General Interest

Expert and Novice Teacher Decision Making

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The thinking and decision making of expert and novice teachers were compared before, during, and after teaching. The novices were five student teachers, and the experts were their five cooperating teachers in a suburban elementary school. Audiotaped planning interviews, videotapes of lessons, stimulated recall interviews, post-teaching interviews, delayed self-reports, and relevant printed materials were analyzed using the constant comparative method. The expert teachers thought about learning from the perspective of the student and performed a cognitive analysis of each learning task during planning, which they adapted to the needs of students during teaching. In contrast, novices used specific lesson objectives to form structured lesson plans that they did not adapt to meet student needs during teaching. Models for expert and novice teacher decision making are proposed, as well as implications for teacher education.

Jackson (1968) initiated a paradigm shift in educational research when he wrote about the complexity of the classroom. He described teacher decision making as preactive, interactive, and postactive, that is, occurring before, during, and after teaching. Until this time, most research in education had focused on teachers' observable behaviors and student outcomes. For example, the *Handbook of Research on Teaching* (Travers, 1973) did not contain a single reference to teach ers' thought processes. During the 1970s, however, research on teacher thinking and the related field of cognitive psychology increased dramatically. In 1973, Shavelson characterized decision making as the basic teaching skill and went on to assert that decision making is involved in every aspect of a teacher's professional life. Near the end of the decade, educational researchers such as Joyce (1978-1979) used an information processing orientation to examine how teachers obtain, organize, and use information from the complex environment of the classroom to make decisions. This type of research led to the realization that teaching is a complex and cognitively demanding activity. Furthermore, a teacher's thinking and decision making organize and direct a teacher's behavior and form the context for both teaching and learning (Medley, 1981). In 1981, Shavelson and Stern proposed a model of teacher decision making showing how teachers integrate information about students, subject matter, the classroom, and other factors in making decisions.

About this time, researchers interested in teacher cognition began to explore the differences between expert and novice teachers. The expert-novice comparison had been used to study the nature of expertise in other domains but not in teaching (Anderson, 1982; Chi, Feltovich, & Glaser, 1981;

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Simon, 1979). Comparisons of expert and novice teachers have shown that they differ in their thinking and decision making. For example, expert and novice teachers differ in how they perceive and interpret classroom events (Calderhead, 1981). Expert teachers have information-rich schemas that allow them to represent the complexities of the classroom in meaningful ways (Calderhead, 1983).

Researchers of teachers' thinking and decision making have used the language and findings of cognitive psychology to contrast the cognitive processes of expert and novice teachers (Berliner, 1987; Clark & Peterson, 1986; Leinhardt & Greeno, 1986). For example, Gagné (1985) and Gage and Berliner (1984) noted that because of their less well-elaborated schemas, novices lack the metacognitive and monitoring skills that experts possess. These skills allow expert teachers to moniter classroom situations, recognize problems, and make decisions that solve the problems. Fogarty, Wang, and Creek (1983) reported that novices fail to adapt instruction in response to student cues. They found that experienced teachers attended to a larger number of instructional goals in making interactive decisions. The experienced teachers also used a larger range of instructional strategies and linked their actions to student cues in more complex ways than the novice teachers. Veenman (1984) explored beginning teachers' perceptions of problems in teaching from a cognitive developmental framework and concluded that teachers at different developmental stages perceive and process classroom problems in different ways. Beginning teachers perceived that they had more difficulty with discipline and classroom management than with delivery of subject content matter.

To teach successfully, teachers must develop expertise in both pedagogical and content knowledge and in how these two forms of knowledge interact in teaching (Berliner, 1986). A mental representation formed by a teacher during planning serves as a guide to move the lesson forward, while interactive decision making allows the teacher to adapt the plan to students' needs as the lesson progresses (Parker & Gehrke, 1986). Shulman (1987) conceptualized a teacher's mental representation of a lesson as a bridge linking the teacher's understanding of the lesson content to the learning of the students. He described teaching as a learned profession and pedagogical content knowledge as teachers' special form of professional understanding. Berliner (1988) suggested that during planning, novice teachers form mental representations of their lessons that are too narrow or incorrect and that therefore lead to problems during teaching.

Research results on expertise in teaching have sometimes been compared to the results of research on expertise in other areas and professions. For example, a study involving teachers designated as expert, novice, and postulant teachers (individuals who possessed content knowledge but had no pedagogical training or experience) found similarities in the ways expert teachers process classroom information (Carter, Sabers, Cushing, Pinnegar, & Berliner, 1987). Like experts in other fields, expert teachers possess well-elaborated schemas that provide a frame-work for the meaningful interpretation of information. Expert teachers had an understanding of what to expect in the classroom and therefore set up procedures and rules for student behavior. Peterson and Comeaux (1987) similarly reported that expert and novice teachers differ in the cognitive complexity of their schemas for classroom situations. These information-rich schemas aid experts in problem solving and decision making during teaching. They interpreted the differences they found as consistent with expert-novice differences in other domains.

