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AUTHOR Speaker, Richard B., Jr.; Madison, Susan Gomez
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ABSTRACT

Understanding the ideas of chaos theory and spectra of teachers' beliefs about literacy provides an additional method of examining, organizing, and interpreting the complex research findings in the area of literacy teachers' thought processes. Historically, research paradigms in the area of teacher thought processes have ranged from the process-product to classroom ethnography. Studies of teacher thinking and knowledge in relation to literacy practices have been designed to document the relationship between teacher belief systems and instructional behaviors or decisions relating to student literacy. The range of findings in such studies suggests a complex interplay of teacher beliefs and behaviors. S. G. Madison uses the metaphor of a spectrum to describe the range of teacher beliefs about literacy, their knowledge, and planning and decision-making processes. Examining more complex systems of teacher beliefs and the nature of literacy teacher behavior is possible under the theory of chaos, the study of nonlinear dynamic systems. The object of research becomes description and understanding of complex educational systems such as those which represent teacher thought processes and beliefs as they operate within the literacy classroom. (Contains 48 references and 10 figures of data.) (RS)

TOWARDS A NEW METAPHOR IN LITERACY TEACHER THOUGHT PROCESSES: UNDERSTANDING TEACHERS' SPECTRA OF BELIEFS AND THE CHAOS OF TEACHING

Richard B. Speaker, Jr., University of New Orleans

Susan Gomez Madison, University of South Florida

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Running Head: Teacher Beliefs, Spectra and Chaos

TOWARDS A NEW METAPHOR IN LITERACY TEACHER THOUGHT PROCESSES: UNDERSTANDING TEACHERS' SPECTRA OF BELIEFS AND THE CHAOS OF TEACHING

Research on literacy teaching examines teacher development, teacher education, leadership, beliefs, thought processes and behaviors. The aim of these studies has been to provide a clearer description of literacy teachers and the processes involved in teaching, and to use that knowledge to develop more effective teacher preparation programs (Shulman, 1986); however, the complexity and the dynamic nature of the social systems involved in classroom interaction has rarely been adequately recognized, even in the most developed models of teacher beliefs which rely on rather simple psychological and cognitive science models (Berliner, 1988; Clark & Peterson, 1986; Feiman-Nemser & Floden, 1986; Livingston & Borko, 1989; Pajares, 1992; Shulman; Westerman, 1991). Only with the newer models of dynamic systems developed through the theory of chaos (Gleick, 1988) can educators begin to understand the complexities involved in such teacher thought processes as planning, decision making, knowledge structuring and belief. Madison (1993) pushes models of teacher beliefs and practices further, dropping the need for a rational-entity hypothesis where all beliefs are consistent and logical and adopting the metaphor of a spectrum as the model for understanding the relationships among and across teacher beliefs. This paper examines the research on literacy teachers' beliefs through the twin lenses of these two metaphors: Spectrum and Chaos.

PRIOR RESEARCH PARADIGMS

Historically, research paradigms in the area of teacher thought processes have ranged from the process-product to classroom ethnography. The process-produce approach was positivistic, reductionist, and designed to "define relationships between what teachers do in classrooms and what happens to students, . . . more specifically, student achievement,"

(Anderson, Evertson, & Brophy, 1979, p. 193; Dunkin & Biddle, 1974). Under process-produce metaphors, classrooms were loci of discrete events which could be generalized across situations; however, the most significant flaw in the process-product metaphor arose from the tenuous assumption of a linear causality relationship between teacher actions and student outcomes (Erickson, 1986; Clark & Peterson, 1986; Shulman, 1986). Criteria for the quality of this research were derived from experimental paradigms in the sciences where the researcher could control initial conditions and the actions of the forces being measured and using the statistical models based on randomness and linearity; furthermore, generalizability of results to extensive populations was a desired result.

