about something other than the assignment.
>
> **Expert:** I *assumed* it was the teacher's desk because [it] was faced a different way from where the students' desks were faced and because of where it was placed in relationship to the chalkboard.

In many other comments made by experts the terms "assume" or "predict" or "hypothesize" could be substituted for the actual words used, as illustrated below:

Expert: It looked like not all students were focused on the same

thing, some were faced forward, some were faced back, some were looking off to the side. So it didn't seem like they were all [*so I assumed/hypothesized/predicted they were not*] having any sort of group activity.

Assuming, hypothesis making, and predicting were much more prevalent in the language of experts than among novices or postulants. We confirmed this in another study where expert, novice, and postulant teachers talked aloud as they thought about how students would answer particular items from the National Assessment of Educational Progress (Stein, Clarridge, & Berliner, 1988). The experts, novices, and postulants differed in their predictions about the student cognitions used in answering an item. Experts seemed to have a fund of knowledge about the way students thought and how those thoughts interacted with the content of the specific mathematics or science items. In addition, the experts seemed able to think through the misalgorithms that students might apply to solve a particular problem. The experts had more experience dealing with student errors and therefore were able to predict what types of errors students might make. Novices and postulants rarely discussed the issue of misalgorithms that students might apply to solve a problem. The inability to predict the kinds of errors that students will make in particular situations is, no doubt, a major deficiency of the beginning teacher. If the tough-to-teach topics for students cannot be distinguished from the easy-to-teach topics and no taxonomy of error types has been built up through experience, a teacher is likely to teach in an inappropriate way. The ability to predict how students will think and err is fundamental to a diagnostic-prescriptive form of teaching. Such knowledge is generally unavailable to novices.

Judging typical and atypical events. The general theory suggests that experts will not pay much attention to things if, in their judgments, they are going along smoothly. In fact, the expert appears rather unreflective as long as no problems are perceived. This is another reason that the expert appears to be so effortless at work. Experts apparently pay attention to

fewer things than do others whose skills are less developed. This does not mean that experts see or hear less, only that they choose to process less of what they encounter. In fact, there is reason to believe that they actually see and hear more than do novices (Sabers, Cushing, & Berliner, 1988; Peterson & Comeaux, 1987). In two of our studies we saw some evidence of this tendency for experts to focus on the atypical rather than the typical.

In one study we asked our subjects to examine extensive information about a class that a teacher had to leave in the fifth week of a semester (Carter, Sabers, Cushing, Pinnegar, & Berliner, 1987). The simulation was designed to determine how these expert, novice, and postulant teachers prepared for taking over the class. Experts acted notably different. While novices and postulants worked diligently to learn all they could about the various students in the classroom, their achievements, problems, home life, and so forth, the experts invested very little mental effort in this activity. They seemed to merge information about students into a "group picture" that they defined as "typical," "normal," or "usual." For example:

> **Expert:** Especially when I start fresh, I start from a clean slate. . . I like getting a little background on the students in that there are going to be severe problems or someone may need special attention on certain things, you know, learning areas, but, in general, it's a conglomeration of the students. I like to learn from them and develop my own opinions.
>
> **Expert:** It was a typical classroom, some problem kids that need to be dealt with. And you have to take that into consideration when you're developing some kind of plan for them. There are the bright kids that were highly self-motivated. There were your shy kids. It was a typical class.
>
> **Expert:** I didn't read the cards. I never do unless there's a comment about a physical impairment such as hearing or sight or something I get from the nurse. I never want to place a judgment

on the students before they start. I find I have a higher success rate if I don't.

The belief that it is atypicalness that is attended to was supported in a different context in the study where slides were used as stimulus materials. Experts tended to describe one of the slides differently from novices or postulants. For example:

> **Expert:** Not a typical row, not a typical group for conversation... Part of them were facing this way and part of them were facing the other direction, so it wasn't like a typical situation.

