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ABSTRACT

A study was aimed at developing a methodology for describing competent classroom teaching performance and analyzing components of competent classroom decision making to be used in improving preservice and inservice teacher training programs. Information processing research suggests that expertise in semantically rich domains involves the ability to apply knowledge effectively in response to environmental cues. This study investigated differences between experienced and novice teachers in terms of: (1) their use of student performance cues; (2) their instructional actions and the relationship of these actions to student performance cues; and (3) the nature of their instructional goals and prior instruction-related knowledge. Stimulated recall data were collected on three experienced and five novice teachers. Results showed that, while both groups attended to the same number of cue categories, experienced teachers implemented twice as many kinds of instructional actions and considered a greater variety of goals, while exhibiting more complex associations between cue and action categories. (Author)

LEARNING RESEARCH AND DEVELOPMENT CENTER

A PROCESS-PRODUCT STUDY OF EXPERIENCED AND NOVICE TEACHERS' INTERACTIVE INSTRUCTIONAL THOUGHTS AND ACTIONS

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Abstract

The study reported in this paper was aimed at developing a methodology for describing competent classroom teaching performance and analyzing components of competent classroom decision making to be used in improving pre-service and in-service teacher training programs. Information processing research suggests that expertise in semantically rich domains involves the ability to apply knowledge effectively in response to environmental cues. This study investigated differences between experienced and novice teachers in terms of (a) their use of student performance cues, (b) their instructional actions and the relationship of these actions to student performance cues, and (c) the nature of their instructional goals and prior instruction-related knowledge. Stimulated recall data were collected on three experienced and five novice teachers. Results showed that while both groups attended to the same number of cue categories, experienced teachers implemented twice as many kinds of instructional actions and considered a greater variety of goals, while exhibiting more complex associations between cue and action categories.

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A topic that has received increasing attention in research on teacher instructional expertise is the nature of information teachers process as they make ongoing instructional decisions in the classroom. These studies of instructional decision making have been particularly influenced by theories of information processing within semantically rich domains. Research in this area has highlighted differences in the ways experienced and novice practitioners organize and process complex bodies of information in fields such as physics and medicine, as well as differences in the ways knowledge is applied to problem solving and decision making (Elstein, Kagan, Shulman, Jason, & Loupe, 1972; Kleinmuntz, 1968; Chi, Glaser, & Rees, Note 1). A general finding of such studies is that expertise often involves the presence in memory of a well-organized knowledge base and the ability to apply knowledge effectively in response to environmental cues and problem features. Generalizing these findings to classroom instructional contexts, particularly those aimed at providing instruction that is adaptive to student differences, it may be hypothesized that teaching expertise includes competencies in monitoring and processing student feedback and other environmental cues; integrating cue information with

instructional goals and stored knowledge about students and instructional content; and, finally, applying this knowledge to on-the-spot decision making about how to adapt planned instruction to environmental conditions and student learning states.

Within the general framework of adaptive instruction, classroom teachers can be viewed as clinical diagnosticians in that they are expected to diagnose individual learning needs of students and make instructional decisions (preplanned or on the spot) that are adaptive to those needs (e.g., Glaser, 1975; Wang, 1973; 1980; Shulman & Elstein, Note 2). However, diagnostic instructional decision making is complex and differs in several ways from diagnosis in fields such as medicine. In contrast to typical clinical diagnostic settings, teachers must deal concurrently with a number of students at one time. Unlike medical diagnosis, which involves seeing individuals for short periods of time, teachers see their students every day for 5 hours over a 10-month period of time. Also, the classroom environment is characterized by large amounts of information, with many kinds of stimuli being emitted simultaneously. Further, classrooms have multidimensional qualities; that is, a number of goal states are possible. In this regard, Doyle (1977) has defined the classroom setting as a system of overlapping task structures, with each task consisting of a goal and a set of operations. In addition, classroom learning environments contain some information sources that are in a constant change state and are largely unpredictable, as well as other more stable information sources. Therefore, an important topic of research on teaching in general, and the study of adaptive instruction practices in particular, is the study

of teachers' processing and selective use of a rather complex array of environmental stimuli in their adaptation and execution of instructional plans.

The study of ways in which teachers perceive input from the classroom environment and utilize this input to generate appropriate instructional actions has been approached from different perspectives. Some researchers have adopted a theoretical approach through the development of conceptual models that trace the processes of teachers' classroom decision making (Collins & Stevens, 1982; Peterson & Clark, 1978; Snow, 1972; Shavelson, Note 3). Others have focused on detailed analyses of the classroom performance of teachers to investigate the extent to which they engage in interactive decision making as well as the nature of the classroom cues and goals that appear to be the most salient inputs into those decisions (McNair, 1979; Peterson & Clark, 1978; MacKay, Note 4; MacKay & Marland, Note 5; Morine-Dershimer & Vallance, Note 6; Shroyer, Note 7).