A contrasting research paradigm consists of qualitative studies which used epistemological assumptions and methodologies from anthropology, sociology, linguistics, semiotics and even cognitive science (see Brookhart & Freeman, 1992; Cazden, 1986; Doyle, 1977a, 1977b; Erickson, 1973; Fox, 1993; Gump, 1989; Heath, 1983; Mehan, 1979; Phillips, 1983; Schunk, 1991). This approach viewed classrooms as socio-cultural environments where the participants contribute to the organization and definition of meaning. These studies were often ecological and examine the relationships among classroom environment, the people in it and aspects of their cultures. Criteria for the quality of this research were derived from the stance of the researcher, the nature of the analytic methodology for reducing and interpreting data and methods of triangulation. generalizability of results was not a desired result; instead, completeness of the description from the point of view of a participant and narrative quality were desired for each particularistic set of entities studied.

Ecological studies emphasize the interactions among persons in the classroom environment, the relationship between the classroom context and other related social contexts and acknowledging unobservable processes as important subjects for study (Shulman, 1986).

The nature of classrooms as socially and culturally organized environments, the nature of teaching as one aspect of a complex environment, and the nature of the meaning perspectives of the teacher were described for particular situations. Sociolinguistic inquiries (Wilkinson, 1982) focused on describing how teachers and students use language. These studies view the classroom as a communicative community which involves particular kinds of social participation (Cazden, 1986; Hymes, 1977). A more recently developed avenue of research involves interest in teacher cognition. Shulman (1986) suggests that this interest resulted in part from the influence of information-processing and cognitive psychology on our understanding of teaching and teachers.

The rational-entity hypothesis pervades all these episemologies, although Pajares (1992) comes close to dropping it. For instance, Shavelson (1983) stated the folowing purpose of research on teacher thinking: "Teachers are rational professionals who, like other professionals, . . . make judgments and carry out decisions in an uncertain, complex environment . . . Teachers' behavior is guided by their thoughts, judgments and decisions" (pp. 392-393). While research on teacher thought processes, before, during and after teaching, has evolved as one means of increasing our understanding of the cognitive processes involved in teaching and their relationship to other aspects of teacher actions and behaviors (Pajares, 1992; Shulman), it has been imbued with a narrow version of the rational-entity hypothesis in attempts to provide unitary views of thinking about complex situations. Indeed, the positivistic search for laws governing teacher behavior and thinking has been fostered by narrow theoretical constructions of literacy theory and instantiated in irrational and irreducible miscommunications such as the division between whole language and skills-based philosophies and the earlier 'great debate' between phonics and sight-word proponents.

These basic epistemological divisions have projected the idea that certain ways of teacher

thinking, planning, decision making, knowledge structuring and belief were correct while others were incorrect with very little gray space between the polar opposites; indeed, rhetorical stances from a theory's poropnents or opponents and the rational-entity hypothesis have prevented the development of an understanding of the ranges in teacher thinking. Although research on teaching has examined discrete entities like beliefs, knowledge, planning and decision making, in reality these entities are integrated in teacher thinking. In discussing the relationships among these entities, Pajares (1992) suggested there are some disagreements about the relative importance of each entity in thinking and decision making. Although teacher thinking may be holistic, it may be situationally specific and there may be inconsistencies among beliefs and knowledge within a teacher's thinking and belief systems (Pajares).

STUDIES OF TEACHER THINKING AND BELIEFS ABOUT LITERACY

Studies of teacher thinking and knowledge in relation to literacy practices have been designed to document the relationship between teacher belief systems and instructional behaviors or decisions relating to student literacy. Research on teacher decision making in relation to reading and writing instruction has produced mixed results. Debate continues over how teachers make literacy decisions and how much control they have over their decisions. Teacher decision making in these studies is often characterized as making decision about classroom practice after evaluating information in terms of theoretical beliefs and then observing teacher behaviors (DeFord, 1978, 1985; Harste & Burke, 1977). Change of teacher beliefs has rarely been examined as belief systems are often consideredwell formed and semi-permanent (Pajares, 1992); however, under specific conditions, major changes in belief structures can occur (Bean & Zulich, 1992; Button, 1992; Johnson & Hoffnam, 1994; Roberts Burke & Myette, 1993; Wilson, Konopak, & Readence, 1993; Walker & Roskos, 1994).

