3 *Characteristics of Expert and Novice Teachers*

In the previous chapter, I reviewed three major theories of expertise and their delineation of the characteristics of experts across skills and disciplines. In this chapter, I shall examine the characteristics of novice and expert teachers that have been identified in the literature on teaching expertise and see to what extent they share the characteristics of novices and experts in other professions.

Studies of expertise in teaching mostly took the form of novice-expert comparisons. They drew on studies of teachers' mental processes in planning and decision-making, which were seen as a link between thought and action, and were heavily influenced by an information processing model of the mind in cognitive psychology (see Calderhead, 1996). In some studies, laboratory tasks were designed, and elicitations of teachers' thought processes were conducted. In other cases direct observations of classroom teaching and stimulated-recall interviews were used. Most studies comparing expert and novice teachers focused on their cognitive processes in different phases of teaching, taking on board the distinction made by Jackson (1968) between 'preactive' and 'interactive' phases of teaching. The former refers to the period before teaching, when teachers are planning the lesson and evaluating and selecting teaching methods and materials. The latter refers to the time when teachers are interacting with students in the classroom. Jackson pointed out that there are qualitative differences in what teachers do in these two phases. Clark and Peterson (1986) proposed a third phase, the "postactive" phase, to describe the period when teachers reflect on their teaching after a lesson and make decisions about subsequent teaching. However, as they themselves pointed out, the distinction in teacher thinking between the preactive and the postactive phases is not as marked as that between the preactive and interactive phases because of the cyclical nature of the teaching process. Reflections on teaching in the postactive phase often serve as input for planning in the preactive phases.

In the rest of this chapter, I shall discuss the findings of expert-novice studies in the preactive and the interactive phases of teaching. It should be noted, however, that decision-making in these two phases

are intertwined and it is sometimes not easy to distinguish between the two.[1]

3.1 Preactive Phase

In the preactive phase, planning is considered the most important thinking process in which teachers engage (Kounin, 1970; Doyle, 1977; Yinger, 1979; Calderhead, 1984). Calderhead (1984) points out that "it is in planning that teachers translate syllabus guidelines, institutional expectations, and their own beliefs and ideologies of education into guides for action in the classroom. This aspect of teaching provides the structure and purpose for what teachers and pupils do in the classroom" (p. 69).

A model of planning, which consists of a linear sequence of decisions, which is widely adopted in teacher education programs, is that proposed by Tyler (1950). First of all, decisions are made about aims and objectives. Aims are the more general statement of purpose, and objectives are the specific realizations of aims. Decisions are then made about the content of the lesson, that is, the kind of materials or activities that would help to achieve the objectives. Following this, the organization of activities, or the presentation of materials, is decided upon. Finally, evaluations are made about the lesson. These evaluations serve as input for future lessons.

Research on the actual planning process of experienced teachers has found, however, that teachers seldom plan in the manner suggested by Tyler. Instead, they consider first aspects such as materials and resources, students' interests and abilities. Aims and purposes are considered last (see Taylor, 1970). The decisions that teachers make when planning have to do with mostly activities, teaching strategies, and content. Only a small proportion has to do with objectives (see Zahorik, 1975; Peterson, Marx, and Clark, 1978). For many teachers, activities or content are the basic structural units of planning and action in the classroom (Clark and Yinger, 1979; Kagan and Tippins, 1992; McCutcheon, 1980; Morine-Dershimer, 1979; Yinger, 1980). However, this does not mean that experienced teachers do not consider aims and objectives when they are planning. In Morine-Dershimer's (1979) study of the mental plan of teachers, it was found that when teachers were probed about objectives and teaching strategies, they had ready answers. This suggests that they did consider such aspects of instruction although these aspects may not have figured explicitly in stated plans. Nunan (1992) observes that though the plans and instructional objectives may be transformed in the teaching act, they provide a framework for the interactive decisions

1 I am grateful to Devon Woods for pointing this out to me.

during the lesson and the evaluation afterwards. In McCutcheon's study (1980), teachers reported that the objectives were implicit in the activities and that it was not necessary to write them down (see also Clark and Yinger, 1987). The question is therefore not *whether* teachers consider objectives, but *when* they do so. Mcleod (1981, cited in Clark and Peterson, 1986) found that teachers thought about intended learning outcomes more in the interactive phase than in the preactive phase. Sadro-Brown (1990) found that decisions about objectives and content were made at the yearly level, while decisions at the daily level typically concerned activities, instructional methods and materials, and individual student needs.

Calderhead (1984) proposed an alternative conception of teacher planning as a problem-solving process. He wrote:

> Research on teachers' planning suggests that teachers engage in a process that contrasts sharply with the prescribed rational planning model. . . . the process of planning seems to be more appropriately conceptualized as a problem-solving process. Teachers, faced with a variety of factors such as pupils with certain knowledge, abilities and interests, the availability of particular textbooks and materials, the syllabus, the timetable, the expectations of head-teachers and others, and their knowledge of previous teaching encounters, *have to solve the problem of how to structure the time and experiences of pupils in the classroom*. Teachers, it seems, adopt a more pragmatic approach than that prescribed for curriculum design. Rather than start with a conception of what is to be achieved and deduce which classroom activities would therefore be ideal, teachers start with a conception of their working context and from that decide what is possible." (p. 74, original emphasis)