'Experience seems to change people so that they literally "see" differently.'

Experts apparently have images of how things ought to be. If students or classrooms appear to be the way they are supposed to be, they are likely to be less attended to—perhaps even ignored. Experience seems to change people so that they literally "see" differently, either by noting atypicalness quicker (the experts seem to have quicker pattern recognition ability), or by simply not seeing certain ordinary things. Surely that is functional. In any domain of expertise one must learn through experience, perhaps thousands of hours of experience, what is worth attending to, particularly because of the severe biological limits humans have for processing information.

Evaluating performance: Responsibility and emotions. When the developmental stage of competence is reached, it is said to be accompanied by a qualitatively different kind of emotionality and sense of responsibility for the work of the performer. We found supporting evidence, obtained in a curious way, in the study where we had experts, novices, and postulants plan and teach a lesson (Berliner, 1988). The postulants in that study were quite happy about their performance, although we did not rate it highly. Novices were generally affectless in describing their experience. They had a task to do and they did it. The experts, however, were quite angry about their participation in the task and quite disappointed in their performance. We had inadvertently taken away

some of the experts' edge. First, we had created an artificial teaching situation. Second, according to their standards, they did not have enough time to prepare the lesson. Third, the students were not trained in the routines that make their classrooms hum. One expert expressed his anger by walking away from the study. Another stopped in the middle of the lesson and had to be coaxed to continue. One started crying during the playback of the videotape. All were upset. Two weeks after the study, one expert, when asked what she remembered of her experience, said:

> **Expert:** I just remember it as the worst experience in my entire life, and I was depressed . . . The things that stick out in my mind are the negative things. I remember just being frustrated the whole time I taught the lesson . . . I don't like what happened. I've been real depressed and down [since then].

Other comments by experts were about their feelings of discomfort, stress, terror, and so forth. In this situation where postulants and novices were virtually untouched at any deep emotional level, our experts were affected deeply. In addition, they felt that in some way they had let us down. Their sense of responsibility played a part in their feelings as well. Expert teachers, apparently like other experts, show more emotionality about their successes and failures in their work.

Miscellaneous. A listing of the qualitative differences between experts and those whose skills are less developed could be continued for some time. Some of these differences are related to the increased personal references made by the experts, which demonstrate how events from their personal history can be recalled and brought to bear on the problems that they face. Some differences are related to the richer, more analytic protocols that the experts provide, as described in a study of experts and novices conducted by Peterson and Comeaux (1987) and found in some of our studies. Some differences are related to the more principled kinds of thinking that experts do, also described in Peterson and Comeaux and

found in our work. Some differences are related to the experts' greater facility in understanding students during interactive teaching, because experience apparently has provided them with mental models of the student, as described in the work on teacher-questioning patterns done by Ropo and Kiehela of Finland (1987) and related to findings from our work.

Rather than continue the documentation of differences in the thinking and performance of individuals at different levels of development, it is time to state the general principle, namely, that important qualitative differences exist in the thinking and the performance of novices and experts. Research is making clear these qualitative differences. The developmental processes involved in the acquisition of expertise, however, are not yet as clear. The theory of stages in the development of expertise that was described above is intended to help us think more about that issue. A point I have made is that data collected for other purposes were supportive of that developmental theory. So let us try to use this developmental model and the accompanying set of data to inquire whether interesting policy considerations can be formulated.

Policy Considerations

Some of the following ideas for policy are tentative, and most need to be stated with more qualifications than are presented here. Still, they should be thought about seriously because a case could be made for each of them, given a developmental theory of skill acquisition and certain interpretations of the data that is accumulating about the differences between experts and novices.