While current research literature on teachers' classroom decision processes suggests the utilization of diverse methodologies, some consistent theoretical underpinnings and generalizable patterns have been noted. Models of teachers' thinking and decision making have posited the following characteristics of the instructional process: (a) a basic teaching skill is the ability to know when to apply an effective instructional action in response to environmental cues; (b) ongoing teaching often involves testing cue information against stored knowledge about students, subject matter, and teaching principles; and (c)

strategies for effective achievement of instructional goals cannot be exactly preplanned, but must depend on the nature of environmental cues, particularly student performance cues that arise during the instructional process (Collins & Stevens, 1982; Peterson & Clark, 1978; Shavelson, 1976; Snow, 1972).

Findings from analyses of actual teacher performance, on the other hand, seem to suggest that (a) teachers probably do not consciously consider a large number of instructional alternatives while teaching, but rather execute "deliberate acts" based on their knowledge of students and the subject matter; (b) while teachers may pursue several instructional goals in the same instructional situation, they most frequently pursue those goals related to subject matter learning; and (c) over-rigid preactive planning by teachers may decrease teacher flexibility in making interactive classroom decisions (Peterson & Clark, 1978; MacKay & Marland, Note 5). These findings are consonant with those from studies of expertise in other complex domains (Chase & Simon, 1973; Hinsley, Hayes, & Simon, 1978; Chi, Glaser, & Rees, Note 1). Results from the latter studies show that experts often do not consider a large number of alternatives in solving problems in domains such as chess, algebra word problems, and mechanical problems in physics. Instead, they rather quickly access an appropriate solution path based on their mental representation of the domain.

While substantial advances have been made in the understanding of teacher decision making in the classroom, certain limitations are noted in the research completed heretofore in this area. Most studies have not differentiated the level of teacher expertise. Data on teachers'

decision processes are aggregated across subjects, regardless of differences in level of expertise. Thus, it is difficult to abstract from the data those particular elements of teacher decisions that contribute to competent performance. Another limitation of previous research in teacher cognition is that very few studies have attempted to simultaneously examine in actual classroom settings several specific dimensions of teachers' decision processes, in order to gain a more thorough understanding of the nature and processes of competent interactive instruction within the classroom environment. It is in this context that the work described in this paper was designed.

The present study was aimed at investigating and comparing the performance and cognition of experienced and novice teachers during interactive instruction in classroom settings. The study focused on the student performance cues that lead to teachers' implementation of instructional actions, the instructional actions employed, and the instructional goals and other information that teachers consider during the instructional process. The following specific questions were addressed.

1. Are there differences between experienced and novice teachers' use of student performance cues in a natural classroom setting?

2. Are there differences between experienced and novice teachers' instructional actions in response to student performance cues, and what is the relationship between categories of student performance cues and instructional actions?

3. Are there differences between experienced and novice teachers in the nature of the instructional goals and prior knowledge that they report pursuing during the process of ongoing instruction?

The Study

Setting

The study was conducted in a university laboratory school. The school utilizes a personalized progress plan as its core approach. This approach features individualized instruction with independent learning and small-group instruction activities. The school is organized into three multi-age groupings: a primary level, which includes kindergarten and first and second grades; an intermediate level, which includes third, fourth, and fifth grades; and a middle school, which includes sixth, seventh, and eighth grades. The study was carried out during regularly scheduled small-group instruction time. Teacher-led lessons for small groups (five to eight students) are part of the regular curricula in each classroom. During these lessons, other students in the classroom generally work on independent assignments.

Subjects

Three experienced teachers and five novice teachers participated in the study. The experienced teachers were asked to participate on the basis of their identification by school administrators as especially

competent. The novices comprised all the participants in the school's internship program at the primary and intermediate grade levels, at the time of the study. The total group of subjects consisted of seven females and one male (a novice). One novice and two experienced teachers taught in primary classrooms (first- and second-grade students). The remaining subjects taught in classrooms with integrated third, fourth, and fifth grades. The average years of experience of the experienced teachers was 10.1. The novices' experience ranged from a few weeks prior to the beginning of the study to a few weeks plus an additional term of student teaching.

Procedure

There were two sources of data for the study. The first was videotapes of teachers conducting small-group lessons within their own classrooms. The videotapes were coded by trained observers in order to classify (a) the types and frequencies of student performance cues which elicited teachers' implementation of instructional actions, and (b) the types of instructional actions teachers implemented in response to each cue. The second source of data was teachers' stimulated recall reports of the instructional goals and prior knowledge they considered during one of the three videotaped lesson segments.

Collection of videotaped small-group lesson data. Three segments, each approximately 15 minutes in length, were videotaped for each teacher as he or she conducted regularly scheduled lessons. Lessons for each teacher were videotaped, in random order, over a 1 1/2 month period during October and November of the school year. Prior to the

videotaping, each teacher was asked to choose a lesson for taping. Three stipulations were imposed: The selection had to be a small-group lesson for five to eight children; the selection had to be a normally scheduled lesson in one of the basic curricula; and, the selection had to include active instruction rather than just monitoring of independent work. Although a majority of the lessons taped were either in reading or language arts, three were in mathematics, one was in social studies, and two were in science. Each of the three segments consisted of 15 minutes taped after the first 5 minutes of the lesson had elapsed. Teachers wore inconspicuous microphones during taping. Pre-study taping was done to accustom students and teachers to the equipment and the experimenter.