At present, however, little is known about the development of learning to teach (Feiman-Nemser, 1983; Zeichner, 1986). In a research program designed to add to the knowledge about novice teachers' thinking and actions, researchers at the University of Maryland are investigating how preservice teachers think about teaching. They examined the relationship between teacher preparation programs and preservice teachers' thinking and concluded that student teachers need help to further develop both pedagogical and content knowledge (Borko, Livingston, McCaleb, & Mauro, 1988). Borko and Livingston (1989) examined the planning, teaching, and reflections

of student teachers and their cooperating teachers and found differences in all of these areas of teaching. They attributed these differences to the novice teachers' less elaborate, less interconnected, and less accessible cognitive schemas. Recently, Clarridge (1990) also investigated the effect of differences in training on classroom performance. She compared individuals ranging in ability from those who had no pedagogical training or classroom experience to those designated as expert teachers. The teachers with a lack of pedagogical skills were lacking in abilities that are important to effective teaching. In spite of a high degree of content knowledge, these teachers failed in their delivery of subject matter content to their students. They lacked precisely those abilities that should be developed as part of a teacher education program.

Research on the cognitive processes of teachers has provided the theoretical basis for this line of research. Although research has shed considerable light on expert-novice differences, few studies have examined these differences before, during, and after teaching. The purpose of this study is to clarify our understanding of the nature of expertise in teaching by comparing the thinking of expert and novice teachers during three stages of decision making: preactive or planning, interactive or teaching, and postactive evaluating and reflecting.

Method

Two groups of teachers participated in this study. The five experts were teachers in a public elementary school in a middle-class suburb of Washington, D.C. This school was participating in a project on reflective teaching being conducted at The Catholic University of America sponsored by a grant from the U.S. Department of Education Office of Educational Research and Improvement. Five schools were identified as target or professional development schools. At each school site, teachers volunteered to be part of the project after we communicated our goals. Five expert teachers were selected by their administrators and by university personnel skilled in observation methods who observed them in their classrooms. Teachers at each of the five schools were selected to act as cooperating teachers for our student teachers.

The criteria for selecting the expert teachers in this study were based on how well their teaching matched our goals. These goals included identifying teachers who implemented an integrated curriculum, who were able to promote reflection in our student teachers, and who were willing to spend time to develop a problem solving orientation toward teaching. The experts in this study were highly qualified and committed to improve teacher education. They consistently used strategies they wanted the student teachers to model. Their classrooms reflected the university teacher education program's instructional philosophy. Each of the expert teachers had over 5 years of teaching experience at the elementary level.

The novices were five undergraduate student teachers in their senior year at the university. All subjects participating in this study were female. Participation was voluntary, with lessons conducted in the teachers' regular classrooms with the students they normally taught. Grades ranged from first to sixth grade, and subjects included language arts, mathematics, social studies, and spelling. Each teacher taught 2 lessons, resulting in a total of 20 lessons for the analysis.

Data were collected in four phases for each lesson. The first phase was during the preactive or planning stage. Each teacher was interviewed before teaching a lesson to determine what decision making went into the planning. A university team developed the structured interview questions on the basis of research on teacher thinking and decision making. The questions probed the teachers' thinking in planning the lesson (e.g., Is this lesson related to anything else you are doing? Where do you start when you plan a lesson? How do you use your plans during actual teaching?) Written lesson plans were a university requirement for student teachers, but none of the experts wrote out plans.

The second phase of data collecting was during the interactive stage of teaching. The lesson was videotaped as it was being taught and, shortly

after the completion of the lesson, a stimulated recall interview was conducted. The videotape of the lesson was played back in its entirety. The teacher was instructed to stop the tape each time she remembered making a decision and explain the thinking that went into the decision. A possible limitation of stimulated recall interviews used to capture interactive thinking and decision making has been discussed in the literature (Ericsson & Simon, 1980; Fogarty, Wang, & Creek, 1983). Stimulated recall interviews were used in this study to trigger teachers' recall of decision making that occurred during teaching. The problem is that the technique may also elicit thinking that occurs as a result of seeing the videotape. This thinking could confound the results, because the interview is postactive rather than interactive. The interviewer was aware of the problem and held postactive decision making to a minimum by carefully watching for it and reminding the teacher that a postactive interview would immediately follow the stimulated recall interview.

The third phase followed immediately after the stimulated recall. The teacher was asked questions to elicit postactive evaluation and reflection (e.g., Would you rate this lesson as successful? Why? Did you gain information during the teaching of this lesson that will be useful in planning future lessons?).

The fourth phase of data collection occurred several months later when a self-report was conducted using the videotape of the lesson without the sound. Unlike the stimulated recall interview, the teacher did not stop the tape. Instead, she was asked to talk continuously while the tape played. The purpose of this phase was to capture any decision making that had not been reported during the stimulated recall interview, as well as any changes in thinking on the part of the teacher.

