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ABSTRACT

The student teaching field experience has proven to be one of the most critical components of teacher preparation programs, and yet little is known about how pedagogical skills develop during this period. The purpose of this exploratory study was to examine student teachers' classroom interactions over the course of a 10-week student teaching experience to determine if interactions changed over time. Increases in student-centered interaction patterns could reflect the development of routines and automaticity that have been associated with expert teaching. Middle school student teachers (N=15) were observed for 6 weeks with the Brophy-Good Teacher-Child Dyadic Observation System. Frequencies of interactions were obtained, and patterns across three time periods were analyzed. Results of the study revealed significant differences across the three time periods: A U-shaped development pattern emerged for eight of nine variables. the interaction frequencies were lower in the middle of student teaching than during the beginning and ending periods. Possible explanations for the developmental pattern of the data are explored through discussion of three cognitive phenomena: cognitive restructuring, episodic growth, and paralysis of action. (Author/LL)

Changes in Student Teacher - Pupil Interactions: Cognitive Restructuring or Paralysis?

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Abstract

The student teaching field experience has proven to be one of the most critical components of teacher preparation programs, and yet little is known about how pedagogical skills develop during this period. The purpose of this exploratory study was to examine student teachers' classroom interactions over the course of a ten-week student teaching experience to determine if interactions changed over time. Increases in student-centered interaction patterns could reflect the development of routines and automaticity that have been associated with expert teaching. Fifteen middle grades teachers were observed for six weeks with the Brophy-Good Teacher-Child Dyadic Observation System. Frequencies of interactions were obtained, and patterns across three time periods were analyzed. Results of the study revealed significant differences across three time periods. A U-shaped developmental pattern emerged for eight of the nine variables; the interaction frequencies were lower in the middle of student teaching than during the beginning and the ending periods. This pattern emerged across the four different content areas, regardless of the place of the lesson in the unit plan. Possible explanations for the developmental pattern of the data are explored through discussion of three cognitive phenomena -- cognitive restructuring, episodic growth, and paralysis of action.

Introduction

Research on experts and novices has led to an increased understanding of how complex cognitive skills develop in a number of areas such as chess (Chase & Simon, 1973; de Groot, 1966), electronics (Egan & Schwartz, 1979), and physics (Chi, Feltovich, & Glaser, 1981). Expertise, according to Leinhardt (1988), "does not refer to doing things the 'right' or 'preferred' way. Expertise is a technical term that refers to working with speed, fluidity, flexibility, situationally encoded informational schemes, and mental models that permit larger chunks of information to be accessed and handled" (p. 147). Studies that focus specifically on teaching expertise have been useful in providing insight into teacher development (Borko & Livingston, 1989; Carter, Sabers, Cushing, Pinnegar, & Berliner, 1987; Leinhardt, 1988; Magliaro & Borko, 1986; Moskowitz & Hayman, 1974; Shulman, 1986; Swanson, O'Connor, &

Cooney, 1990; Veenman, 1984). These expert-novice studies document differences in expert and novice teachers' ability to process information and decide on subsequent actions, but little is known about how student teaching contributes to the development of expertise.

Expert teachers share common traits such as having scripted, shared, and automated routines (Berliner, 1986; Borko & Livingston, 1989; Leinhardt, 1988). The development of well-established routines may be critical for the development of expertise in teaching. Routines allow the teacher to reduce the complexity of the instructional process (Berliner, 1986) and free the teacher to think ahead and concentrate on future strategies (Perkins & Salomon, 1989). Beginning teachers tend to have more variable behavior and lack time-saving routines when compared to expert teachers (Moskowitz & Hayman, 1974). This lack of predictability and routine may interfere with the development of more advanced skills.

Expert teachers also have rapid and accurate pattern-recognition capacities that act like schema instantiations (Berliner, 1986). Experts reason in chunks that allow them to access complex, interconnected schema while teaching (Borko & Livingston, 1989; Chi, Glaser, & Rees, 1981). On the other hand, beginning teachers tend to focus on irrelevant or superficial components of instruction (Perkins & Salomon, 1989). The underdeveloped schema of the novice teacher is due in part to a lack of depth in content knowledge (Berliner, 1986) and limited situational knowledge of the classroom context (Leinhardt, 1988).