1. Let us start with a warning about those who come into education through an alternative certification route. These greenhorns do not possess much pedagogical knowledge. The content knowledge that they possess will not help them much, particularly with hard-to-teach students or in tough teaching assignments. With their minimum of classroom experience, often with no student teaching, and with just a little time spent in observation, they should be considered severely handicapped because of their ignorance. Most of the data we have informs us that our postulants—the rawest recruits to the novice rank—lack the perceptual and

conceptual skills to do well. Policies to support these people after they are in the classroom should be formulated. Additionally, if these kinds of people will be relied on to fill shortages in the teaching ranks in the next few years, we need short-term training programs of demonstrable effectiveness to rapidly compensate for some of their perceptual and conceptual deficiencies. Such programs ought to be developed at the national level. If the secretary of education and certain state governors want such people in the teaching ranks, then the federal and state governments must either convince us that the existing information documenting the deficiencies of these people is of no consequence and will not prove harmful to children, or that they can provide training or apprenticeship programs that overcome the deficiencies these individuals have.

2. Novices are at work to gain experience. Perhaps during student teaching and during the early months of their first year of classroom teaching we try to present too much knowledge and knowledge that is too subtle or too sophisticated for them. It is possible that lectures on the ways to adapt instruction to individual differences, readings on how to promote creativity, and criticisms of performance that focus on the level of mental processing that is communicated in a message by a teacher, are all beyond the genuine comprehension of the beginning teacher. The point of beginning teaching is the accumulation of experience. That is all beginning teaching is for and that is all we should expect of it. From that experience comes the ability to understand what individual differences look and feel like in the classroom, how creative lessons interact with other instructional goals, and how level of processing can be inferred from classroom cues. Perhaps the communication of the fine points of pedagogical theory and the subtleties of pedagogical criticism need to wait until substantial experience has been gained. Early training might better concentrate on (a) perceptual training—teaching the novice to see what teacher educators believe is important for later development; and (b) identifying instances of concepts—teaching the novice to classify things that teacher educators consider important for understanding what occurs when one is a classroom teacher.

'The point of beginning teaching is the accumulation of experience.'

There is also some evidence that teachers become expert, in part, by keeping records of what they did and using these in subsequent years to think about what to do when teaching something similar. So perhaps beginning teachers need training and feedback in keeping journals and other records of their teaching behavior and thoughts about teaching. What they probably least need is input from overzealous curriculum reformers and brilliant analysts of teaching who may expect far too much from the beginning teacher.

3. The novices' relative inexperience in a complex environment allows a good case to be made for the importance of teaching them standard lesson forms and scripts. The image of the new teacher as the creative lesson planner, eschewing the teachers' manual and bringing a fresh eye to the creation of curriculum, has already been attacked as unfair by others (Ball & Feiman-Nemser,1986). It is precisely the new teacher who most needs the manuals, even with all their deficiencies. Teacher educators who would woo the novice away from the inadequate manuals should consider the developmental level of their students and ask where another guide can be found for teaching two-column addition with regrouping for the first time. But having defended the use of the teachers' manuals, we might even go farther, designing model scripts for beginning teachers to use in teaching the common things that they are most likely to teach. Beginning teachers could gain their experience while under the control of a script designed by someone who knows better how to teach a particular lesson. Holding an experienced teacher to a scripted lesson, as recommended by some behavioral programs concerned about the fidelity of implementation, is a terrible idea. This is a policy that will stifle the development of expertise because such systems require the teacher to always use context-free rules. But such systems actually do manage to have teachers deliver the curriculum that was designed. And for teachers who are in their first year, it could be a crutch of considerable importance and a way for the public to be assured that beginning teachers provide the required curriculum.