This problem-solving process is not linear, but cyclic and recursive. Teachers may begin with a vague conception of an activity that will take shape in the implementation process. It will then be refined and elaborated in subsequent implementations until it becomes a set of routines that is incorporated in their weekly or yearly planning (Clark and Yinger, 1987; Kagan and Tippins, 1992). In this process teachers will draw on their knowledge of a wide range of domains, such as knowledge of the students, the materials, teaching strategies, context (including the context of the classroom), the school, and the expectations of parents and students themselves. They will also plan in a way that suits their own personal style. One of the teachers in Sadro-Brown's study (1990) said, "I'm comfortable with the Frankenstein model that I've created" (p. 66; see also Sardo, 1982, cited in Clark and Peterson, 1986). Calderhead sums up planning as a "creative, interactive, problem-finding and problem-solving process" (1993, p. 15).

In the ensuing discussion, I shall examine the characteristics of expert and novice teachers' planning identified in the expert-novice comparative studies.

3.1.1 Lesson planning

When the planning processes of expert or experienced teachers were compared to those of novice teachers, it was found that some novices planned each lesson by following the Tyler model closely, whereas experienced or expert teachers never did. The latter were more concerned about the flow of the activities over a period of time, or how to get the classroom to "work" (Carter, Sabers, Cushing, Pinnegar, and Berliner, 1987). The reason novice teachers followed the model closely was because they were required to do so in their professional training courses. In fact, in a study on teacher planning, student teachers reported that they would not have done so in their practicum otherwise. (Neale, Pace, and Case, 1983; cited in Clark and Peterson, 1986). Brown and McIntyre (1992) observe the following:

> Not infrequently the students return to the college or university after a spell in a school bewailing the fact that teaching is not so straightforward, and their best laid plans have gone awry because of unexpected events, constraints, disruptions and so on. The model they have been given, they often claim, is unrealistic and takes inadequate account of the practicalities of schools and classrooms. (p. 69)

When the experienced teachers in their study were asked to comment on the current practices in the preparation of teachers, most of them remarked that "A formal 'aims and objectives' approach may have a place in planning the work of a class but it is divorced from the reality of how teachers think about their actual teaching" (ibid., p. 88).

Novice teachers were also found to adhere closely to the stated objectives in the prescribed curriculum guide. In Westerman's study (1991) the novice teachers explained their planning by making remarks such as, "The main topic is graphs, and the curriculum guide gives you an instructional objective," and "I just had to make sure that they met all the objectives" (p. 296). The expert teachers demonstrated more autonomy in their planning. While they used the curriculum guidelines for building their lessons, they made modifications according to the needs of their students and their own goals. One of the expert teachers commented, "I always do what I am supposed to do (i.e., teach the curriculum objectives), but then how I implement it comes from my own self" (ibid.). Novice teachers, on the other hand, lacked confidence to depart from what was prescribed or to try out alternative teaching methods even though they believed the alternatives might be better than what they were currently using (see Borko and Livingston, 1989).

In other words, novice teachers tend to act according to rules and guidelines laid down by people with authority, whereas expert teachers rely on their own judgment and exercise autonomy when planning.

3.1.2 Long-term and short-term planning

Besides the differences outlined above, most expert teachers were found to engage in longer-term planning (cf. McCutcheon, 1980).[2] Besides lesson planning, they also engaged in unit planning, daily planning, weekly planning, term planning, and yearly planning. When they engaged in yearly planning, they established the content to be covered, a sequence for the curriculum components for the whole year, and a timeline for content coverage. When they planned at the unit or chapter level, they determined a timeline for each topic. Their decisions were often made on the basis of how things went in the previous year (Yinger, 1980; Borko and Livingston, 1989).

Novice teachers, on the other hand, were found to engage in short-term planning, usually not going beyond the next couple of sections or pages. One reason was that they had to spend so much time and energy preparing for teaching the following day that they did not have the spare capacity to think too far ahead. A novice teacher in Borko and Livingston's study (1989) remarked that her lack of experience and professional knowledge had an impact on her planning. She commented:

> This is all so new to me that thinking up, I have to do a lot of thinking ahead of time. I really do. I have to think out what kind of questions to ask. I have to think out the answers to the questions . . . so that my answers are theoretically correct and yet simple enough to make sense . . . I can't ad-lib it too well. (see also Westerman, 1991)

Expert teachers, by contrast, were described as much more efficient in lesson planning. They had various plans in their memory because of their previous experience, and they rarely had to design classroom activities from scratch. They usually had well-mastered routines for these activities. For these teachers, planning often involved recalling how the lesson went the last time it was taught, and deciding whether amendments were needed. Unlike experts, novices had little or no previous experience to fall back on and less knowledge of their students and the teaching materials. They had to devote plenty of time and energy to design activities and to think of techniques to set up and maintain them. Calderhead (1984) points out that what is "routine" to experienced teachers are "conscious decisions" to novice teachers (p. 15).