In a study of student teachers and their cooperating teachers, Borko and Livingston (1989) reported that student teachers were unable to predict where in the curriculum students would have problems. They also observed that during instruction student teachers were often unable to maintain the direction of the lesson when responding to students' questions. Interviews with the student teachers revealed that all of them reported being concerned about interactions involving students' questions and comments that arose while teaching. Borko and Livingston concluded:

> Novices do not have as many potentially appropriate scripts for instructional strategies to draw upon in any given classroom situation as do experts. Nor do they have sufficiently well-developed propositional structures for pedagogical content knowledge to enable the construction of explanations or examples on the spot. Also, because their scripts and propositional structures are not well connected, when they are drawn away from the lesson agenda (during interactions with students) they have difficulty getting back on track. (p. 491)

Another common characteristic of expert teachers is the automaticity of many classroom behaviors (Berliner, 1986; Perkins & Salomon, 1989). Automaticity occurs when a skill has been repeated many times to the point of being overlearned. Automatic behavior occurs without conscious effort and enables the individual to do two very different cognitive processes at the same time (Bloom, 1986).

Bloom (1986) examined experts in six different fields, including athletics, art, and mathematics, and found that each had developed automaticity of skills. Bloom reported that the benefits of automaticity include: economy of effort, more rapid responses than if the skill were under conscious control, and increased accuracy. An individual develops automaticity by first learning isolated details, then learning units of details, and finally learning a series of units (Bloom, 1986). Thus, a well developed, hierarchical schema emerges with the development of automaticity. Bloom's research fits well with what we know about differences in expert and novice teachers, specifically that beginning teachers tend to focus on irrelevant details without seeing patterns and are slow to respond to classroom signals.

The expert-novice studies provide useful data about the two endpoints of the process of becoming a pedagogical expert, but little is known about how this developmental process takes place. Borko and Livingston (1989) have suggested that documenting the differences between experts and novices is not enough and that we need more research on the process by which novices become experts.

The present study attempts to describe that developmental process by looking at changes over time in student teachers' classroom interactions. Several studies that have emerged from effective teaching research have shown that increases in interactions, such as the use of abstract questions, praise, and sustaining feedback increase student achievement (Brophy & Evertson, 1976; Flanders, 1970; LaShier, 1965; Soar, 1973; Stallings, 1975). As discussed previously (Berliner, 1986; Borko and Livingston 1989; Bloom, 1986), expert teachers have developed routines that allow the teachers to focus on pupils' concerns and participation. Student teachers who lack automaticity are unable to respond quickly to classroom signals and are more likely to exhibit teacher-centered interactions.

A number of previous studies have examined classroom interaction patterns of experienced teachers (Brophy & Good, 1969; Good & Brophy, 1970; Good & Brophy, 1980; Good, Sikes, & Brophy, 1973; Jones, 1988, 1990; Jones & Wheatley, 1989, 1990; Tobin & Gallagher, 1987). There is little classroom-interaction research, however, that focuses on the interactions of student teachers with pupils. Magliaro and Borko (1986) specifically concluded in their study that the "identification and description of changes in interaction patterns over time would offer additional insight into teaching as a developmental process" (p. 135).

The purpose of this study was to explore classroom interaction patterns of student teachers. This study is grounded in the belief that changes in interaction behaviors can indicate cognitive changes that occur as the novice teacher begins the process of becoming an expert teacher. It was hypothesized that student teacher-pupil interactions would become less teacher-directed and more student-oriented as the student teacher became more familiar with the subject content, gained experience with class management, and developed pedagogical routines and automaticity. According to our hypothesis, even small gains in control of content, class management, and routines would, as suggested by Borko and Livingston, allow the student teacher to pay more attention to student-oriented activity.

Study 1: Student Teachers' Interactions with Pupils

Method

Research Participants

Fifteen middle-school student teachers (10 female and 5 male) were selected from a pool of 18 student teachers enrolled in a ten-week student teaching field experience at a large southeastern university. Three of the student teachers were not selected to participate in the study due to the distance of their student teaching placement from the university. All of the subjects were seniors completing student teaching in either mathematics, science, language arts, or social studies. None of the student teachers had prior teaching experience. Each student teacher was observed for one complete class period for 10 consecutive weeks. The first three observations and the last observation of student teaching were not included in the study due to the limited teaching responsibilities of the student teachers during those times. No observations were made of classes in which the student teacher showed films, tested or used individual seatwork for most of the period. Observations of the student teachers were made of the same class and period each week. As a component of their teacher education program, each student teacher learned to design lesson plans following the same Hunter (1982) lesson plan format. Throughout student teaching, including the lessons observed in the present study, the student teacher prepared written lesson plans using the Hunter format. The university supervisor and the cooperating teacher evaluated lesson plans and implementation of lessons according to this format. Although subject topics differed for each student teacher, there was a common lesson framework.