Results from a number of studies suggest that teachers do operate under a set of beliefs

about teaching and about literacy which guide their planning and instruction (Brophy & Good, 1974; Feiman-Nemser & Floden, 1986; Harste & Burke, 1977; Ray, Lee, & Stansell, 1986; Scharer, Freeman, Lehman, & Allen, 1993; Schommer, 1990; Smith, 1982). Teachers make decisions in the classroom and guide their behavior based upon these beliefs (DeFord, 1978, 1981; Harste, Woodward & Burke, 1984). Some studies have suggested that teacher beliefs about literacy directly influence their instructional decisions (Borko & Niles, 1982; Borko, Shavelson & Stern, 1981). Teachers purposefully make decisions which adapt and alter their literacy instruction (Borko, Eisenhart, Kello & Vandett 1984; Leinhardt, Weidman & Hammond, 1984). Kinzer (1989) found that teachers do draw upon their knowledge of theory to guide literacy instruction but that the process tends to be situation-specific. Ruddell and Harris (1989)found a positive correlation between effective teaching and teacher beliefs.

Research on teachers' theoretical beliefs about literacy has also produced conflicting findings. Harste and Burke (1977) concluded that teachers make decisions about reading based on a set of theoretical beliefs which guide the decision making process about many elements of classroom practices and setting. Mangano and Allen (1986) examined teacher theoretical beliefs in writing classrooms. This study purposely selected teachers with differing orientations to see whether participating in a whole language seminar changed beliefs or influenced classroom interaction. Results indicated that while teacher beliefs did change somewhat, students continued to maintain a skills orientation in their writing. The authors point out that a major limitation of this study was the use of only two subjects. They suggest that future research use a larger number of teachers in a variety of classrooms in order to better categorize teacher beliefs. Davis, Konopak, and Readence (1993) found considerable variance in teacher behaviors and decisions even when the teachers had very similar belief systems. Wilson, Konopak and Readence (1992) interpreted inconsistencies between stated beliefs on a survey and practice

observed in a teacher's classroom as reflecting inconsistencies between "what should be done rather than what is done..." (p. 481). Furthermore, teacher decision making in relation to literacy instruction is mitigated by outside factors related to situations (Duffy, 1977; Duffy, Roehler & Johnson, 1986), an expected finding from chaos theory where initial conditions can greatly influence patterns. Conley (1986) suggested extensive training can help reading teachers become more adept at decision making when implementing new reading strategies. Although teachers in the study held shared beliefs about reading methods, all varied in how the methods were implemented in their classrooms. This finding suggests that decisions made by teachers arise from a complexity of individual and external factors and are not directly linked to teacher thought processes.

Results of other studies have found no overt connection between beliefs and instruction (Borko & Caldwell, 1982; Duffy, 1982); indeed, findings in some cases suggest that other social, environmental or psychological factors may outweigh the influence of the teacher's theoretical beliefs. Ray, Lee and Stansell (1986) examined one teacher's attempts to implement new beliefs about writing into her classroom. Their results suggest that when teachers are not in touch with their implicit theories and beliefs, classroom implementation of new ideas may be only superficial. This finding implies that change in the classroom can only occur when there is a change in teacher theory. These conclusions, along with future research, are especially significant in light of efforts to implement reforms in teaching.

Several studies have found that teacher decision making in relation to literacy instruction is mitigated by outside factors (Duffy, 1977; Duffy, Roehler & Johnson, 1986). Findings from an ethnographic study by Conley (1986) suggest that extensive training can help reading teachers become more adept at decision making when implementing new reading strategies. Although teachers in the study held shared beliefs about reading methods, all varied

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Recent research designs have used narrative and reflective methods to examine teacher thinking in relation to literacy. In a study of how elementary teachers teach reading (Meyerson, 1992), teachers completed narrative accounts of their teaching approaches, along with a conceptual map of factors which influenced their teaching. Using constant comparison methods, Meyerson collapsed factors into four core categories: personal background, teaching context, professional development and professional knowledge. Teachers in this study reported that their personal background was the most influential core factor, while professional development was the least influential factor. A related study by Tidwell (1992) examined teacher beliefs about whole language instruction. Results of this study indicated that teacher beliefs and approaches ranged along a continuum and did not, as might be expected, fall into two dichotomous groups. These findings suggest that teacher thinking in relation to literacy may be more complex and individualistic than previous models and conclusions have implied; indeed, a spectral organization and chaos theory may be necessary for adequate interpretation.