3.1.3 Written and mental lesson plans

Differences were also identified between the forms of the lesson plans that expert and novice teachers make. Most studies reported that expert

2 McCutcheon's study (1980, p. 11) found that experienced teachers did not engage in long-range planning. For some of them it was because long-range planning was handled by the textbooks. Others reported that planning too far ahead would lead to inflexibility; they could not incorporate children's interests.

teachers planned their lessons mentally, sometimes with brief notes resembling a list for grocery shopping as a reminder. McCutcheon observes that the richest form of planning is the mental dialogs that teachers engage in before writing the plans or before the lesson. These mental dialogs include rehearsing a lesson and recalling what happened when a similar lesson was taught. These dialogs often take place continuously, even through the summer months. The teachers in his study said that they "take school home" (p. 8). He also found that expert teachers planned at odd moments like taking a shower, watching football, or driving home (see also Morine-Dershimer, 1979; McCutcheon, 1980; Calderhead, 1984; Livingston and Borko, 1989).

Novice teachers' plans were found to be much more detailed. Some of them wrote down what they were going to say and the actions that they intended to carry out, even noting down what they would write on the blackboard. Sometimes they just read their notes out. (Calderhead, 1984; Borko and Livingston, 1989). In Kagan and Tippin's study (1992), when secondary teachers were not confident about their knowledge of subject matter and their ability to maintain discipline in disruptive classes, they scripted their lessons into minilectures to make sure that the content they delivered was correct and to show the disruptive students that they "mean business."

It was argued that one reason why expert teachers seldom need to write detailed lesson plans is that they have a rich memory of previous lessons that they can call on when they are planning. They also have repertoires of well-mastered routines for a variety of situations that they can call upon easily when planning lessons. Another possible reason is their belief that it is impossible to determine in great detail how a lesson should proceed. There are many contingencies in the classroom that will affect the development of the lesson. Brown and McIntyre (1992) found that the experienced teachers had basic, consistent, planned patterns for their teaching, but the patterns were "almost infinitely flexible and implementation was crucially influenced by the conditions which impinged upon their teaching" (p. 44). These conditions included students' behavior and performance, availability of resources, time of the day, and time of the year. Expert teachers are able to anticipate possible situations in lessons and have contingency plans to deal with these situations (Housner and Griffey, 1985; Borko and Livingston, 1989). They are also able to anticipate the difficulties that students are likely to have, and they have in store a number of routines that they can immediately call upon in response to student cues (Carter et al., 1987). Novice teachers often have difficulties anticipating problems in the classroom and the difficulties that students have with the curriculum, and novice teachers are reluctant to depart from their plans in response to student cues (Borko and Livingston, 1989; Kagan and Tippins, 1992).

In other words, while expert teachers incorporate an element of flexibility in their plans, they plan for what they want to achieve in the lesson and the general direction that the lesson should take. They are always prepared to respond to cues in the classroom and change their plans. Novice teachers, on the other hand, being less able to anticipate problems, are much less flexible in their planning.

3.1.4 Planning thoughts

Although the written lesson plans of expert teachers are very brief, their mental plans are very rich. Expert teachers in Westerman's study (1991) thought in terms of how their individual lessons fit into the entire curriculum, how the lessons related to the curriculum content already covered earlier in the year, and how they were related to other subjects in the curriculum. Novice teachers had difficulties making sense of the sequence of topics in textbooks and consequently they planned each lesson as discrete units on the basis of the prescribed objectives without understanding how the units fit together (Schram, Feiman-Nemser, and Ball, 1989).

Expert teachers take into consideration students' prior learning, academic performances, and abilities when planning lessons. They also pay attention to competencies and difficulties of individual students and make strategic decisions accordingly (Calderhead, 1984; Housner and Griffey, 1985). In Carter et al.'s study (1987), when expert teachers were asked to take over a new class, they were more concerned about finding out the students' knowledge of the subject matter for the teacher's benefit. Novice teachers, on the other hand, focused more on reviewing the content with students for the latter's benefit rather than for their own benefit. In studying teachers' statements about planning, Leinhardt (1989) found that the expert teachers in her study always began their planning by stating what their students had learned the day before, whereas none of the novice teachers did (see also Paine, 1989; Carter, Cushing, Sabers, Stein, and Berliner, 1988; Fogarty, Wang, and Creek, 1983). Their planning thoughts contained more details and included student actions, not just teacher action, and planning for test point(s) within the lesson, which were checkpoints to evaluate student understanding or lesson progress. Most of their plans demonstrated that the flow of the lesson was driven by instructional logic, whereas most of the novice teachers did not show any guiding logic to their instructional actions.

The above findings show that expert teachers draw upon a wide range of knowledge when they are planning, including knowledge of the pupils, both as a group and as individuals, the curriculum, classroom organization, student learning, and the subject matter. Novice teachers have a much less sophisticated knowledge base, and therefore, they have much less to draw upon.

3.1.5 Characteristics of expert and novice teachers in preactive teaching

To summarize the above discussion, we may say that there are four main characteristics of preactive thinking identified in the research literature, on which novice and expert teachers differ. The first characteristic is that in the planning process, expert teachers exercise more *autonomy*. Novice teachers' planning is guided by rules and models. As Dreyfus and Dreyfus (1986) point out, these rules are often devoid of context. This is why novice teachers often have problems implementing their plans in the classroom when there are many contextual elements affecting the general direction of the lesson. Expert teachers, on the other hand, are fully aware of the contextual variables that they need to consider when planning. From their experience, they know what works in the classroom and what does not. Hence they are much more ready to depart from rules and take responsibility for their own actions.