Collection of stimulated recall data. Soon after the first lesson segment was videotaped, a second data collection procedure was carried out with each teacher. The teacher was shown the segment of his or her own teaching behavior and was asked to recall thoughts or decisions made during the instructional process. The interview was conducted by the first author. Prior to the interview, the tape was reviewed by the interviewer to identify instances on the tape where an interactive decision by the teacher appeared to have occurred. A check was made for reliability of identification of interactive decisions. Three tapes were randomly selected to be independently coded by the interviewer and a trained observer. An interrater agreement of 85% was obtained.

At the beginning of the interview, the teacher was asked to stop the tape at points where he or she recalled any thoughts or decisions. If the teacher didn't stop the tape at the points noted previously by the interviewer as possible decision points, the interviewer stopped the tape and asked whether a decision was made at that point. If the teacher answered negatively, he or she was asked to continue reviewing the tape; but if the teacher answered positively, the interviewer followed the same procedure used for teacher-initiated pauses. At each point where the tape was stopped by either the teacher or the interviewer, a series of preplanned probe questions was asked to elicit the teacher's recall of the instructional goals and prior knowledge surrounding the decision point. Probe questions included, "What were you aiming at there?"; "What were you getting at with that question?"; "At that point, what were your thoughts?"; and, "What was the reason for that decision?

A limitation of the stimulated recall technique should be noted at this point. While the technique is designed to probe teachers' recall of their thinking processes at the time of teaching, it is possible that the technique also could elicit thinking that occurs at the time the videotape is viewed. Thus it might not be a pure measure of teachers' interactive decisions. This limitation could be lessened by attending to the way in which the interview is conducted. More detailed discussion of this issue has been provided by Ericsson and Simon (1980), Lynch (Note 8), and Nisbett and Wilson (1977).

Data Analysis

A separate data analysis procedure was carried out for each of the sources of data collected in the study. For the videotape data, a system of categories was developed to classify student performance cues and the instructional actions made in response to the cues. For the stimulated recall data, additional categories were developed to classify teachers' reports of the instructional goals and prior knowledge that influenced their interactive decision making processes.

Analysis of videotape data. Videotape data were analyzed through a two-step procedure. First, points were identified at which teachers responded to ongoing student performance cues by implementing specific instructional actions. A check was made for reliability of identification of these interactive decision points. Three taped segments were randomly selected to be independently coded by two trained observers. Interrater agreement of 85% was obtained. In the second procedure, each decision point was examined and classified according to (a) the nature of the student performance cue eliciting the implementation of an instructional action, and (b) the instructional action made in response to that student performance cue.

Categories of student performance cues and instructional actions were developed from an analysis of the Collins and Stevens (1982) theory of interactive teacher cognition; Shavelson's (Note 3) work on teacher decision making; and preliminary classroom observations by the authors. The classification schemes for student performance cues and instructional actions are summarized in the Appendix. The videotapes were classified by both the first author and an independent rater trained in the use of the scheme. The average percentage agreements for

the student performance cues and instructional action dimensions were 86 and 75, respectively. Overall agreement of 80% was obtained.

Analysis of stimulated recall data. The information teachers recalled spontaneously while viewing a videotape of their teaching behaviors, as well as the information teachers recalled following a probe statement by the experimenter, was combined and classified. The stimulated recall data were classified in two general categories: the instructional goals teachers reported pursuing through the implementation of instructional actions, and the prior knowledge teachers recalled utilizing during implementation of instructional actions. The classification schemes for these two dimensions of teachers' recall are presented in the Appendix.

Stimulated recall protocols were classified by both the first investigator and an independent rater trained in the use of the classification scheme. Average percentage agreements for the prior knowledge dimension and the instructional goals dimension were 88 and 83, respectively. Overall agreement of 85% was obtained.

Results

Data from the study were analyzed to provide a summary description and comparison of the student performance cues and instructional actions utilized and implemented by experienced and novice teachers, as well as the instructional goals and prior knowledge considered by both groups of teachers during the instructional process. The results are discussed in the sequence of information related to the study's three basic research

questions: use of student performance cues, instructional actions and the relationships between categories of cues and actions, and the nature of instructional goals and prior knowledge.

The use of student performance cues. Percentage frequencies of different categories of cues utilized by experienced and novice teachers during ongoing instruction are summarized in Table 1. As shown in the table, the results indicate individual differences in the frequency of use of different categories of student performance cues. However, few clear-cut differences are indicated between experienced teachers' and novice teachers' use of cues. There is some indication that teachers' frequency patterns of cue utilization may be more closely related to the nature of their instructional goals than to their levels of experience. Results from a separate analysis (not reported in Table 1) provide evidence in support of this hypothesis. Data from a comparison of (a) the cue utilization patterns in the lesson for which a stimulated recall interview was given, and (b) teachers' patterns of instructional goals for that lesson as reported during the interview suggest that, when student motivation and involvement was a predominant reported goal, teachers more frequently utilized the Initiations and Attention cues during the lesson. Alternately, when student understanding was a prominent goal, the Deficient Responses and Errors cues were utilized more frequently. These trends must be regarded as tentative, however, as they are based on a limited segment of teaching time.