All interviews and videotapes were transcribed. Additional data included school system curriculum guidelines, classroom handouts, students' work, and field notes taken during the teaching of lessons. Qualitative analysis of these data followed the constant comparative method developed by Glaser and Strauss (1967). This is an inductive approach that produces theory grounded in the data.

Each of the 20 protocols was analyzed for patterns of similarities and differences among the three stages of decision making and between expert and novice teachers. Categories were identified from these patterns and used to code the transcripts. The first round of analysis of the planning protocols was followed by returning to the transcripts for further comparison and refinement of categories, identification of additional categories, and substantiation of the preliminary hypotheses. Each incident or decision point was compared and contrasted with other incidents across protocols, thereby generating hypotheses that were interconnected and constantly refined by information emerging from the data. For the interactive decision-making stage, each videotape was examined along with the corresponding stimulated recall transcript to analyze decision points identified by the teacher. Tables were constructed comparing frequencies of categories for experts and novices. Lists were made of incidences of categories abstracted from the protocols for further coding and refinement. For postactive evaluation and reflection, categories generated for planning and teaching were used to code the protocols. Incidences of categories for each stage were abstracted from the protocols and placed on lists to undergo further coding and refinement. This cyclical pattern of category construction and protocol coding continued through several phases of analysis and led, eventually, to the reduction of categories and the generation of theoretical propositions. At each step in the analysis, interrater reliability provided verification of the categories and emerging hypotheses.

Results

Important differences between the thinking and decision making of expert and novice teachers emerged as the data were analyzed and reanalyzed. The most notable of these differences involved (a) integration of knowledge, (b) student behavior, and (c) interaction among the three stages of decision making.

Integration of Knowledge

Integration of knowledge, as used here, means combining new subject matter content knowledge with prior knowledge and is an essential part of any learning. Integration of knowledge emerged as a difference between expert and novice teachers during the first round of analysis. This category referred to comments by teachers about the way their individual lessons fit into the total curriculum. For example, one expert sixth grade teacher explained, "This is our reading curriculum....In the early grades they begin to discuss works of fiction in terms of setting, et cetera. So they've been through this curriculum since third grade." When planning lessons, the expert teachers performed a cognitive analysis of the learning task that lay ahead. The experts were able to do this because they thought about the learning task from the perspective of the student. For example, while planning a math lesson, one expert teacher commented, "We've worked with grids before, and we've worked with paths, but we've never worked with closed area." Because the experts thought about learning as a sequential process, they made planning decisions on the basis of related content knowledge that their students had been exposed to and could be expected to have retained. Another expert teacher said, "I decided to tie this lesson to what we had discussed earlier in the year." This cognitive analysis, along with the teacher's knowledge about her students' abilities, learning styles, interests, and motivations, formed the basis for her planning.

Integration of knowledge also involves relating current lesson content to other subjects in the curriculum. For example, while reflecting on her teaching of a social studies lesson, an expert teacher explained, "I mentioned the hero to tie in an activity that we had done last writing lesson, which was to write an adventure story featuring a hero or heroine." This awareness on the part of expert teachers is important because it allows them to place new learning in the context of prior knowledge and allows students to see where the present lesson fits in with what they already know. Research in cognitive psychology suggests that providing a context for new information in this way can help students learn (Sternberg, 1981).

Expert teachers used the curriculum guidelines as a foundation for building lessons and making them uniquely their own by changing, combining, and adding to them according to their students' needs and their own goals. One expert teacher commented, "I always do what I'm supposed to do (i.e., teach the curriculum objectives), but then how I implement it comes from my own self."

Novice teachers, on the other hand, did not have enough knowledge about the overall curriculum nor sufficient awareness of student characteristics to allow them to perform an adequate cognitive analysis of the lessons they were planning. Novices rarely mentioned integrating the present lesson with prior knowledge as the experts had during their preactive interviews. Instead, when planning lessons, the novices relied on the one thing they knew about and felt accountable for, that is, the curriculum objectives for their grade as prescribed by the county public school system.

During the preactive interviews, most novices explained their planning by saying something like, "I just had to make sure they met all the objectives." Whereas the expert teachers used the curriculum guidelines in an interpretive way based on the needs of their students, the novices used the guidelines in a more literal way. When the interviewer asked how a novice teacher had planned the lesson, she replied, "The main topic is graphs, and the curriculum guide gives you an instructional objective." Novice teachers' planning indicated that they did not have a well-developed theory of instruction nor an overview of student learning in a subject matter content area and therefore planned each lesson as a discrete entity based on the prescribed objectives. This meant that novices sometimes planned to teach sub-skills without an understanding of how these sub-skills fit together. When asked if the lesson they planned related to anything else, novices often answered, "No, not really."