4. To do the scripting or provide the practice opportunities necessary to prepare teachers for their actual performance means knowing what a teacher is going to teach. There is something odd about having to prepare a beginning teacher for all six elementary grades or all the mathematics curriculum in a high school. It is difficult to become an expert without having an area of expertise such as fourth grade, beginning reading, biology, or government. We should prepare our novices for particular assignments that they will have their first year. Local districts ought to be able to say to the new teachers they hire, long before the day that school opens, what grade or courses they will need to be prepared to teach. Among the factors that we are sure distinguished the experts in our studies from other teachers was their concern for preparation. They were simply eloquent about the need for time to think through what and how they were going to teach. They put in many hours every week doing this. But in that most vulnerable first year, we usually send novices to schools where they do not know what they will be teaching, have no lesson scripts or lesson prototypes to rely on, and are given little planning time during the instructional day. Under these conditions, it will be the rare novice who will have a successful first year of teaching.

5. Teacher educators can do more to provide novice teachers with practice in routines that make classrooms run smoother. Practice in checking and giving homework assignments, taking attendance, and getting students to submit papers efficiently are all relatively easy-to-train skills. The novice also must learn how to introduce rules for discipline or for conducting a recitation into the ordinary life of the classroom, and must practice how to enforce those rules if they are violated. Routines need to be learned for handling everyday housekeeping chores and events that have a high likelihood of occurrence, such as a fight or a sudden illness.

Theoretical knowledge is important, but the novice often would be better served by practice in routines so that when they run their own class they can rapidly learn to perform regularly occurring tasks smoothly. One important function of routines, which every expert has, is that they allow

'Theoretical knowledge is important, but the novice often would be better served by practice in routines . . .'

the expert to go into "automatic"—to process other information and think about other aspects of the performance. Experts who have routinized whole sequences of behavior—concert pianists, tennis pros, chess masters, and teachers—are free to plan their next steps and monitor more subtle aspects of their performance. Thus, the identification of teaching routines and an emphasis in training to perform such routines are recommended.

6. Many of the recent concerns about first-year teachers have resulted in some form of mentor program. The goal has been to find expert teachers and pair them in some way with novice teachers in order to help overcome the problems faced by the novice. We might, however, want to think again about the qualities that mark an expert, including fluidity in action, holistic similarity recognition, intuitive and apparently nonreflective patterns of response, and so forth. Perhaps many fine mentor teachers could be drawn instead from the competent or the proficient group—those still analytical enough to communicate their reasons for thinking and acting the way they do.

It has often been noted that many of the great coaches in baseball and football were themselves not the most outstanding of athletes. The greatest athletes often operate intuitively, making it difficult for any but the most sensitive and articulate of them to communicate the basis of their expertise. (The great Babe Ruth was interviewed in 1928 by Carl Sandburg, who asked about the Babe's secret of success. The Babe said "I don't know, I just pick a good one and sock it.") Competent and proficient athletes have to be more analytical about their performance to achieve their high status, and it is these who often become the exemplary coaches. A similar phenomenon may hold for teaching as well . Perhaps we should investigate closely the nature and quality of the mentoring programs we have and inquire if the proficient and competent are likely to be better at this task than the expert.

Although an expert teacher may not be an ideal coach, experts can be excellent models. A classic study of expertise in chicken sexing (Lunn, 1948) makes this point abundantly clear. It is virtually impossible to ex-

plain to another person how to sex a chicken. But if you stand next to an expert chicken sexer for three months, imitating moves and remembering decisions, you will eventually be able to sex 1,000 chickens per hour with 98 percent accuracy. Being a good model and being a good coach are different characteristics, and we may be confusing them in teacher education.

7. The recent concerns about teacher evaluation, part of the press for accountability in our age of educational ferment, have resulted in the use of research-based teacher evaluation instruments. The perfectly logical belief undergirding this approach is that because certain teaching practices and methods have been reliably associated with certain desirable educational outcomes, they should be the focus of evaluation. This strategy may be, in fact, appropriate for the evaluation of novices and advanced beginners, whose job is to learn elements of instruction and who need context-free rules and procedures to guide them in acquiring experience. But certainly by the time we are dealing with proficient and expert teachers, where context moderates performance and more intuitive performance is expected, such evaluation systems are simply irrelevant and an interference. They are not tuned to the developmental needs of the teacher.