Table 1

Percentage Frequencies of Categories of Student Performance Cues Utilized by Experienced and Novice Teachers

Student Performance Cues	Percentage Frequencies							
	Experienced Teachers			Novice Teachers				
	A	B	C	A	B	C	D	E
Deficient Responses	48	33	31	20	38	47	30	38
Initiations	16	17	40	33	19	12	18	17
Errors	32	19	8	30	24	12	30	31
Attention	4	30	20	17	20	30	37	13

Instructional actions and relationships between categories of cues and actions. Table 2 presents results of the analysis of the overall frequency of instructional actions teachers implemented for all categories of student performance cues. Again, no distinctive differences were found between the experienced and novice groups, although there were individual differences among teachers. Except for Experienced Teacher C and Novice Teacher A, over 25% of teachers' instructional actions involved giving feedback. Four of the five novice teachers and one of the experienced teachers implemented management-related instructional actions with at least a 25% frequency. Overall, instructional actions involving applying, extending, or planning were used least frequently. The exception was Experienced Teacher A, who used instructional actions in this category with a frequency of 14%.

Table 3 reports percentage frequencies of instructional actions implemented for each of the separate cue categories. As shown in the table, in this analysis, patterns of differences did emerge between the experienced and novice groups. For example, in regard to Deficient Responses, experienced teachers implemented instructional actions in the categories Applies, Extends, or Plans and Elicits and Incorporates Input with a combined frequency of 18%, while novices implemented actions in these categories quite infrequently (1% combined frequency) in response to students' Deficient Responses. Novices did implement management actions frequently when confronted with Deficient Responses, however. In fact, 26% of their instructional actions with respect to Deficient

Table 2

Categories and Percentage Frequencies of Instructional Actions Utilized by Experienced and Novice Teachers

Instructional Actions	Percentage Frequencies							
	Experienced Teachers			Novice Teachers				
	A	B	C	A	B	C	D	E
Gives Feedback	34	25	19	24	43	37	32	31
Explains Concept/ Procedure	14	2	7	21	14	5	4	3
Checks Knowledge	9	11	12	18	0	10	7	13
Focusses Attention/ Effort	11	11	21	9	29	20	25	28
Applies, Extends, or Plans	14	2	2	0	0	2	4	0
Elicits and Incorporates Input	9	23	24	3	10	0	0	0
Manages	9	14	26	26	5	25	29	25

Table 3

Percentage Frequencies of Instructional Actions Utilized by Experienced and Novice Teachers for Categories of Student Performance Cues

Instructional Actions	Percentage Frequencies of Cues							
	Deficient Responses		Initiations		Errors		Attention	
	Experienced Total Actions = 44	Novice Total Actions = 91	Experienced Total Actions = 30	Novice Total Actions = 28	Experienced Total Actions = 38	Novice Total Actions = 66	Experienced Total Actions = 11	Novice Total Actions = 4
Gives Feedback	25	36	23	21	37	42	0	25
Explains Concept/ Procedure	7	5	17	21	3	6	0	0
Checks Knowledge	14	10	0	7	24	9	27	25
Focusses Attention/ Effort	27	22	6	22	5	15	18	25
Applies, Extends, or Plans	9	1	4	0	8	2	0	0
Elicits and Incorporates Input	9	0	30	7	0	0	55	25
Manages	9	26	20	22	23	26	0	0

Responses were management-related, while only 9% of the instructional actions of experienced teachers fell into that category.

These and other trends reported in Table 3 suggest that novice teachers displayed different frequency patterns of instructional actions than experienced teachers in response to specific categories of student performance cues. Novices appeared to utilize management actions more frequently when confronted with Deficient Responses, and they utilized Focusses Attention/Effort actions when confronted with Initiations and Errors. Experienced teachers, on the other hand, responded more frequently with non-management related actions when confronted with Deficient Responses. In response to the Initiations and Errors cue categories, experienced teachers implemented the Elicits and Incorporates Input and Checks Knowledge categories more frequently, and they implemented the Focusses Attention/Effort category less frequently.

The data shown in Table 4 suggest another dimension of differences between experienced and novice teachers in terms of the relationship between student performance cues and instructional actions. Experienced and novice teachers' use of an instructional action at least once in response to a given cue category is charted in Table 4. As shown in the table, for example, Experienced Teacher A implemented the Gives Feedback action in response to the cues Deficient Responses, Initiations, and Errors at different points during the videotaped segments. This response was never made to the Attention cue, however. In all, Experienced Teacher A utilized 17 of the 28 possible cue-action pairs at some time during the videotaped instructional segments.