The differences between expert and novice teachers in the integration of knowledge became even more obvious during teaching. At the beginning of their lessons, the expert teachers spent a

few minutes reviewing relevant information. They frequently began with the words, "Remember when we learned about...." This simple strategy provided the teacher with valuable information about how much of the topic the class remembered and, therefore, about where to start. For the students, it brought the topic and relevant information to short-term memory and provided a framework for new learning. An expert teacher commented on this by saying,

> I'm trying to make them see where this lesson fits into something they already know so they can let it become part of the knowledge base. I think kids need to be able to key into something they already know and build on it.

The data produced a wealth of evidence that as their lessons progressed, expert teachers carefully integrated present learning with the students' prior knowledge. For example, another expert explained, "That was to clarify for the kids that subjects are interrelated; things aren't in isolation." The expert teachers often doubled back to repeat a point, relate new information to prior knowledge, and assess their students' understanding: "That's a decision to go back and repeat the idea so that they know this is a focal point. This is what you have to listen for. This is what we're dealing with." Furthermore, before going on to a new point, these teachers summarized what had been discussed and set the stage for what was coming next.

The novice teachers, on the other hand, often started their lessons without recalling students' prior knowledge about the topic of the lesson: "Today we're going to talk about consonant blends." As their lessons progressed, novices did little to relate present learning to past or future learning. Furthermore, the novices did not summarize information or set the stage for new learning at transition points in the lesson as the experts did. One novice stopped the videotape and said, "I made a decision that they had talked enough so I just gave them the assignment." The failure of the novice teachers to relate subject content information can have an important effect on student learning, particularly for those students who are unable to independently provide a framework for new knowledge.

Student Behavior

The novice teachers' attention to student behavior will surprise no one. Although there may be several reasons for the novices' preoccupation with student behavior, what was of special interest was the way expert and novice teachers thought about student behavior and what decisions each group made about it. This difference became apparent during the second round of analysis when the interactive data, that is, videotapes and stimulated recall transcripts, were examined.

When off-task behavior, such as talking or inattentiveness, occurred during an expert teacher's lesson, she brought the offending child back to the lesson by calling on the child or using some other strategy from her repertoire of management techniques. For example, an expert teacher called on a first-grade boy who was talking by saying, "Jimmy, I know you know a lot about butterflies so pay attention and help us add to the chart." This got the child involved again and gave him a new opportunity to learn without disrupting the lesson for other class members. As their lessons progressed, expert teachers were aware of behavioral cues that told them when to change their approach. For example, one expert teacher reported, "I wanted to get them moving because they were getting antsy." Expert teachers prevented problems by using their voices and body language along with well-practiced management strategies to motivate students and control their attention. During the postactive interviews, the expert teachers usually offered some reason for poor behavior such as, "Reading is hard for Jimmy, and that's why he can't sit still." In other words, the experts seemed to see causal relationships between the child's behavior and the underlying reasons for it.

Novice teachers usually ignored off-task behavior when it first occurred. When the behavior became too obvious to ignore, sometimes to the point of disrupting the class, the novices usually interrupted the lesson to punish the child by a glare, a reprimand, or, as happened in one

case, sending the student into the hall. Punitive actions can cause children to "tune out" for the remainder of the class period and can disrupt the learning of the other children as well; a group of studies has demonstrated that student achievement is higher in classes where a smooth flow of instruction is maintained (Emmer, 1982; Emmer, Evertson, & Anderson, 1980; Evertson & Anderson, 1978). Novice teachers did not adapt their lessons even when the children became restless from being too long at a task. When asked about her reasons for this, one novice reported, "I had my lesson plan, and I just wanted to get to every part of it and get it finished." Another said, "I wanted to avoid kids getting out of their seats as much as possible." During postactive interviews, the novices commented on student behavior without giving any underlying reasons for their actions. For example, one novice commented, "They were very rowdy and all talking at the same time," without offering any possible reasons for the behavior.

Interaction of the Three Stages of Decision Making

For the expert teachers, the three stages of decision making—preactive, interactive, and postactive—were highly related. This allowed for a wide range of possibilities during teaching. The expert teachers used many types of information, such as knowledge of the overall curriculum, subject matter, and students' interests, to arrive at goals for their lessons. For example, one expert teacher said, "I have here a lesson which I have planned and overplanned because I know what I want to get out of the students." Because the experts were able to predict possible problems, these goals contained contingency plans in case the lesson did not go as planned. One expert teacher explained, "I'm not sure how much information they will have (about the topic). If they know a lot already, then the lesson will go very quickly. If they don't know a lot, then I'm going to have to give them information from these books and pictures I got from the library."

The data provided evidence that expert teachers form an image or a mental representation of the lessons they plan that includes their goals. The teachers were asked, during the structured planning interview, if they had imagined how their lesson would go. One expert reported, "I've been teaching for 23 years and when I plan a new activity, I can picture it in my mind and predict how it will go, and I plan for that." Another expert said, "I have a vision. I sort of know exactly how it's going to go. I've imagined what will happen." The novices' comments, however, sounded less sure about what would happen: "I can't predict. It could go one way or the other," and "I imagine my part, mostly because the kids, you never know what they'll do."