The student teachers and the cooperating teachers who participated in the study were told that the study would examine student teacher behavior and classroom interactions. The student teaching sites included five schools located in three counties.

Procedure

A slightly modified version of the Brophy-Good Teacher-Child Dyadic Observation Instrument (Brophy & Good, 1969) was used during each observation for a period of 30 minutes to record every interaction that occurred between a student teacher and his/her pupils. The first and last five minutes of each class were not used in the observation. Seating charts were made for each class, and students were identified by gender, race, and an assigned number.

The Brophy-Good Observation Instrument allows for the coding of teacher-student interactions into 43 types of contacts. The instrument allows for the recording of only dyadic interactions, that is, those interactions that occur between the teacher and an individual student (Brophy & Good, 1969). Not all interactions that occur in the classroom are recorded; for example, the instrument does not include categories for recording interactions between the teacher and the class as a whole or interactions among peers.

The broad categories of coded behaviors recorded by the instrument include: type of contact, type of question, student's response, teacher feedback, child-created private contacts, and teacher-afforded private contacts. Type of contact includes the opportunities the student has to respond verbally to the teacher. Examples of contacts include the teacher's direct questions, student-initiated contacts, and call-outs by students. Type of question refers to the level of difficulty of the question and includes categories such as abstract questions. The student's response categories include categories for correct, incorrect, or no response. The teacher's feedback includes categories for terminal and sustaining feedback. Child-created private contacts are coded as either work-related or procedural. Teacher-afforded private contacts are further broken down into academic and nonacademic contacts.

Observations were made by three trained observers. Prior to beginning the study, intercoder reliability was established using the instrument with middle school classes. The intercoder reliability for the three observers was .80 and was measured as described by Brophy and Good (1969).

Analysis

The frequencies of each type of student teacher-pupil interaction were obtained for each of the pupils in the classes observed. The behaviors were then combined to form nine broad categories of interactions: student-initiated interactions, student call outs, procedural questions, direct teacher questions, teacher's abstract questions, praise, criticism, warning, and sustaining feedback. The broad categories include combinations of related behaviors. For example, the specific types of sustaining feedback (repeats question, gives clue, asks new question and expands question) comprised one broad category for analysis called sustaining feedback (Brophy & Good, 1969). The goal of the analysis was not to look at whether a student teacher was giving clues as opposed to asking new questions. Rather, the analysis determined the degree to which the student teacher used all types of sustaining feedback. These broad categories of interactions allowed the investigators to examine changes in teacher-originated and student-originated interactions (see Table 1).

Categories in which there were very few or no interactions (such as child-created, private, academic contacts) were not included in the analysis. In addition, all 43 categories of interactions were combined and analyzed to represent the total frequency of interactions that occurred during an individual observation period for each middle school pupil. In order to examine the data for changes in interactions over time, the six weeks of teaching were divided into two-week time periods. Combining the data into early student teaching, middle, and final periods controlled for the effects of individual lessons. The independent variables (direct questions, abstract questions, praise, criticism, warning, sustaining feedback, student-initiated interactions, student call-outs, student procedural questions, and total interactions) were each analyzed by analysis of variance. The Friedman test (Sachs, 1984) was used to determine if the three time periods were significantly different from each other.

Results

The analysis of variance revealed significant differences over the three time periods for two variables: student-initiated interactions ($F= 3.6, p<.02$) and procedural questions ($F=7.37, p<.03$). Means and standard errors for the interaction variables are shown in Table I. When the interaction variables were analyzed together across the three time periods, an interesting and statistically sicnificant U-shaped pattern in the data emerged ($\chi^2_R = 6.2$, significant at $p< 0.05$). For eight of the nine variables, the frequency of interactions dropped during the second time period but rose again for the third period. The use of abstract questions dropped during both the second and third time periods. Although the differences between student means may appear small, when considered for a class of thirty students the number of total interactions, for example, decreases by nearly 19 interactions per class period (11.5%) between the first time period of student teaching and the second time period.

Insert Table 1 here.

Study 2: Experienced-Novice Teacher- Student Interactions

Method

<u>**Research Participants**</u>

Five of the student teachers who taught science from Study 1 were selected as a sample of novice teacners, and their classroom interactions were compared to those of 13 experienced science teachers. The experienced teachers were part of a larger study of classroom interactions (Jones, 1990). The experienced teachers each had more than six years of experience and taught middle school science. The five student teachers selected for further study all taught middle school science. None of the experienced teachers served as cooperating teachers for the student teachers.