Table 4

Categories of Experienced and Novice Teachers' Instructional Actions Utilized at Least Once in Response to Specific Categories of Student Performance Cues

Instructional Actions/ Student Performance Cues	Experienced Teachers			Novice Teachers				
	A	B	C	A	B	C	D	E
Gives Feedback								
Deficient Responses	X	X	X			X	X	X
Initiations	X	X	X	X	X	X		X
Errors	X	X	X	X	X	X	X	X
Attention		X			X			
Explains Concept/Procedure								
Deficient Responses	X				X			X
Initiations	X	X	X	X	X	X		
Errors	X			X	X		X	
Attention				X				
Checks Knowledge								
Deficient Responses	X	X	X	X		X	X	X
Initiations								
Errors	X	X	X	X		X	X	X
Attention		X				X		
Focuses Attention/Effort								
Deficient Responses	X	X	X	X	X	X	X	X
Initiations			X		X	X	X	
Errors	X			X			X	X
Attention		X	X			X	X	
Applies, Extends, or Plans								
Deficient Responses	X	X	X					
Initiations		X						
Errors	X	X				X	X	
Attention								
Elicits and Incorporates Input								
Deficient Responses	X	X	X					
Initiations	X			X	X			
Errors								
Attention		X	X		X			
Manages								
Deficient Responses	X			X		X		
Initiations	X	X	X	X		X	X	X
Errors				X				X
Attention		X	X	X		X	X	X
Total	17	17	15	14	10	14	12	11

To investigate the extent to which there may exist patterns of teaching strategies commonly used by all teachers, the summary data across all teachers were examined. As shown in Table 4, seven of the eight teachers responded at least once to the Deficient Responses cue by checking students' knowledge. In regard to the same student performance cue, all eight teachers responded at least once by focussing attention or effort. Nearly all the teachers responded to the Initiations cue by giving feedback and/or managing. Similarly, nearly all the teachers responded to the Errors cue by giving feedback and checking knowledge. Finally, seven of the eight teachers responded at least once to the Attention cue with a management action. Two cue-action pairs were utilized by all three experienced teachers but none of the novices. Used in response to the Deficient Responses cue, these instructional action categories were Applies, Extends, or Plans and Elicits and Incorporates Input.

The data also were analyzed to examine the extent to which novice and experienced teachers differed in their utilization of the full variety of instructional action categories. The results reported in Table 4 show that, while each experienced teacher utilized the full repertoire of instructional action categories at different points in the videotaped segments, each of the novices utilized only five or six of the seven possible categories. For example, Novice Teacher A did not utilize the category Applies, Extends, or Plans, and Novice Teacher E utilized neither the Applies, Extends, or Plans category nor the Elicits/Incorporates Input category. These results suggest that the

novices in the study failed to utilize as varied a repertoire of instructional actions as did the experienced teachers.

To further investigate the nature of the differences between experienced and novice teachers, the relationship between categories of student performance cues and the associated instructional actions made in response to those cues by teachers in each group were examined. For illustration purposes, Figure 1 provides a graphic representation of the data for Experienced Teacher A and Novice Teacher E. As shown in Figure 1, the responses of Experienced Teacher A form a more complex, connected representation than those of Novice Teacher E. For Experienced Teacher A, all cue categories are connected to instructional actions, often with connections to several kinds of actions at different points in the lesson. By contrast, the representation for Novice Teacher E shows fewer connections, with two categories of instructional actions (Elicits/Incorporates Input and Applies, Extends, or Plans) unconnected to any cue category.

Goals and prior knowledge. Information on the instructional goals teachers pursued and the prior knowledge they utilized during the instructional process was obtained from stimulated recall interviews conducted for one of the videotaped segments. The instructional goals reported by the experienced and novice teachers are summarized and compared in Table 5. Included in the table is an indication of the variety of categories utilized by subjects at least once in their decision processes, as well as the percentages of the total number of goals reported by teachers in each of the categories.