For the experts, the interactive stage, or actual teaching, was driven by the goals they formulated during planning. During the stimulated recall interview, one expert teacher commented, "It appears that every time we get off the subject, I try to get them back onto the right track because, although I'm certainly open to discussion, I have my idea of what I want to accomplish with them." The experts were flexible in how they moved toward their goals. As they were teaching, they monitored what went on and adapted their lessons accordingly. For example, an expert teacher reported, "That was a decision to go with their ideas and not force them into what I thought they were going to do." The experts modified their preactive decisions in response to student reactions while moving the lesson forward to attain their goals. The expert teachers often accomplished this by using well-practiced classroom strategies or routines. Experts' lessons were highly interactive, with students and teacher having equal parts to play. Comments made during the stimulated recall interviews indicated that the expert teachers felt free to deviate from their plans to discuss or review when needed. For example: "I think it's important to be open-ended with kids. I don't care if the lesson doesn't go exactly the way I planned as long as I know where we're heading."

During the postactive interviews, the experts evaluated their lessons according to how well they had achieved their goals with regard to the needs of their students. Most experts were pleased with

their lessons. For example, an expert evaluated her lesson in these words, "I thought the lesson was extremely successful. I felt that it was going in just the direction I would have wanted. People were involved and I thought it was working very smoothly." Because the expert teachers' mental representations were so comprehensive and because they adapted their lessons based on cues from students, decisions made during lesson planning did not appear to constrain what happened during teaching.

For the novices, the three stages of decision making were more linearly related. In other words, they planned; they taught the lessons; and then they evaluated them. The three stages of decision making did not connect to each other in a dynamic way, as they did for the experts. The novice teachers did not have the experts' comprehensive view of the classroom nor the knowledge to know what components of their lessons might connect to what the students already knew. The narrow focus of their planning, based almost solely on the curriculum objectives, seemed to limit what went on in the classroom. During teaching, the novices stuck closely to their lesson plans, sometimes ignoring students who brought up interesting points for discussion. As one novice put it, "I just didn't know enough about the topic to discuss it freely. I just wanted to stay close to my lesson plan and get it all done." In this way, the novices limited the discussion to what they knew. Another novice teacher commented, "I didn't know what I'd do if someone brought up a point that was different from the answer I had but was also correct." This remark demonstrates a lack of both content and pedagogical knowledge.

During postactive interviews, the novices evaluated their lessons according to two criteria: whether they had achieved the prescribed objective and how the students had behaved. The novices did not have all of the information that the experts had and, therefore, formed narrow mental representations of their lessons that seemed to restrict their classroom interactions. Rather than adapting their lesson plans when cues from students warranted it, the novices seemed determined to carry out their plans, sometimes in spite of anything that happened during the lesson. Furthermore, the novices seemed unsure of how to use the information gained during teaching to plan future lessons. This lack of confidence in how to use available information is true of novices in fields other than teaching (Lesgold, Feltovich, Glaser, & Wang, 1981; Patel, Frederiksen, & Groen, 1984).

Discussion

The mental representations that teachers form during planning have been discussed at length in the literature. There is wide acceptance that a mental representation, sometimes called an image, is important because it drives a teacher's interactive performance (Berliner, 1988; Calderhead, 1983; Medley, 1981; Parker & Gehrke, 1986). The in-depth analysis performed in this study provided striking evidence of the differences between the mental representations of the expert and novice teachers. The experts' mental representations, including their goals, were based on a much more comprehensive view of the classroom whereas those of the novices had a much narrower scope. The novices in this study formed goals as part of their mental representations, as the experts had. The novices' goals, however, were most often the same as the lesson objectives. This seems to counter Parker and Gehrke's (1986) assertion that interactive decision making is shaped by learning activities rather than by lesson objectives. Although their assertion seems true for expert teachers in this study, the novices indicated that they did not respond to student cues because their lessons were driven by wanting to accomplish the objectives. Parker and Gehrke also maintained that interactive decision making about subject matter is nearly indistinguishable from decision making about classroom management. Again, my data indicated this to be true for the expert teachers but not for novices.