Procedure

The same observation procedures and analysis were used for the experienced teachers as were used for the student teachers in Study 1, except that each of the 13 expert teachers was observed for one randomly selected class period and the interactions of the student teachers were averaged over the six observations. The interaction means of the student teachers were compared to the experienced teachers using analysis of variance.

Results

The analysis of variance for the expert-novice teacher interactions revealed significant differences for sustaining feedback, procedural questions, and behavioral warnings. Means and standard errors are shown in Table 2. The expert teachers had more instances of student-initiated interactions, direct questions, call outs, and behavioral warnings. The student teachers used more praise, sustaining feedback, abstract questions, and were asked more procedural questions. Overall, the expert teachers averaged 2.48 interactions per student, per class and the novice teachers averaged 1.83 interactions per student, per class.

The fact that student teachers received significantly more procedural questions was not unexpected in light of their inexperience in structuring lessons. The significantly greater use of sustaining feedback by the student teachers was an unexpected finding, although, the use of sustaining feedback was a teaching skill that was stressed throughout the methods course and during supervision.

The greater use of behavioral warnings by the expert teachers may reflect their more mature psychological development. Fuller and Bown (1975) have described stages of concerns that teachers possess during different stages of their careers. Beginning teachers typically are concerned about being liked by students and being able to control students. Perhaps the concern with being liked leads them to avoid warnings and to look for other means of classroom management.

The fewer number of interactions for student teachers may be a reflection of their greater use of sustaining feedback and abstract questions. These two types of interactions require more time for student response and could result in fewer overall interactions. An alternative hypothesis is that the student teacher lacks the experience to make rapid decisions, would require more time to think about their own questions and responses as well as those of their students. The student teacher's lack of automaticity of thought could lead to a slower rate of overall interactions.

Discussion and Conclusions

The data from study 1 show a decrease in the frequency of teacher-pupil interactions during the middle time period of student teaching. During this phase, the interactions also became more teacher-directed and less student centered. This trend occurred regardless of the subject taught (science, mathematics, language arts or social studies) and was independent of the lesson plan and unit plan. Each student teacher was teaching a different lesson and moved into new unit plans at very different times within the semester. The common pattern found across the 15 student teachers for eight of the nine variables suggests a shared developmental phenomenon.

The U-shaped interaction pattern found in this study is similar to the U-shaped behavioral patterns described for the development of language (Bowerman, 1982), concepts of ratio comparisons (Stavy, Strauss, Orpaz, & Carmi, 1982), artistry (Gardner & Winner, 1982), and gender identity (Emmerich, 1982). The mechanisms underlying U-shaped behavioral patterns are not yet fully known, but there is increasing evidence that conceptual growth occurs as the individual discovers underlying combinations of relationships that result in different, more integrated understandings, such as those related to automaticity in experts' behavior. The decreases in expert-like behavior, typical of U-shaped behavioral patterns, signify efforts to integrate new knowledge (Stavy et al., 1982).

If the data are examined within this developmental framework, the changes in classroom interactions that appear to reflect paralysis or episodic growth (discussed below) may be a strong indication that the student teacher is undergoing radical cognitive restructuring during the middle time period of the student teaching experience.

Cognitive Restructuring

Borko and Livingston (1989) have suggested that the central component of pedagogical reasoning is the development of abstract knowledge structures known as schemas. Teachers' schemas are composed of scripts, scenes, and propositional structures (Shavelson, 1986). Scripts are knowledge structures about the daily experiences that make up teaching, such as checking homework and collecting papers. Scenes are knowledge structures that relate to common events, such as small group discussion or whole class direct instruction. Propositional structures include factual knowledge of students, classrooms, and subject matter (Borko & Livingston, 1989). While the expert or experienced teacher may have well-developed schemas, the student teacher has limited schemas, propositions, and scenes to draw upon while trying to grapple with the complexities of teaching. As the student teacher begins to assume a full teaching load, student teaching becomes a time of potentially rapid change in schemas.

The notion of cognitive restructuring is useful in understanding such cognitive change. Vosniadou and Brewer (1987) have described two types of knowledge acquisition: one type is weak restructuring involving the accumulation of facts and relationships; the second type is radical restructuring, which results in a change in core concepts and a change in the cognitive structure. This radical restructuring has been associated with the expert/novice shift found in areas such as chess or physics (Vosniadou & Brewer, 1987). The variability observed in our study of interactions over time may be a result of radical cognitive restructuring that arises as the student teacher's schemas are challenged by classroom experiences.