The complex interplay of teacher beliefs and behaviors related to literacy must be acknowledged because of the range of findings in the research literature briefly reviewed above. Ruddell and Sperling (1988) report three directions in the research on the relationship between teacher thinking and effective literacy teaching which still need to be explored: teacher's perceptions of their knowledge base about teaching and literacy; development of "contextualized profiles" of practitioners; further study of the role of organizational barriers which intervene in the teaching process. Madison (1993) found that whether or not teachers expressed clear theoretical beliefs, they exhibited a range of statements and behaviors in

differing situations, leading her to proposed a spectrum of teacher beliefs about early literacyinstruction environments, knowledge, planning and decision making. She proposed using the metaphor of a spectrum to describe this range of teacher beliefs about literacy, their knowledge, and planning and decision-making processes. With the spectrum metaphor, chaos theory with its non-linearity enters as a metaphor for interpreting the results of teacher thinking and beliefs. The remainder of this paper discusses the notion of spectrum in teacher beliefs and practices, reanalyzes data from Madison (1993) to provide more graphic evidence of spectral patterns, and discusses the nature of chaos theory and its application to literacy theory, beliefs and practices.

THE SPECTRUM OF LITERACY TEACHER BELIEFS

A spectrum implies the establishment of a continuum. This continuum can be used to measure patterns of light emission in the natural sciences or patterns of beliefs or behaviors among participants in a social or cultural situation. Instead of occupying a single position on the continuum, each entity produces a characteristic spectral pattern which can change over time and with the presence of different trace materials. In the area of teacher thought processes, a continuum is usually constructed between two theoretical orientations (i.e., whole language and skills-based instructional philosophies) and teachers' thinking is presented as being somewhere on that continuum. Madison (1993) posits that this representation must include a spectral analysis derived from the various situations, behaviors, models, and participants which the teacher considers in thinking about planning, decision making, knowledge structuring and beliefs. Furthermore, given the complexity of the situated interactions which occur in classrooms, predictability of outcomes requires an implicit understanding of the chaos inherent in the behaviors of a complex dynamic system; yet teachers develop mental models of this complexity and can devise plans, make decisions and construct (or reconstruct) knowledge

structures which allow them to design and participate in functioning classrooms.

Madison (1993), in a naturalistic study of 10 preschool teachers and their classrooms. found teachers who expressed a clear theoretical belief (holistic or skills-based) and those who did not. Here she found an anomally in the epistemological beliefs which requires a shift in theoretical paradigm on teacher beliefs. Even some of the teachers who professed a clear theoretical orientation in their belief statements, exhibited a range of statements and behaviors in certain situations, leading her to propose a spectrum of teacher beliefs, knowledge, planning and decision making as a useful metaphor in describing teacher thinking and behavior. Teo of the teacher, new to the preschool classroom after teaching in other grades, appeared to be undergoing a period of transition as they experimented with new teaching procedures. Those teachers who did not profess a clear theoretical orientation were not clearly unusual or confused although a previous metahpor might have used these epithets. Instead, she found that these teachers also exhibited a range of statements and behaviors in certain situations which reflected the range of their belief statements.

The continuum ranges from Emergent to Eclectic to Skills-Based with a transitional teacher between Emergent and Eclectic and another between Eclectic and Skills-Based. Examples of the spectra of teacher beliefs are found in Figures 1, 2 and 3. Figure 1 presents data on years of teaching experience (not all in preschool), materials available in each teacher's classroom, and codings of interview responses into skills-based, eclectic and emergent categories from the three clusters of teachers identified by Madison as Eclectic, Emergent and Skills-based and two transitional teachers. Notice that years of teaching experience are similar and that materials forms a peak on Figure 1, with this peak highest in the Emergent Cluster. Teachers in the Emergent Cluster have another peak on interview responses in the emergent category and low scores on the skills-based and eclectic categories. Teachers in the Skills-based Cluster have

another peak, although not as strong a one as in the Emergent Cluster. in the skills-based category and lower scores on eclectic and emergent categories. Teachers in the Eclectic Cluster have no real peak, appearing about the same in the skills-based, eclectic and emergent categories.