Peterson and Clark (1978) and Shavelson and Stern (1981) proposed models of interactive decision making. I propose a model of expert teachers' decision making that encompasses all three stages: preactive, interactive, and postactive

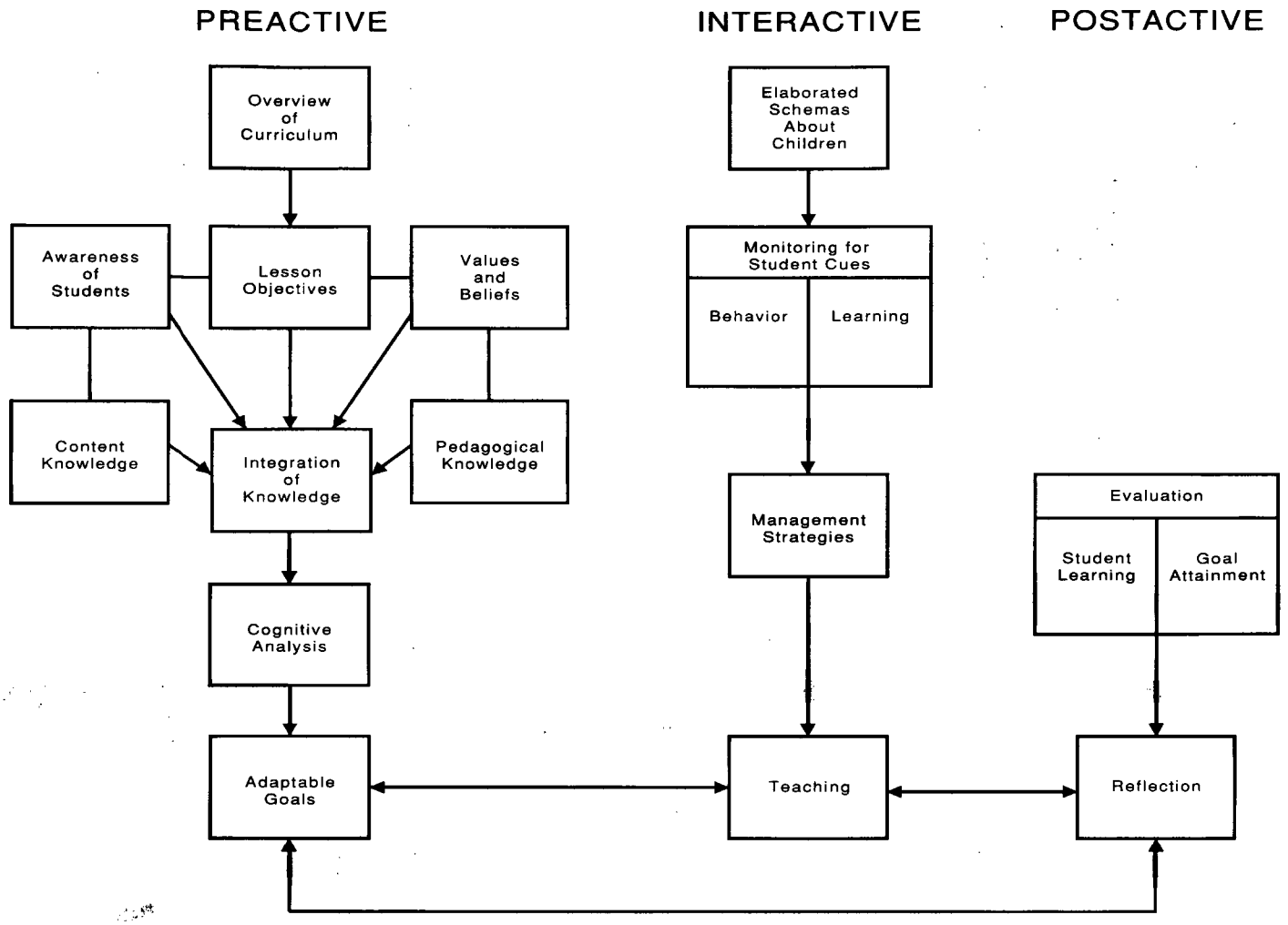

Figure 1. Expert teachers' decision making.

(see Figure 1). This model is dynamic in the way that all information processing is dynamic. For experts, the components of each of the three stages are related in the process of decision making. Berliner (1986) suggested that teachers develop expertise in both pedagogical and content knowledge, but that is not enough to become an expert teacher. The two forms of knowledge must interact in teaching. In a similar way, all the components of this model taken together do not account for expertise in teaching. A novice could have a good deal of this information available and still not teach effectively. Rather, it is the information-rich components, and, more importantly, the interaction among the components that account for expertise. To illustrate, during planning, the expert teacher's goals are based on his or her understanding of the learning task. However, during teaching, these goals are shaped and tailored to what is happening in the classroom. Tailoring lesson plans to accommodate student needs is what many novices cannot do. This holds true even for novices who have a high degree of content knowledge as the result of having careers in professional fields other than teaching.