Although student teachers may arrive at their student teaching sites with propositional knowledge gained from university courses, they lack two other types of knowledge deemed by Shulman (1986) to be essential to professional knowledge. These are case knowledge, which is knowledge of specific, richly described events, and strategic knowledge. According to Shulman, strategic knowledge "comes into play as the teacher confronts particular situations or problems, whether theoretical, practical, or moral, where principles collide and no simple solution is possible" (p. 13). As the student teacher assumes the full teaching load, cognitive restructuring results from confrontation with decisions for which the student teacher has no strategic knowledge.

How then does cognitive restructuring relate to student teacher behavior and specifically to the classroom interactions observed in this study? McNeil (1986) reported that when teachers were uncertain about their content knowledge or were unable to predict the consequences of innovative instructional strategies (a lack of strategic knowledge), they reduced student input in lessons and reduced student discussion. Joyce (1988) also reported that as student teachers develop, their behavior tends to become more teacher-controlled, involving more punishment and fewer rewards.

The tendency toward more teacher control was also found for the students in the present study. McLaughlin (1991) conducted an interpretive case study of 3 of the 18 student teachers that comprised the pool of subjects for the present study. He reported that Kerry (pseudonym), one of the student teachers, developed a tension between wanting to care for her students and wanting to control the class. Kerry's attempts to engage her students resulted in tension about control. "Kerry wanted to control herself and the physical and social environment so that her students could learn" (p. 189). McLaughlin found that the three student teachers in the case study developed tight control of the content of the classes and solicited few questions from students. In addition, McLaughlin reported that the student teachers circumscribed the questions that they asked students.

This tendency toward more teacher control was also seen in the interactions of the 15 student teachers in the present study. The data reveal that those interactions that are most likely to result in student control of the lesson or those that would sustain student responses decreased in the middle time period. For example, in the middle period student-initiated interactions decreased 33% and sustaining feedback decreased 26%. The decrease in student teachers' sustaining feedback suggests that the student teacher is not incorporating students' signals into the routines. Perhaps this is a defense, an attempt to gain predictability by controlling the flow of recitation and discussion.

Direct questions also decreased during the middle period, but only by 10%, resulting in a teacher-dominated lesson structure. We thus conclude that lack of automaticity, lack of strategic knowledge and the need for control appears to accompany the process of radical restructuring in the student teacher. Furthermore, this attempt to gain control during a period of restructuring explains the decrease in total interactions and the decrease in student-generated interactions found in this study.

Paralysis

Two other concepts -- paralysis and episodic growth -- have been used to describe nonlinear development in student teachers. Both paralysis and episodic growth can be viewed as symptoms of cognitive restructuring. The U-shaped data pattern in the present study is congruent with definitions both of paralysis and of episodic growth.

Corcoran (1981) described paralysis experienced by beginning teachers:

> The large number of factual and procedural unknowns can send the beginning teacher into a state of shock, wherein it becomes impossible to transfer previously mastered concepts and skills from the university to the public school classroom... What complicates this inevitable shock of not knowing for the beginning teacher is the need to appear competent and confident.. Implicit in the role of the teacher is the notion of being knowledgeable, a notion that contradicts the very essence of being a beginner... Thus the beginning teacher is trapped in a paradox that leads to paralysis. Each time the beginner experiences the shock of not knowing, of being caught off guard, the paradox closes in once again. The feelings of confusion and personal violation that arise from this beginner's paradox are complex and varied. One common effect is that it renders the beginner unable to transfer previously mastered concepts and skills from university to public school classroom. (p. 20)

Student teachers find themselves at times unable to act or react to the complexities of the classroom. Approximately mid-way through student teaching, supervisors can usually predict a crisis of confidence. Corcoran (1981) described a student teacher, Debra, who develops problems with class management and becomes paralyzed, unable to take charge. She eventually pulls herself out of the crisis and reaches back into her previous training to integrate her current problems with her undergraduate teacher preparation. Debra, like the students in the current study, developed this change in behavior midway through her student teaching.

This midpoint often occurs when the student teacher is beginning to assume full responsibility for all the classes. Usually the cooperating teacher begins to withdraw from the room with increasing frequency, and the pupils begin to challenge the authority of the student teacher. Under these extreme demands anxiety may accompany paralysis. Harootunian and Koon (1970) reported that high teacher anxiety leads to less verbal interaction in support of students.

Caruso (1977) has suggested that student teachers move through a series of distinctive stages that begin with anxiety, then move to confusion, competence, criticism, and end with a sense of loss or relief. Only through experience are student teachers able to move from confusion to competence.