The second characteristic is that expert teachers are much more *efficient* in lesson planning. They spend much less time planning, and yet their planning is often much more effective. According to the research literature, this is because expert teachers have in store well-established routines that they can call upon when planning. They can also recall their experience in teaching similar lessons and make whatever amendments necessary. It appears that there is a certain degree of "automaticity" and "effortlessness" in their planning, because they can rely on routinized behavior and "what normally works," especially if they are planning for something that they have taught before. In this respect, expert teachers seem to be similar to experts in other fields. However, the research literature also found that expert teachers' mental plans are much richer and that they do engage in detailed planning. Since this is the case, how far can we say that their planning is "effortless"? Furthermore, we can see that expert teachers also engage in conscious deliberation and reflection when they are doing long-term planning, when they consider whether they need to make any amendments to what they did the year before, and when they make mental plans. Teachers who have high professional standards often reflect on how their lessons went in previous years and how they could improve on them. As Bereiter and Scardamalia (1993) point out, teachers who always go by routinized behavior and "what normally works" are those who get into a rut and wallow in mediocrity. Therefore, how far is their planning "automatic"?

The third characteristic of preactive thinking is that expert teachers are much more *flexible* in planning; they are much more responsive to contextual cues, and much more ready to make changes to their plans accordingly. In other words, it is the way teachers relate to their specific context of work that differentiate the expert from the novice. For expert teachers, the context is very much an integral part of their teaching act,

whereas for novice teachers, context is very often taken as something external and ignored.

The fourth characteristic is that the planning thoughts of expert teachers reflect a *rich and integrated knowledge base*. When they plan, they integrate their knowledge of the curriculum, the students, teaching methods and strategies, the context including expectations of the principal, teachers and parents, the classroom setting, the time of the day, the time of the year, and so on.

The discussion in this section shows that teacher thinking and decision-making in the preactive phase are inextricably linked to those in the interactive phase. Decisions made in the preactive phase are subject to modification as teachers implement them in the classroom. As pointed out above, one of the characteristics of expertise in teaching is teachers' ability to respond to the contingencies in the classroom. We shall therefore turn to the interactive phase of teaching and examine the differences between novice and expert teachers that have been identified.

3.2 Interactive Phase

The classroom is a complex and relatively unpredictable environment where many things happen very quickly at the same time. Doyle, drawing on the work of Jackson (1968) and Smith and Geoffrey (1968), depicts the classroom as follows:

> A classroom is *multidimensional* in that many events occur over time, many purposes are served, and many people with different styles and desires participate. The sheer quantity of elements, in other words, is large. In addition, many events in a classroom occur *simultaneously*. While phrasing a question, a teacher must monitor different levels of involvement in work, search for an appropriate student to answer, anticipate interruptions, and judge whether particular students are violating classroom rules. . . . The simultaneous occurrence of multiple elements shortens the time frame and confers *immediacy* to the flow of classroom experience. Decisions must be made rapidly with little time for reflection. At the same time, these qualities of classroom life together with a high frequency of interruptions make the course of events at a given moment *unpredictable*." (1979, p. 44; my emphasis)

Because of the multidimensionality, simultaneity, immediacy, and unpredictability of the classroom, teachers need to be able to process simultaneously transmitted information very quickly, to attend to multiple events simultaneously, to detect signs of disruptive behavior and to act on them before they become problems (Kounin, 1970). This is a very demanding task. Copeland (1987) describes teachers who are successful classroom managers as having "eyes in the back of the head" (p. 220).

Various attempts have been made to capture teachers' cognitive processes in the interactive phase. For example, Peterson and Clark (1978), based on a model of teacher thinking proposed by Snow (1972, cited in Peterson and Clark, 1978), put forward a model of decision-making in the interactive phase. The model represents a cyclical process in which teachers observe cues from students and decide whether student behavior is within tolerable limits. If it is, then they continue with the lesson. If not, they decide whether there are alternative teaching behaviors that can bring student behavior back to tolerable limits. If they do not have an alternative, they will continue with the lesson as before. If they do, then they may make the decision to behave differently, or they may still decide to continue as before.

Calderhead (1984) points out that not all decisions made by teachers follow the same model. He suggests that there are three types of decisions that we make in everyday life. The first type are decisions that involve a great deal of thinking, identifying the alternatives, and evaluating the possible outcomes. These decisions for example, making career choices, usually take time. He refers to them as "reflective decisions." The second type are those which have to be made instantaneously; there is very little time for considering alternatives and evaluating the outcome, as in when you are crossing the road and a bus is speeding toward you. He refers to them as "immediate decisions." The last type are decisions that are made so often that they become automatic and routine. For example, decisions to change gears when driving. He refers to them as "routine decisions." In different contexts, different types of decisions will be made. In the teaching situation, he points out, there are some decisions that are reflective, such as planning the curriculum and selecting teaching methods and materials. There are other decisions, however, which are, and must be, made immediately. For example, decisions regarding disciplinary problems cannot wait until the teacher has weighed several alternatives. If the disciplinary problems are unanticipated, then "immediate decisions" will be made; but if they are recurrent, then "routine decisions" will be made.