In contrast to the model for expert teachers, decision making for novices seems more linear than dynamic across the three stages (see Figure

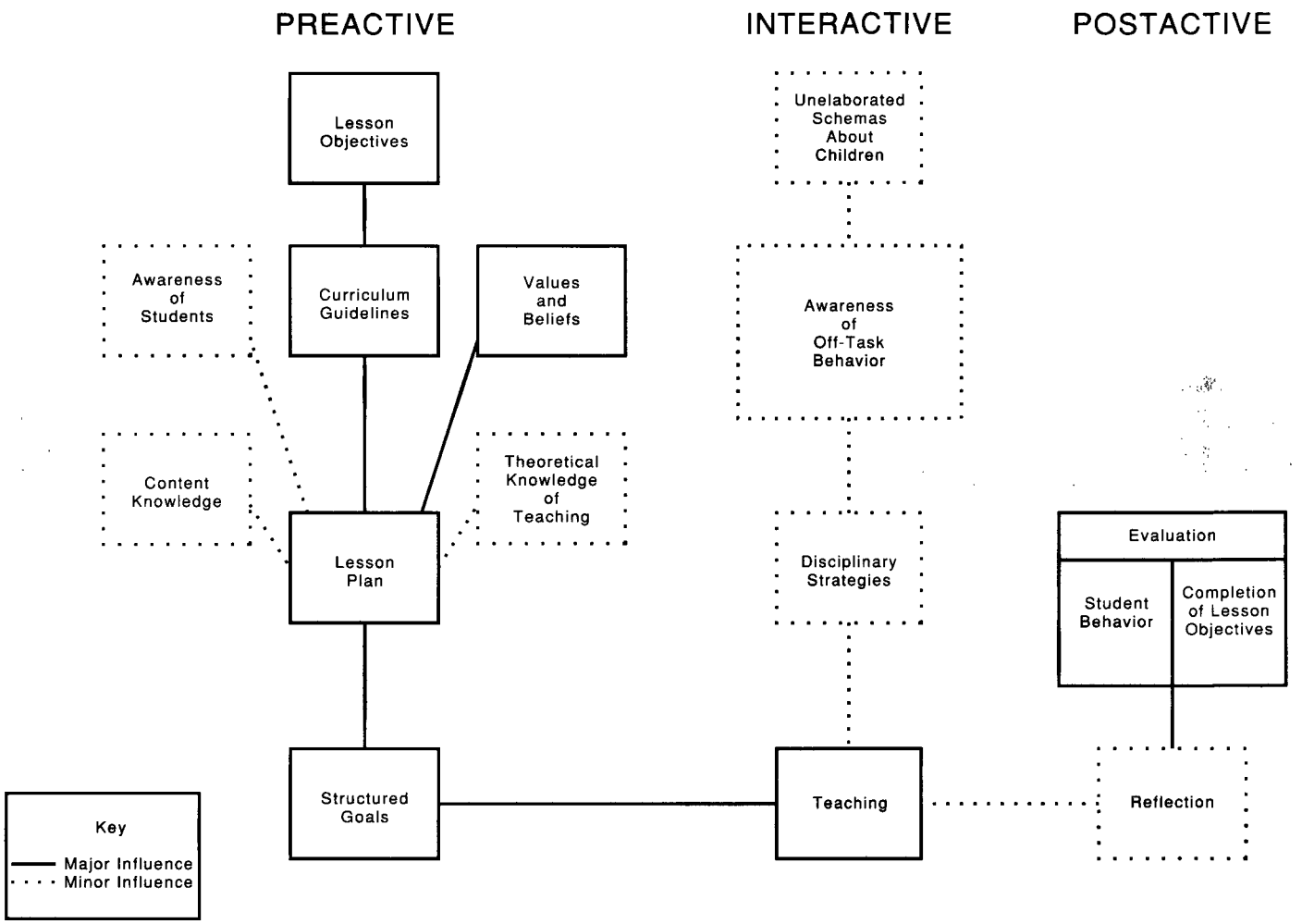

Figure 2. Novice teachers' decision making

2). When making decisions, novices attend to a limited number of factors in the teaching domain and know few teaching strategies or alternatives. The dotted lines in Figure 2 indicate that the components of the model are not as information-rich as those of the experts. Furthermore, the information components that novices do have are not interconnected to other components in the way that the experts' knowledge seems to be. Carter et al. (1987) discussed this idea when they concluded that what makes a teacher an expert is more than simply having more elaborate schemas. Rather, their schemas permit experts to weigh information quickly. This skill in processing information is of utmost importance in the complex and unpredictable world of the classroom. Borko and Livingston (1989) found that differences in all areas of teaching were the result of the novices' less elaborate, less interconnected, and less accessible schemas.

These decision-making models are offered in the hope that they will help to clarify our understanding about expert-novice differences in teaching. Comparing the models may provide evidence, as well as reasons, for Veenman's (1984) conclusion that teachers at different developmental stages perceive and process classroom problems in different ways. For example, the models suggest

that experts effectively use information from a wide variety of sources when they interpret classroom situations. Furthermore, the models may shed light on reasons why, when solving classroom problems, expert teachers are guided by underlying causes, whereas novices pay more attention to surface features, as was reported by Peterson and Comeaux (1987). One reason may be that the novices lack information about underlying causes because of their unelaborated schemas about children. In addition, surface features of classroom problems preoccupy a novice's attention because they know that they do not have strategies for dealing with them. These models may also lead to understanding how expert teachers are able to move the lesson forward to their goals while responding to cues from the students as reported in the literature (Fogarty et al., 1983; Parker & Gehrke, 1986). The models suggest that experts monitor student learning and behavior and adapt their lessons to student needs, changing instructional strategies when necessary, but always moving toward attainment of their goals.