Veenman (1984) also reported a phenomenon of "reality shock" which beginning teachers experience as they attempt to make sense of the reality of the classroom. Veenman indicated that this "reality shock" is accompanied by psychological and physical complaints, changes in behavior, changes in attitudes and beliefs, and changes in emotions and self-concept. These stages may be necessary for the development of higher levels of performance.

Paralysis and this "shock of not knowing" as well as the attendant cluster of symptoms just described, all indicate the onset of the student teacher's restructuring of prior knowledge with new experiences.

Episodic Growth

Episodic growth may also be a component of radical cognitive restructuring. For example, the U-shaped pattern observed in the present study, if followed over longer time periods, could assume a larger pattern of peaks and valleys.

Roehler and Stoddart (1991) examined knowledge structures of elementary preservice teachers and also found nonlinear growth. They reported that growth in literacy expertise assumes a series of regressions and plateaus in which student teachers appear disorganized and confused. These periods of regression occur when teacher candidates are confronted with many new concepts at once. The regressions occur as the student "retrenches" while reorganizing and consolidating new knowledge, a process similar to cognitive restructuring. Roehler and Stoddart have also suggested that the simultaneous reconfiguration of existing knowledge structures, along with the addition of new knowledge structures, can explain the "washing out" of the effects of teacher education.

Other researchers have suggested that reorganization of knowledge occurs as a result of chunking. Studies have shown that experts reason using knowledge of patterns or chunks rather than thinking about specific parts of a task (Anderson, 1983; Perkins & Saloman, 1989; Swanson, O'Connor, & Cooney, 1990). This type of reasoning frees the mind to think ahead and devise complex strategies.

Chunking has also been associated with memory. Anderson (1983) suggested that there are three types of memory: working, declarative, and production. The declarative memory is based on knowledge chunks or units that are each composed further of a series of no more than five elements. Anderson maintains that these chunks make up a more complex network that can be thought of as a tangled hierarchy. A novice teacher, such as the student teachers in the present study, would be expected to have a less complex hierarchy than an expert teacher.

Swanson, O'Connor, and Cooney (1990) in their study of expert and novice teachers' problem-solving suggested that expert teachers' reasoning patterns are more comprehensive and contain more mental subroutines than do those of the novice. They noted that novice teachers tend to focus on surface details. Swanson, O'Connor and Cooney recommended that "preservice teachers should be exposed to classroom problems and taught heuristics and strategies to solve problems. It makes sense that if pattern recognition is important for expertise in other fields such as medicine, physics and chess playing, it should also be important when considering expertise in teaching" (p. 549).

The midpoint variance observed in the present study may be due to the inability of student teachers to put classroom interactions into a predictable sequence. Episodic gains in predictability and routines of interactions (chunks) may result as student teachers put together sequences of interactions that result in student achievement and comprehension.

Additional studies could reveal if the distinctive student teacher interaction patterns found in this study exist for other groups and grade levels of student teachers. Additional research is needed to determine if these interaction patterns indicate a U-shaped behavioral change or whether interaction changes actually represent a long series of peaks and valleys caused by the continual radical cognitive restructuring of pedagogical knowledge.

Implications

The interaction patterns revealed by the data and the observations by the university supervisors indicate that there is a phase of stress and tension for the student teacher that occurs during the middle of student teaching. This U-shaped pattern in interaction behavior may signify a period of cognitive restructuring for the student teacher.

Case study research is needed to explore sources of student teachers' initial schemas of professional knowledge. Informal observations of student teachers suggest that these initial schemas come from childhood experiences of schooling, field observations in schools, media representations of teachers, and university courses. Student teachers may derive inconsistent schemas from psychology, content area courses, and methods courses. To what extent these inconsistencies influence the degree of cognitive restructuring or the intensity of paralysis is yet unknown.

If paralysis does indeed signal the onset of cognitive restructuring, then supervisors and cooperating teachers need to find ways to help student teachers examine the sources of their schemas and to use their new teaching experiences for cognitive restructuring.

One implication that arises from this study is that student teachers need time to reflect and to make sense of their teaching experiences. Assigning student teachers to a full load may not be justified if they lose ground in their attempts at cognitive restructuring. Ten weeks of student teaching may not be long enough for students to develop routines of basic skills that can form the foundation for more advanced teaching strategies. Other studies suggest that it takes up to five years for beginning teachers to master the basics of teaching (Berliner, 1986), and the expert-novice studies have revealed that expertise is gained only after years of experience. A better understanding of the relationship between cognitive restructuring and student teaching can enable teacher educators to design more effective programs.

References

Anderson, J. (1983). The architecture of cognition. London: Harvard University Press.