The term *routine* refers to a set of procedures which has been established over time to control and coordinate specific sequences of behavior (Yinger 1979). Researchers have proposed that by setting up routines, teachers make the timing, sequencing, and students' behavior predictable, hence reducing their information processing load and freeing up their capacity to monitor deviations from the original plan (Clark and Yinger, 1979; Joyce, 1979; Morine-Dershimer, 1979; Peterson and Clark, 1978; Shavelson and Stern, 1981). The use of routine is therefore a very important part of interactive teaching. In fact, it is considered to be an essential element in classroom survival (Brophy and Good, 1986; Calderhead, 1984; Doyle, 1986).

It has been pointed out that teacher decision-making usually takes place when the routine is not going ahead as planned. When that happens, contrary to Peterson and Clark's description in their model, teachers do not consider a number of alternatives. They are more likely to see if there is a routine available that they can use to deal with the anomaly. If there is no available routine, they will improvise. If the anomaly does not require immediate action, then they will respond to it either after the lesson or in a subsequent lesson (see Shavelson and Stern, 1981).

The studies reviewed above suggest that teachers' decision-making is triggered by student behavior that is not within the teacher's tolerance limit. However, investigations in the antecedents for teachers' interactive decisions showed that most of the time, the decisions were not made in response to students' intolerable behavior, but rather in response to a student's question, a choice of appropriate techniques, transition from one activity to another, insufficient time left in the lesson, shortage of materials, the teacher's own emotional state, and so on (Marland, 1977, Wodlinger, 1980, cited in Clark and Peterson, 1986; Forgarty et al., 1983). Clark and Peterson (1986) call for more descriptive research on how teachers make interactive decisions.

Studies of expert-novice teaching have drawn on the findings in teacher decision-making processes to compare the cognitive processes that expert and novice teachers are engaged in interactive teaching, which we shall discuss below.

3.2.1 Making sense of and attending to classroom events

As mentioned above, in interactive teaching, multiple events take place simultaneously at a very fast pace. To operate successfully in the classroom, teachers need to be able to make sense of the events and to respond to them. To investigate how expert and beginning teachers perceive and monitor the simultaneous occurrence of events in the classroom, Sabers et al. (1991) showed them a videotape of one classroom period that was edited into three tapes, each showing a different view of the classroom. These three tapes were played simultaneously and teachers were asked to monitor all three screens. They were asked to describe the instructional and management techniques used by the teacher, to think aloud about what they were seeing, to respond to questions about content, student and teacher attitudes, the environment, and to recall specific details afterwards. Sabers et al. found that expert teachers were able to make sense of the events that "puzzled" the beginning teachers (whom they called "advanced beginners") and "baffled" those without any classroom experience (whom they called "novices"). Beginning teachers, on the other hand, were overwhelmed by the complex incoming information. When asked to comment on the classroom events and

the teacher's instructional practices, expert teachers frequently assigned meaning to the classroom events that they saw and made evaluative judgments about them. Beginning teachers' comments were often detailed but descriptive, "reminiscent of radio announcers reporting an athletic event" (p. 73). For example, one of the beginning teachers commented: "In the right monitor, we have the teacher lecturing, students taking notes," whereas one of the expert teachers commented: "on the left monitor, the students' note taking indicates that they have seen sheets like this and have had presentations like this before; it is fairly efficient at this point because they're used to the format they are using" (p. 72).

Similar to master chess players who can recognize thousands of chess patterns, expert teachers can readily recognize patterns in classroom events and hence make sense of them because of their hundreds and thousands of hours of experience in the classroom. In a study that Berliner and his colleagues conducted, novice and expert teachers were shown briefly a photographic slide of a science laboratory session three times. After each viewing, teachers were asked to write down what they saw and to update the information in the second and third viewing. After the second viewing, one of the expert teachers said, "It's not necessarily a lab class. There just seemed to be more writing activity. There were people filling out forms. It could have been the end of a lab class after they started putting the equipment away. . . ." After the third viewing, the expert teacher said, "Yeah – there was . . . very little equipment out, and it almost appeared to be towards the end of the hour. The books appeared to be closed. Almost looked like it was a clean-up type situation" (Berliner, 1986, p. 11). The expert teacher's perception was correct; it was a cleaning-up activity at the end of a laboratory session. It is likely that because classroom events were perceived in a meaningful way, expert teachers were able to recall them much better than novices who could not make sense of them (Peterson and Comeaux, 1987).

Besides being able to make sense of classroom events, expert teachers' perceptions of classroom events were also more analytical and interpretive. In Saber et al.'s study (1991), when asked to comment on the teacher's instructional practices, expert teachers gave more elaborate comments, which were analytical and interpretive, whereas beginning teachers merely described what they saw with little evidence of analytical thinking. The following are extracts of the comments from an expert and a beginning teacher.

Expert teacher: There was some formal lecture, and there was a formal activity. I think the technique that she used was very low key, perhaps a process type approach to teaching science rather than a very structured approach.

Beginning teacher: It looks . . . well, mostly lecture. She had some activities for the kids to do. Some use of media. She used the overhead a little bit. (p. 74)

Similar findings have been obtained in Berliner and his colleague's study reported above. Expert teachers were found to draw upon their rich store of classroom knowledge to interpret what they saw on the slide. For example, after viewing a slide of a mathematics lesson, one of the expert teachers said, "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" (Berliner and Carter, 1989, p. 60). Novice teachers' descriptions, according to Berliner and Carter, were detailed but "flat" (ibid.), with no explanations for what they described and showed little relationship between events. It is interesting to note that the expert teachers in this study were cautious in interpretation and demonstrated an awareness of the possible variables not presented in the slides that could affect their interpretation of the classroom events.