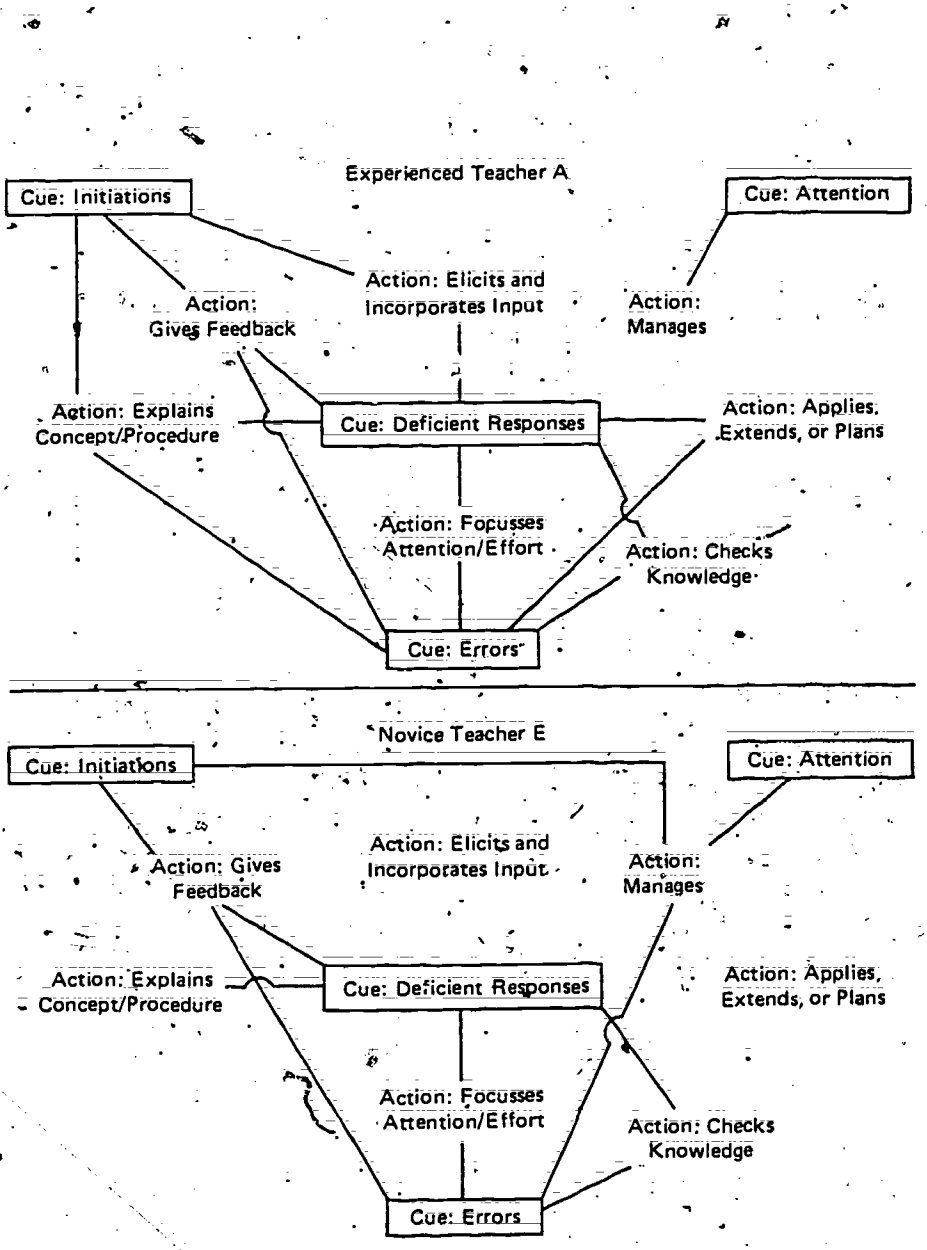

Figure 1. Relationship between categories of instructional action responses and categories of student performance cues for Experienced Teacher A and Novice Teacher E.

Table 5

Categories and Percentage Frequencies of Instructional Goals Reported by Experienced and Novice Teachers

Categories of Instructional Goals	Experienced Teachers				Novice Teachers					
	A	B	C	% of Total No. of Goal Reports	A	B	C	D	E	% of Total No. of Goal Reports
Student Motivation and Involvement	X		X	28		X	X	X	X	26
Group Management	X	X	X	10	X		X	X	X	14
Curriculum Integration	X		X	9			X			3
Social Development	X	X	X	9					X	3
Subject Matter Content	X	X		6		X	X	X	X	20
Student Understanding	X	X	X	38	X	X	X		X	34
% of Total No. of Categories Reported by Each Subject	100	67	83		33	50	83	50	83	
Average % of Categories Reported by Each Group			83						60	

Note. X indicates that the subject reported a particular goal category at least once.

Near the bottom of the table, the row labelled "% of Total No. of Categories Reported by Each Subject" indicates the number of goal categories reported by each subject at least once divided by the total possible goal categories. For example, Experienced Teacher A reported attending to six different goal categories, or 100% of the total possible categories, at least once during her report protocol. The last row of the table indicates the average number of goal categories reported divided by the total possible categories for experienced teachers as a group and for novice teachers as a group. As shown in the table, experienced teachers reported 83% of the total possible goal categories, while novice teachers reported only 60% of the categories.

The categories of instructional goals considered most consistently and most frequently were Student Understanding and Student Motivation and Involvement. A high percentage of teachers reported the Group Management goal at least once, although the relative frequency of reporting this goal was low. Thus, it appears that, while teachers considered a variety of instructional goals during a lesson in response to classroom events, and while they addressed different specific goals at different times, they focussed most often on facilitating student understanding and motivation. Experienced teachers reported a somewhat greater variety of goals in the process of making classroom decisions than did novice teachers. For example, only one novice reported considering the Social Development goal as a basis for classroom decisions, while all of the experienced teachers reported this goal.

The data on teachers' reports of the kinds of prior knowledge recalled during the process of instruction are summarized in Table 6. It is in this area that the greatest differences were found between experienced and novice teachers. Experienced teachers appeared to utilize prior knowledge during instruction much more frequently than did the novices. Each of the three experienced teachers recalled drawing upon prior knowledge in at least five of the six possible categories, while four of the five novices reported only two categories of prior knowledge about students, subject matter, or pedagogical principles. Novice Teacher E was the exception, with a report of four categories of prior knowledge. Most of the reports of prior knowledge by the novices were in the category Student History/Social Behavior, while experienced teachers didn't concentrate reports in any single category. These results suggest that the use of prior knowledge during instruction is an important aspect of experienced teaching that is not as well developed in novice practitioners.