Berliner, D. (1986). In pursuit of the expert pedagogue. Educational Researcher, 15, 5-13.

Bloom, B. (February, 1986). Automaticity. Educational Leadership, 43, 70-77.

Borko, H., & Livingston, C. (1989). Cognition and improvisation: Differences in mathematics instruction by expert and novice teachers. American Educational Research Journal, 26, 473-498.

Bowerman, M.(1982). Starting to talk worse: Clues to Language acquisition from children's late speech errors. In S. Strauss & R. Stavy (Eds.), U-Shaped behavioral growth (pp. 101-145). New York: Academic.

Brophy, J., & Evertson, C. (1976). Learning from teaching: A developmental perspective. Boston: Allyn & Bacon.

Brophy, J., & Good, T. (1969). Teacher-child dyadic interaction: A manual for coding classroom behavior (Report Series No. 27). Austin: The University of Texas, Research and Development Center for Teacher Education.

Carter, K., Sabers, D., Cushing, K., Pinnegar, S., & Berliner, D. (1987). Processing and using information about students: A study of expert, novice and postulant teachers. Teaching and Teacher Education, 3, 147-157.

Caruso, J. (1977). Phases in student teaching. Young Children, 33, 57-63.

Chase, W.G., & Simon, H.A. (1973). Perception in chess. Cognitive Psychology, 4, 55-81.

Chi, M., Feltovich, P., & Glaser, R. (1981). Categorization and representation of physics problems by experts and novices. Cognitive Science, 5, 121-152.

Chi, M., Glaser, R., & Rees, E. (1981). Expertise in problem solving. In R. Sternberg (Ed.), Advances in the psychology of human intelligence. Hillsdale, NJ: Lawrence Erlbaum.

Corcoran, E. (1981). Transition shock: The beginning teacher's paradox. Journal of Teacher Education, 32, 19-23.

de Groot, A. (1966). Perception and memory vs. thought: Some old ideas and recent findings. In B. Kleinmontz (Ed.), Problem solving. New York: Wiley.

Egan, D.E., & Schwartz, B. (1979). Chunking in recall of symbolic drawings. Memory and Cognition, 7, 149-158.

Emmerich, W. (1982). Nonmonotonic developmental trends in social cognition: The case of gender identity. In S. Strauss & R. Stavy (Eds.), U-Shaped behavioral growth (pp. 249-269). New York: Academic.

Flanders, N. (1970). Analyzing teaching behavior. Reading, MA.:Addison-Wesley.

Fuller, F.F., & Bown, O.H. (1975). Becoming a teacher. In K. Ryan (Ed.), Teacher education

(Seventy-fourth Yearbook of the National Society for the Study of Education). Chicago: University of Chicago Press.

Gardner, H., & Winner, E. (1982). First intimations of artistry. In S. Strauss & R. Stavy (Eds.), U-Shaped behavioral growth (pp. 147-168). New York: Academic.

Good, T.L., & Brophy, J.E. (1970). Teacher-child dyadic interaction: A new method of classroom observation. Journal of School Psychology, 8, 131-138.

Good, T.L., & Brophy, J.E. (1980). Educational psychology: A realistic approach. New York: Holt, Rinehart & Winston.

Good, T. L., Sikes, J., & Brophy, J.E. (1973). Effects of teacher sex and student sex on classroom interaction. Journal of Educational Psychology, 65, 74-87.

Harootunian, B., & Koon, J. (1970). The reinforcement behaviors of teachers in training. Paper presented at the annual meeting of the American Educational Research Association, MN. (ERIC Document Reproduction Service No. ED 040 951)

Hunter, M. (1982). Mastery teaching. El Segundo, Ca: TIP Publications.

Jones, M. G. (1988). Gender issues in teacher education. Journal of Teacher Education, 40, 33-38.

Jones, M.G. (1990). Action zone theory and target students in science classrooms. Journal of Research in Science Teaching, 27, 651-660.

Jones, M.G., & Wheatley, J. (1989). Gender influences in classroom displays and student-teacher behavior. Science Education, 73, 525-545.

Jones, M. G., & Wheatley, J. (1990). Gender differences in teacher-student interactions in science classrooms. Journal of Research in Science Teaching, 27, 861-874.

Joyce, B. (1988). Training research and preservice teacher education: A reconsideration. Journal of Teacher Education, 39, 32-36.

LaShier, W. (1965). An analysis of certain aspects of the verbal behavior of student teachers of eighth grade students participating in a BSCS laboratory block. Unpublished doctoral dissertation, University of Texas, Austin.