A further dimension on which expert and novice teachers were found to differ is selectivity. The term *selectivity,* as proposed by Corno (1981, p. 364), refers to "an ability to separate important from salient incidental information." One possible reason why, in Sabers et al.'s study (1991) reported above, the "advanced beginners" and "novices" experienced information overload when they were watching the videotapes is that they were not selective when they processed the information. As Doyle (1977) points out, the demand created by the complex environment of the classroom is very great and one of the strategies by which teachers deal with it is to simplify the complexity by being selective about the events to which they attend. His study of "successful" and "unsuccessful" student teachers[3] found that the former were better able to differentiate the immediate and long-term significance of classroom events. Morine and Vallance's study of more and less "effective" teachers[4] found that less "effective" teachers took into consideration more items of information on almost all aspects of their interactive decision-making compared to more "effective" teachers (Morine and Vallance, 1975, cited in Clark and Peterson, 1986, p. 279).

Similar findings have been reported in comparisons of expert and novice teachers. Sabers et al. (1991, p. 64) observe that expert teachers "assess only certain classroom behaviors and events, namely, those needing immediate teacher attention. Other perceived behaviors and events are rapidly assessed as being less critical, resulting in a decision by the teacher to delay action or to take no action at all." In many studies

3 "Successful" teachers were defined as those who maintained high levels of student involvement and low levels of disruption (see Doyle, 1977, p. 53fn).

4 'Effective' teachers were those whose students had higher gain scores on achievement tests, and less 'effective' teachers were those whose students had lower gain scores. This definition of *effectiveness* is typically used in the process-product paradigm (see Shulman, 1992).

it was found that what expert teachers attended to were things related to instructional objectives. Carter et al. (1987) gave expert and novice teachers detailed information about the students of a new class that they were going to take over, including grades, demographic data, and teacher comments. When they were asked to recall the information about these students, expert teachers could only remember the number of students in this class, but not the number of female and male students, the ethnicity of the students, and the number of students in a specified grade. However, they remembered that one of the students was visually impaired because they thought this information was important. Carter et al. point out that this could be because the number of students and the presence of a visually impaired student in the class have important implications for instructional and managerial decisions, but not the specific details about individual students. Novice teachers, on the other hand, remembered many more details about the students, but they did not differentiate the importance of the various pieces of information given to them.

Selectivity is also observed in the interactive teaching of expert teachers. Just as chess masters do not consider a large number of possibilities for the next move but only the good moves, expert teachers do not consider a large number of alternative routines when the lesson does not go according to what has been planned. In most cases they consider only one alternative routine (Shavelson and Stern, 1981).

In terms of the kind of events to which expert and novice teachers attend, novice teachers were found to attend more to student behavior, especially behavior that they consider to be unruly, and consequently, events related to the achievement of instructional objectives were given less attention (Veenman, 1984; Copeland, 1987; Sabers et al., 1991). By contrast, expert teachers were more concerned about instructional objectives. They were keen to maximize time on-task, to make sure that students were engaged in meaningful activities, and to minimize off-task time. Hence, they tended to ignore minor interruptions and inattention, and to attend to only major disruptions (Reynolds, 1992). Nunan's study (1992) showed that compared to inexperienced ESL teachers, experienced ones made twice as many decisions relating to language and focused significantly more on content than on classroom processes. Fogarty et al. (1983) found that in expert teachers' reports of the cues that led them to make interactive decisions, few pertained to students' disruptive behavior. This was partly because they ignored disruptive behavior and partly because they were able to prevent disruptive behaviors by picking up behavioral cues and taking action accordingly (Westerman, 1991; see also Reynolds, 1992). This suggests that the selectivity demonstrated by teachers is a reflection of their perception of what a classroom should be like (Peterson and Clark, 1978).

From the above findings, we can see that expert teachers are not only more *efficient* in recognizing meaningful patterns and making sense of multiple events, they are also more *selective* in attending to classroom events. In fact, the latter could be a reason for the former. They are better able to differentiate important from unimportant information and events through their experience. This frees their capacity to attend to the more important ones. Their criteria for selection are often governed by the instructional goals of the lesson and better student learning. As Berliner (1994, p. 182) points out, "Expertise, apparently, lets us process less, rather than more, of the information available from the environment, thus allowing more efficient use of the very limited working memory system that all of us possess."

3.2.2 *Improvisational skills*

The characteristics of expert teachers that we have discussed so far, efficiency and selectivity in making sense of and attending to classroom events, are very much related to the demands made on teachers as a result of the simultaneity and the multidimensionality of classroom events. The immediacy and unpredictability of classroom events require that teachers be able to respond to them very quickly, to improvise when the events are unpredicted, and to be flexible and ready to change their plans when need arises. Borko and Livingston (1989), using the metaphor of improvisational performance, propose that teaching not only involves cognitive skills but also improvisational skills.