'Being a good model and being a good coach are different characteristics, and we may be confusing them in teacher education.'

On the other side of the evaluation spectrum, far from the behavioral, low-inference measurement systems of those who use the research-based instruments, are those who argue that connoisseurship and aesthetic criticism are the appropriate evaluation techniques to use with teachers. Here we note that such interpretive evaluation systems may be the *only* way to evaluate those whose competence in the classroom is not in doubt, the proficient and the expert teachers. Because of the level of sophistication these instruments assume about the person being evaluated, such interpretive techniques may not be as appropriate for the novice teacher. At the very least, feedback from such instruments may be beyond the comprehension of the typical novice teacher. Advocates of teacher evaluation by means of connoisseurship and criticism, like their more quantitative brethren, typically have failed to consider the developmental level of the

teacher. The evaluation of teachers is a complex task. As professional teacher educators. however, we can noticeably improve the process if we stop allowing the perpetuation of the myth that a single evaluation instrument will suffice for teachers at every level of development.

8. The metaphors for describing teaching now include many more references to executives and decision makers, reflecting our increasing understanding of the complexity of the job of the classroom teacher. These have led, naturally enough, to calls for teacher preparation that provides opportunities in decision making. But a developmental model of the acquisition of pedagogical skill suggests that such training may be most relevant *after* the level of competence is attained, not before. Decision making, priority setting, and other aspects demonstrating personal control over the environment are characteristic of the developmental stage of competence. We probably need to think through the scope and sequence of teacher education experiences in the same way and with the same care that we develop scope and sequence guides for students from kindergarten to twelfth grade. In the process we may learn that certain decision-making games and simulations may be more appropriate for the third-year teacher than the preservice teacher, or that some kinds of case studies to provide practice in analysis and decision making may require knowledge that preservice teachers simply do not possess, thus leading to discussions that are uninformed. Perhaps, also, the practical arguments of the preservice teacher are not really practical arguments at all—merely prejudices and beliefs untouched by experience. Thus, developing programs to modify the practical arguments of teachers may have to wait until some real world practice has affected their cognitions.

The question that must be raised while the personnel in preservice programs of teacher education struggle to develop reflective practitioners, sensible decision makers, and proficient problem solvers is whether those are proper goals for teachers who are more experienced than the novices in those preservice programs. The research on the development of expertise suggests that we have not recognized the limits of the novice and the

potential for growth of the advanced beginner and competent teacher as we develop teacher education programs.

Conclusion

Other policy considerations may be derived from the theory of the acquisition of expertise and the supporting empirical data about the differences between experts and novices. But the point has now been made, I hope, that developmental differences are real and that they may have important implications for the policies we adopt for the education of teachers. But a caution is needed as well. Too many educators, upon reading Piaget, thought that we should not bother with asking children sophisticated scientific questions because they did not have the requisite experience to handle them. Fortunately, others recognized that a developmental theory does not mean that certain experiences should be avoided completely or that individuals should be exposed to problems only at the appropriate level of their development. Thus, I am not advocating a narrow form of job training as the curriculum for preservice teacher preparation. I am suggesting that our extensive knowledge base about teaching and teachers be thought of as more or less appropriate to people in different stages of their development. I am also suggesting that preservice education may not be the most appropriate place to teach some things, and therefore we may have to extend our programs of teacher education for some time after our students have entered practice. I am suggesting as well that the forms of evaluation for experienced and beginning teachers may have to differ. And I am suggesting that experts, revered as they may be, may not always make the best teachers of novices. I am arguing that the development of competence out of ignorance and expertise out of competence may take a long time in a profession as complicated as teaching. We may be unable to shorten the trip very much because extensive experience is fundamental to development, but we certainly ought to help nurture those willing to undertake the journey by providing training and evaluation appropriate for their level of development.

'. . . developmental differences are real and . . . they may have important implications for the policies we adopt for the education of teachers.'

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