Leinhardt, G. (1988). Situated knowledge and expertise in teaching. In J. Calderhead (Ed.), Teachers Professional Learning. New York: Falmer.

Magliaro, S., & Borko, H. (1986). A naturalistic investigation of experienced teachers' and student teachers' instructional practice. Teaching and Teacher Education, 2(2), 127-137.

McLaughlin, H. (1991). Reconciling care and control: Authority in classroom relationships. Journal of Teacher Education, 42, 182-195.

McNeil, L. (1986). Contradictions of control. New York: Routledge.

Moskowitz, G., & Hayman, J. (1974). Interaction patterns of first-year, typical and "best" teachers in inner-city schools. Journal of Educational Research, 67(5), 224-230. .

Perkins, D., & Salomon, G. (1989). Are cognitive skills context-bound? Educational Researcher, 18(1), 16-25.

Roehler, L., & Stoddart, T. (1991). The structuring and restructuring of teacher candidate thinking. Unpublished manuscript, Michigan State University.

Sachs, L. (1984). Applied statistics: A handbook of techniques. New York: Springer-Verlag.

Shavelson, R.J. (1986, June). Interactive decision-making: Some thoughts on teacher cognition. Invited address, I Congreso Internacional, "Pensamientos de los Profesores y Toma de Decisiones," Seville, Spain.

Shulman, L. (1986). Those who understand: Knowledge growth in teaching. Educational Researcher, 15(2), 4-14.

Soar, R. (1973). Follow through classroom process measurement and pupil growth: Final report. Gainsville: College of Education, University of Florida.

Stallings, J. (1975). Implementation and child effects of teaching practices in follow-through classrooms. Monographs of the Society for Research in Child Development, 41(7-8), Serial No. 163.

Stavy, R., Strauss, S., Orpaz, N., & Carmi, G. (1982). U-Shaped behavioral growth in ratio comparisons. In S. Strauss & R. Stavy (Eds.), U-Shaped behavioral growth (pp. 11-36). New York: Academic.

Swanson, H., O'Connor, J., & Cooney, J. (1990). An information processing analysis of expert and novice teachers' problem solving. American Educational Research Journal, 27(3), 533-556.

Tobin, K., & Gallagher, J. (1987). Target students in the science classroom. Journal of Research in Science Teaching, 24(1), 61-75.

Veenman, S. (1984). Perceived problems of beginning teachers. Review of Educational Research, 54(2), 143-178.

Vosniadou, S., & Brewer, W. (1987). Theories of knowledge restructuring in development. Review of Educational Research, 57(1), 51-67.

TABLE 1
Mean Number of Student Teacher-Pupil Interactions Over Time

Type of Interaction	Means (Standard Error)		
	Weeks 4-5	Weeks 6-7	Weeks 8-9
Student-Originated Interactions			
Student Initiated	0.18(.02)	0.12(.02)	0.14(.02)
Call-Outs	0.05(.01)	0.03(.01)	0.04(.01)
Procedural Questions	0.10(.02)	0.07(.01)	0.15(.02)
Teacher-Originated Interactions			
Direct Questions	0.69(.05)	0.62(.04)	0.67(.05)
Praise	0.08(.01)	0.06(.01)	0.09(.01)
Warnings	0.04(.01)	0.03(.01)	0.04(.01)
Criticism	0.03(.01)	0.02(.01)	0.03(.01)
Sustaining Feedback	0.19(.02)	0.14(.02)	0.20(.03)
Abstract Questions	0.36(.03)	0.30(.03)	0.28(.03)
Total Interactions	5.50(.23)	4.87(.22)	4.96(.25)

Note [1]. Friedman test for the three time periods revealed $X^2R = 6.2$, significant at $p < 0.05$.

Note [2]. Means represent the mean number of interactions per pupil, during a 30 minute observation.

TABLE 2

Frequencies of Student Teacher and Expert Teacher Interactions With Students

Type of Interaction	Means (Standard Error)	
	Student Teacher	Experienced Teacher
Student Initiated	0.14(.01)	0.33(.12)
Direct Questions	0.52(.20)	0.72(.33)
Call Outs	0.08(.05)	0.27(.11)
Praise	0.11(.04)	0.07(.04)
Warning*	0.04(.02)	0.24(.22)
Sustaining Feedback*	0.20(.10)	0.04(.02)
Procedural Questions*	0.12(.00)	0.03(.01)
Abstract Questions	0.37(.08)	0.20(.07)
Total Interactions	1.83(.23)	2.48(.52)

* $p < 0.05$

Note. Means represent the mean number of interactions per pupil, during a 30 minute observation.