Many questions about the development of expertise in teaching remain. Researchers should continue to explore the developmental milestones that lie between novice and expert decision making. Piaget proposed that the thinking of children, rather than being simply a matter of the amount of knowledge an individual has, is qualitatively different from that of adults (Furth, 1981). Similarly, this and other studies provide evidence that the thinking of novice teachers is qualitatively different from the thinking of experts. That is, the major developmental difference between expert and novice teachers is the way they use pedagogical and content knowledge. Are there stages in developing expertise as there are in a child's construction of logic? A longitudinal study could provide valuable evidence about the nature of developing expertise in teaching.

Implications for Teacher Education

The results of this study suggest some teaching skills that should be emphasized during teacher education. Understanding the differences between expert and novice teachers, explicated by naturalistic studies such as this, can enable teacher educators to intervene in effective ways during university course work and student teaching to help novice teachers develop expertise in teaching.

For example, teaching in a way that aids in the organization and integration of knowledge involves a set of skills that should be emphasized. Novice teachers should be taught to plan lessons using an overview of the curriculum rather than to simply consider the objectives for the specific lesson they are preparing to teach. They should be taught to assess the prior learning of their students and then build lessons that help students integrate new information with old knowledge. The education program at the university included the teaching of these skills. The findings of this study suggest, however, that these skills are difficult to acquire and need in-depth attention and emphasis. Through teaching and modeling effective classroom procedures, university and school personnel can give novices a comprehensive view of teaching and student learning similar to that which guides expert teachers. This overview will permit novices to think of learning as a sequence of interrelated skills rather than as discrete bits of information. In a recent article, Feiman-Nemser and Parker (1990) discussed differences in the ways teachers treat subject matter. They found that mentor teachers who treated learning, in this case multiplication, as a process rather than as an outcome encouraged novices to think of subject matter in relation to students' thinking. Novices should be given guidance and practice in seeing the learning task and, indeed, the entire school situation, from the students' perspective. In the present study, this ability was a hallmark of expert teachers' decision making in both planning and teaching.

In the realm of student behavior, novice teachers can be directed to look for causes underlying inattention or off-task behavior. They can be guided to monitor students for cues that tell them to adapt their lesson plans, rather than to follow their plans so closely that they constrain interactive decision making. During planning, student teachers should be asked to predict possible problems with their lessons and to plan alternative ways to carry

out the lesson. This would encourage the novices to formulate the contingency plans for their lessons that were apparent in so many of the experts' plans.

During the postactive stage, novice teachers should be taught to evaluate their lessons with a broader perspective. Rather than judging lessons on the objectives and student behavior, they should rate them on the basis of meeting students' needs, as the experts do. In this study, the delayed self-report seemed to help novice teachers understand their own thinking and decision making. Perhaps the delay allowed them to evaluate their lessons from the point of view of the students rather than to focus on their own performance.

Teacher educators can provide opportunities for students to practice integrating the three stages of decision making and, in this way, build some of the connections that are so apparent in the thinking of expert teachers. This can be accomplished by presenting information about classrooms that provides evidence of how planning, teaching, and evaluative reflection are related. For example, emphasizing the relationship between contingency planning, classroom management, and lesson evaluation would be valuable to novice teachers.

Finally, important implications for both teacher education and the professional development of experienced teachers can be found in the data gathering methods used for this study. The integrated approach used here included preactive conferencing and interactive videotaping, followed by watching and discussing the videotaped lessons and postactive reflection. Student teachers could work closely with cooperating teachers and university personnel using this methodology to examine their teaching as well as the teaching of other novices and experts. Experienced teachers can work with peers or administrators. These procedures offer insights into decision making that are unavailable through more traditional methods. The increased awareness of teaching strategies and how to use them can aid both experienced and novice teachers in planning and conducting lessons that help students learn. This methodology promotes reflection for expert teachers as well as for novices. The value of this methodology in promoting teacher reflection was apparent in one expert teacher's statement: "This [set of procedures] really made me think things through; it forced me to think about my ideas and philosophies and forever changed the way I taught after this process ended." Student teachers, it must be remembered, will not become experts simply by being forewarned about the pitfalls brought out by this research. As Mayer (1987) asserted, "There is no shortcut to becoming an expert in a professional field" (p. 240). Rather, results of this study suggest that novices can benefit from teacher education programs that provide systematic teaching of sound decision making during course work and student teaching. These programs will foster the development of teaching skills that should, in turn, aid in the development of expertise.

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