Summary and Discussion

This study suggests differential patterns in the performance and thinking processes of experienced and novice teachers during classroom instruction. Differences between the two groups of teachers centered primarily on the failure of novices to implement as large a variety of instructional actions in response to student performance cues, and in the lesser tendency of novices to consider prior knowledge about subject matter content, student history, and pedagogical principles during ongoing instruction. In addition, the data suggest that experienced

Table 6

Categories and Percentage Frequencies of Prior Knowledge Reported by Experienced and Novice Teachers

Categories of Prior Knowledge	Experienced Teachers				Novice Teachers					
	A	B	C	% of Total No. of Prior Knowledge Reports	A	B	C	D	E	% of Total No. of Prior Knowledge Reports
Important Content	X	X	X	14		X				5
Pedagogical Principles	X	X	X	21	X				X	17
Student History										
Social Behavior	X	X	X	14	X	X	X	X	X	51
Academic Skills and Abilities	X		X	18				X	X	11
Knowledge	X	X		12			X		X	16
Preferences		X	X	21						
% of Total No. of Categories Reported by Each Subject	83	83	83		33	33	33	33	67	
Average % of Categories Reported by Each Group		83					40			

Note. X indicates that the subject reported the prior knowledge category at least once.

teachers considered a greater variety of instructional goals in making classroom decisions. Furthermore, links between specific categories of instructional actions and categories of student performance cues were found to be more complex for experienced teachers than for novice teachers. The study supports earlier research findings on characteristics of teachers' classroom decision processes, including (a) the ability of teachers to flexibly attend to a number of kinds of classroom cues, (b) the ability of teachers to attend to multiple instructional goals, and (c) the dominance of the consideration of goals related to student understanding and motivation.

The findings, however, must be interpreted in light of several limitations of the study design. These limitations include the small number of subjects and limited amount of teaching time sampled, as well as the problems associated with use of the stimulated recall technique. As discussed earlier, this technique is designed to measure teachers' recall of their thought processes at the time of teaching, but may also include thoughts that occur after the fact.

Nevertheless, the results of the study do suggest some major differences between experienced and novice teachers' interactive thoughts and actions that bear further investigation. Replication studies with a larger sample of teachers in a variety of classroom settings may prove fruitful for specifying areas in which to focus teacher training efforts. Based on the results of this study, one area for further study might well be the ways in which the prior knowledge that teachers apply during ongoing instruction affects the nature and quality of their instruction. Important prior knowledge may include

knowledge of students' learning history based on previous experience with individual students and written records, as well as knowledge of the common errors students make, areas of subject matter to be stressed, and theories of instruction that might best be utilized to assist learning progress. Little research has been done to elucidate whether and how teachers use their knowledge during ongoing instruction and how the nature of teachers' knowledge affects their instructional decisions.

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Appendix A

A Classification Scheme for
Dimensions of Interactive Instruction

The following classificatsion scheme is composed of categories developed to describe student performance cues and teachers' instructional actions and cognition during interactive instruction. The following are the four dimensions of the scheme.

1) Student performance cues. Student behaviors that lead teachers to implement an instructional action.

2) Instructional actions. The actual instructional behaviors teachers implement as a result of attendance to student performance cues.

3) Instructional goals. The goals or instructional aims teachers report pursuing during their classroom decision processes.

4) Prior knowledge. The knowledge about students, instructional content, and pedagogy that teachers report considering during interactive instruction.

In the following sections, categories, definitions of categories, and examples from videotaped lesson segments and teacher report protocols are presented for the four dimensions of this scheme.

I. Student Performance Cues

A. Deficient Responses

Definition:

A behavior or response is not made by the student or students, after being elicited by the teacher.

Example:

When a teacher asked students to read sentences aloud in unison, students did not respond.

B. Initiations

Definition:

Students initiate spontaneous behaviors or responses.

Example:

A student spontaneously praised another student's response.

C. Errors

Definition:

Students make a response that is incorrect, insufficient, or unnecessary.

Example:

When given a task involving the use of map symbols, a student misplaced a symbol on the map key.

D. Attention

Definition:

The level of student attention or interest is either above or below appropriate levels.

Example:

Students manifested a high level of enthusiasm for composing the ending sentence of a story.

II. Instructional Actions

A. Gives Feedback

Definition:

The teacher provides the student with information regarding the nature of the student's performance. This may include providing information on correctness, providing correct answers, comparing incorrect responses with correct responses, explaining responses, and providing clues and hints for incomplete responses.

Example:

After a teacher noticed that a student was unable to place the proper symbol on a map key, the teacher provided the student with the correct answer and compared the correct response with the student's response.

B. Explains Concept/Procedure

Definition:

The teacher provides or elicits an explanation of a concept or a procedure for completing a task without reference to a particular student response.

Example:

A teacher explained the procedure for playing a language game, after students were unable to respond to initial questions about game rules.