Expert and novice teachers were found to differ in their ability to improvise. Borko and Livingston (1989) reported that in their study of mathematics teachers, expert teachers were able to use student responses and questions as springboards for further discussion and keep the lesson on track at the same time. They were able to maintain a balance between student-centeredness and content-centeredness. They were also able to generate on-the-spot examples and mathematical problems for illustration and clarification of concepts. By contrast, novice teachers had difficulties maintaining the direction of the lesson when responding to student questions. They also had problems with questions that were unplanned. Consequently, they decided to curtail questions so that they could get through what they had planned, despite the fact that they valued responsiveness to students. In other words, instead of modifying their plans to suit students' needs, novice teachers suited their own needs by ignoring the students (see also Westerman, 1991; cf. Nunan, 1992). Doyle's study (1977) of "successful" and "unsuccessful" teachers found that one strategy that the latter developed to simplify the complexity of the classroom environment was to localize attention to one region of the classroom and to engross students in one activity at a

time. It seems that the novice teachers in Livingston and Borko's study, by not responding to students, were trying to reduce the complexity of the classroom by just focusing on their own delivery of content to students.

Many studies have pointed out that the reason why expert and experienced teachers are able to respond very quickly to classroom events and to improvise is because they have developed repertoires of routines for handling a variety of situations. As mentioned before, the use of routines is a very important part in interactive teaching; it creates and manages the learning environment (Doyle, 1986; Brophy and Good, 1986). Hence, like experts in other professions, the use of routines frees up mental resources of expert teachers so that they can deal with other nonroutinized aspects of teaching. Routines have often been taken as procedures that teachers pick up as they gather experience and in which there is very little thinking involved. This is probably because teachers are often unable to give a well articulated account of what is embedded in the routines that they use and why they use them. However, as Olson (1992) argues, "Teachers may not be able to give a well articulated, propositional account of their practice. But complex ideas about how to teach are embedded in the familiar routines of the classroom" (p. 55). Routines are realizations of teachers' conceptions of how life in the classroom should be structured to facilitate student learning. They are by no means thoughtless.

3.2.3 Problem representation and problem-solving

Just as experts in fields like physics and social science can represent and solve problems that are guided by principles (Chi, Feltovich, and Glaser, 1981; Chi et al., 1988), expert teachers are able to analyze and interpret classroom events and problems in a principled way and provide justifications for their suggestions for alternative practices. Peterson and Comeaux (1987) presented ten pairs of experienced[5] and novice teachers with three classroom scenes and asked them to describe the scenes, to analyze the problems that the teacher faced during interactive teaching, and to suggest alternatives. The findings showed that experienced teachers' analyses of classroom events reflected a knowledge of classroom procedures and principles of effective classroom teaching. They also provided justifications for their comments. For example, one of the experienced teachers commented on a teacher returning an essay test by pointing out that the teacher could read the essay aloud if it was a good one, or make some comments on errors made, or clear some misconceptions.

5 The term *experienced teacher* is used interchangeably with *expert teachers* in Peterson and Comeaux's paper.

This teacher said, "You can use the test as a learning experience rather than just hand it back, to put away, or throw away probably" (p. 328).

Novice teachers, by contrast, gave simple comments with little justification (see also Kagan and Tippins, 1992). As Berliner (1994) points out, the teacher's comment reflected the teacher's understanding of the pedagogical principle that tests can be used for teaching and learning and not just for evaluation purposes. He reported that in one of his expert-novice studies, when teachers were asked to respond to scenarios about educational problems associated with gifted children, they found that the responses from expert teachers' representations of the problem were much more sophisticated and principled. For example, one of scenarios described Mark, an eight-year-old Asian boy who had hearing problems but liked mathematics, science, and who had a strong interest in computers. In response to this scenario, novice teachers gave superficial responses like "Mark seems like a very talented individual with many diverse interests" and "Mark should be encouraged by his teacher to continue his science experiments and work on the computer." By contrast, one of the expert teachers wrote, "Mark's needs can be broken into three broad areas: academic enrichment, emotional adjustment, and training to cope with his handicap" (p. 175). Berliner pointed out that the sophisticated problem representation by the expert teacher was necessary for effective problem solving.

3.2.4 Characteristics of expert and novice teachers in the interactive phase

From the studies reported in the above discussion, we can see that the characteristics, identified in the expert-novice comparative studies, which differentiate expert teachers from novice teachers are quite similar to the characteristics which differentiate experts and novices in other domains. The first characteristic is *efficiency* in processing information in the classroom. Like experts in other fields, expert teachers are able to make sense of and recognize patterns in a large quantity of simultaneously transmitted information within a short period of time. The second characteristic is *selectivity* in processing information. Similar to expert chess players who are selective in processing only the good moves, expert teachers are more selective in information processing, and they often consider student learning the most important criterion for selection. The third characteristic is the ability of expert teachers to *improvise*. Expert teachers are better able to respond to student needs and classroom events that require decisions and actions because they have well-established routines, which they can call upon to respond to a variety of unanticipated events. Like experts in other domains, expert teachers attend to a larger number of important events in the classroom because of automaticity resulting

from the use of routines. The fourth characteristic is that expert teachers' representation and analysis of problems are deeper and principled. Like experts in physics who used principles of mechanics to organize categories, expert teachers are able to offer interpretations and solutions that are guided by principles.

While these characteristics seem to be a convincing description of what expert teachers are capable of doing, how far do the cognitive processes identified capture the teaching act and the nature of teachers' work in the classroom? How far do these characteristics highlight *critical* differences between expert and novice teachers?