C. Checks Knowledge

Definition:

The teacher queries a student or students about student knowledge of a concept, topic, or procedure.

Example:

After a student gave an incomplete answer to a question on math procedures, a teacher asked the student to provide a more complete answer.

D. Focusses Attention/Effort

Definition:

The teacher directs student attention to a concept or lesson topic, or encourages a student to persist with a task.

Example:

A teacher placed a work card directly in front of a student and

asked him a question after noticing that the student's attention was wandering.

E. Applies, Extends, or Plans

Definition:

The teacher applies concepts to new examples, extends instruction to new concepts, or plans future instruction with students.

Examples:

a. A teacher spontaneously illustrated the location of the Great Barrier Reef on a map in the room following student confusion during a discussion of the term "reef."

b. After stating that she noticed, during a reading lesson, that students didn't understand the directions North, South, East, and West, a teacher made plans with students to conduct a future lesson on that topic.

F. Elicits and Incorporates Input

Definition:

The teacher elicits or encourages student initiations and uses them in the lesson.

Example:

As students were enthusiastically composing the ending sentence of a story, a teacher spontaneously asked for each student's ending, and wrote them on the board.

III. Instructional Goals

A. Student Motivation and Involvement

Definition:

The teacher makes a decision with consideration for increasing or maintaining students' motivation or involvement with the lesson.

Example:

A teacher made a decision to allow a student to work independently on his own suggested activity, giving the following reason: "I sort of wanted to allow T. to do what he wanted to because he's a very creative child when it comes to drawing and illustrating...I need enough activities for T. like that to hold the rest of his interest because he knows he has difficulty reading and he's not reading at the level he should be."

B. Group Management

Definition:

The teacher makes a decision with consideration for the effect of overall group process and/or structure on the lesson.

Example:

A teacher made a decision to answer a student's question, even though it was irrelevant to the lesson, giving the following reason: "All it takes is for me to answer a question, even if it doesn't really have to do exactly with what we're concerned with right then, at least it will bring him back on task and he won't disrupt the other children."

C. Curriculum Integration

Definition:

The teacher makes a decision with consideration for the sequence of lesson content and/or its integration with later activities.

Example:

A teacher made a decision to continue an activity even though it wasn't working out well, giving the following reason: "(I decided to) just finish it up...because our next activity was going to be writing it. If I stopped, I think I would have lost him."

D. Social Development

Definition:

The teacher makes a decision with consideration for students' social learning and/or developmental needs.

Example:

A teacher made a decision to allow a particular student to contribute when she raised her hand, even though other students raised their hands first, giving this reason: "I'm finally getting her out of her shell."

E. Subject Matter Content

Definition:

The teacher makes a decision with consideration for the nature of the lesson content.

Example:

A teacher made a decision to probe for more specific responses in a sentence composition lesson, giving the following reason: "I was trying to do this in terms of words that might be more descriptive of what it was going to be used for...just to show we don't want to start every sentence with the same word."

F. Student Understanding

Definition:

The teacher makes a decision with primary consideration for increasing students' ability to understand the lesson content.

Example:

A teacher made the decision to add an unplanned instructional example, giving the following reason: "That came into my head to use that example...I think it helps them to hopefully relate to a delta (the term being taught)."

IV Prior Knowledge

A. Important Content

Definition:

The teacher recalls considering knowledge related to the emphasis of particular concepts or subject matter content of the lesson.

Example:

During a reading lesson, a teacher recalled: "I remembered that I had brought some yarn in the day before for them to make puppets and I thought that that was a good idea to show and maybe to tear apart."

B. Pedagogical Principles

Definition:

The teacher recalls considering knowledge related to instructional principles.

Example:

During a math lesson, a teacher recalled: "I try to vary who I ask to answer a question with a weighted emphasis on those who I think are having problems to just make sure whether or not they're involved and so on."

C. Student History

1. Social Behavior

Definition:

The teacher recalls considering knowledge related to characteristics of students' social behavior or attention span.

Example:

A teacher recalled the following information about a student during a reading lesson: "Molly (is) real shy about blending out loud. She can do it silently, but when you ask her to do it out loud, she sort of clams up and forgets about what she's doing."

2. Academic Skills and Abilities

Definition:

The teacher recalls considering knowledge related to influences on the level of students' academic skills and/or ability.

Example:

During a creative writing lesson, a teacher recalled the following: "I need enough activities for J. like that to hold the rest of his interest because...he's not reading at the level where he should be reading and hopefully will get him up there."

3. Knowledge

Definition:

The teacher recalls consideration of knowledge related to students' probable knowledge of content or concepts.

Example:

During a social studies lesson, a teacher recalled: "I was in a sorority that had all deltas in the name, so I was very aware of what delta meant...and I'm sure a lot of them live around

campus... They might have seen the delta in a sorority, and as it turned out, they had."

4. Preferences

Definition:

The teacher recalls consideration of knowledge related to judgments of students' preferred activities and methods.

Example:

During a language arts lesson in which the teacher asked students to find a state on the map, she recalled: "They like to do that; they like to find things on the map."