3.3 Knowledge Schemata

In the review of studies on teachers' cognitive processes in the preactive and interactive phases teaching, references have frequently been made to the knowledge base of expert and novice teachers. Teacher knowledge is very much understood from the perspective of cognitive psychologists who used the term *schema* to describe the way knowledge is stored in memory (see, for example, Anderson, 1977; Rumelhart, 1980). For example, Livingston and Borko (1989, p. 37) observe:

> . . . the cognitive schemata of experts typically are more elaborate, more complex, more interconnected, and more easily accessible than those of novices. . . . Therefore, expert teachers have larger, better-integrated stores of facts, principles, and experiences to draw upon as they engage in planning, interactive teaching and reflection (see also Peterson and Comeaux, 1987; Borko and Livingston, 1989; Westerman, 1991; Leinhardt et al., 1991).

The characteristics of expert and novice teachers that have been identified in the research literature are believed to be related to their "knowledge schemata."

Expert teachers' ability to interpret, recognize meaningful patterns in, and make sense of multiple classroom events is attributed to their better-developed schemata for classroom events than novice teachers (see Peterson and Clark, 1978). Expert teachers' better recall of classroom events and their more principled ways of analyzing and solving problems are considered to be caused by their more-complex knowledge schemata (see Peterson and Comeaux, 1987). Peterson and Comeaux further argue that it is this knowledge schemata that affect teachers' perception and understanding of classroom events, the students, and their problem-solving, as well as decision-making in interactive teaching.

The rich and elaborate schemata of expert teachers are also considered to be crucial in helping them determine the relative importance and the relevance of information to their planning and teaching

(see Carter et al., 1987). This is why they are able to attend selectively to information that is crucial to teaching. By contrast, novice teachers' schemata are still being developed in the process of decision-making. Therefore, they are less able to determine whether the information is relevant, and they consider much more information before they make decisions in both planning and teaching. Consequently, they are less efficient in both processes (see Livingston and Borko, 1989, p. 39).

The more sophisticated knowledge schemata of expert teachers are also used to account for improvisational skills. According to Livingston and Borko (1989), to improvise successfully, teachers need to have an extensive network of interconnected, easily accessible schemata from which they can select particular strategies, routines, and information in interactive teaching. Novice teachers have difficulties improvising when the lesson deviates from their plan. This, Livingstone and Borko explain, is because they do not have as many "appropriate schemata for instructional strategies to draw upon," nor do they have "sufficiently well-developed schemata for pedagogical content knowledge to enable the construction of explanations or examples on the spot" (ibid.). The extensive network of strategies and routines that expert teachers possess also enables them to plan more efficiently than novice teachers.

It is indisputable that expert teachers have much richer knowledge of all aspects of their work as a teacher than novice teachers. As Bereiter and Scardamalia (1993) point out, there are no experts who lack expert knowledge of their fields. However, does teacher knowledge consist of structured facts that are stored in individual teachers' memory and can be retrieved and accessed as necessary? Or is teacher knowledge embedded in the very act of teaching, which is highly context specific? How far does the concept of "knowledge schemata" accurately capture the nature of teacher knowledge, and how it is developed?

Many of the expert-novice studies focused on the management of the classroom or the more generic aspects of teacher behavior, such as pacing, questioning, explanation, or qualities like clarity and enthusiasm (see Ball, 1991; Brophy, 1991). They were relatively less focused on the "management of ideas" in the classroom (Shulman, 1987, p. 1) until Shulman's call for attention to teachers' subject matter knowledge in 1986 (see 4.1.4). As Shulman points out, both emphases are necessary.

The lack of attention to the knowledge of expert teachers until recently is partly because much of their knowledge is tacit. Very often, experts themselves are unaware of the knowledge that they have. Even if they are aware of it, they are unable to articulate it, as pointed out above. Unlike performance in the classroom, the knowledge that is embedded in it is not observable and often very difficult to tease out. The lack of attention is also partly because teachers have never been seen as possessing a body of professional knowledge (see Chapter 4 for a detailed discussion). Yet,

as Bereiter and Scardamalia (1993) point out, understanding teachers' knowledge and how it is developed as they live through their experiences is crucial to the understanding of expertise.

3.4 Summary

In this chapter I have summarized the characteristics of novice and expert teachers as reported in studies of teaching expertise. Most of these studies compare the cognitive processes of expert and novice teachers, looking mainly at teacher planning in the preactive phase and teacher thinking and decision making in the interactive phase. The findings replicate to a large extent the common features identified in expertise studies in other domains, particularly those that adopted the information processing approach. Expert teachers are more efficient in planning and more selective in information processing. They are also able to recognize meaningful patterns quickly. They demonstrate more autonomy and flexibility in both planning and teaching. Because they have a large repertoire of routines on which to rely, they are able to improvise and respond to the needs of the students and the situation very quickly. The automaticity that is made possible by the availability of these routines allows them to direct their attention to more important information. Similar to experts in other domains, these characteristics of their cognitive processes are very much related to their sophisticated knowledge schemata and knowledge base. (See Berliner, 1994, for a discussion of the similarities between expert teachers and experts in other domains.)

A review of these studies shows that like expert-novice studies in other domains, the focus has been very much on what experts can do that novices cannot. The findings provide valuable insight into the complexities of teaching and the tacit knowledge that teachers gain through experience. However, like many expertise studies, there are relatively few studies that address the question of how expertise is developed and the ways in which their knowledge development differs from less experienced and novice teachers.