The numbers and types of center present in the cluster of teachers exhibiting characteristic spectra provides other interesting patterns (see Figure 2). Emergent Cluster teachers had the highest number of center, followed by transitional teachers, and then Eclectic Cluster teachers. Skills-based Cluster teachers had the lowest number of centers overall. The types of center in each cluster converge dramatically: Emergent Cluster teachers all had block, library and writing centers with writing materials appearing in other centers; Eclectic Cluster teachers all had block, library, writing and teacher centers with writing materials appearing in other centers only for one teacher; Skills-based Cluster teachers all lacked library and writing centers, and none had writing materials appearing in other centers. Figure 3 provides composite views of the clusters.

THE CHAOS OF TEACHING

Examining more complex systems of teacher beliefs and the nature of literacy teacher behavior is possible under the theory of chaos. It allows for an understanding of the particularistic and the general, by making assumptions and relationships interpretable through the lens of chaos:

> The whole shape of things depends upon the minutest part. The part is the whole in this respect, for through the action of any part, the whole in the form of chaos or transformative change may manifest. The transformative "part," the incipient whole, is the "missing informaion" which through iteration traces out the system's

> unpredictability (Briggs & Peat, 1990, p. 75).
>
> Complex systems -- both chaotic and orderly ones -- are ultimately unanalyzable, irreducible into parts, because the parts are constantly being folded into each other by iterations and feedback. Therefore, it's an illusion to speak of isolating a single interaction between two particles... Any interaction takes place in the larger system and the system as a whole is constantly changing, bifurcating, iterating (Briggs & Peat, 1990, pp. 147-148).

Given the complexity of the situational interactions which occur in classrooms and in individuals' beliefs once the rational-entity hypothesis is abandoned, predictability of outcomes requires an understanding of the chaos inherent in the behaviors of complex dynamic systems. Indeed, even research which under positivistic or ecological standards can be criticized for methodological reasons must be interpreted as presenting patterns interpretable through the noisy data which has been presented.

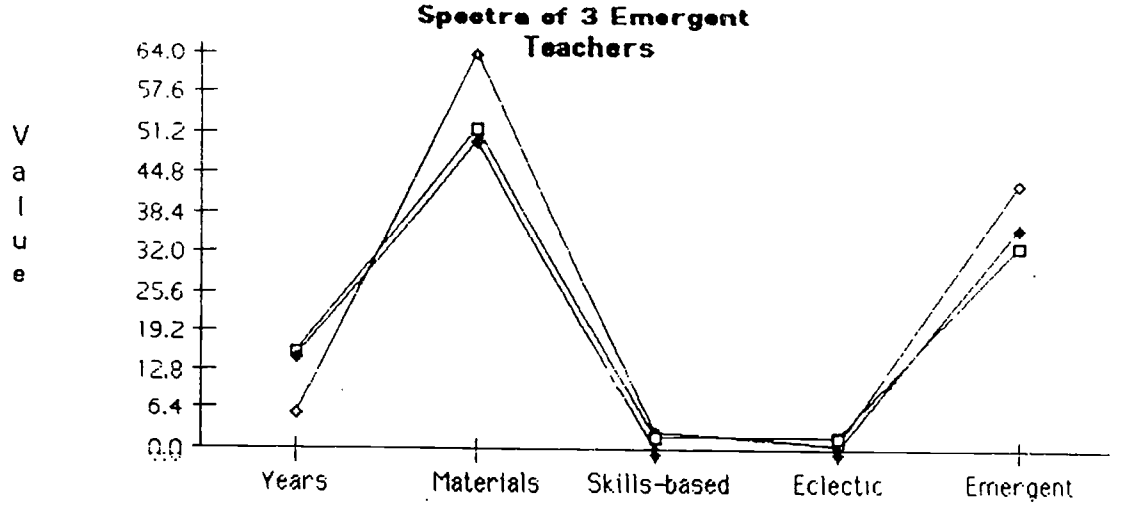
Chaos theory is defined as the study of nonlinear dynamic systems (see Briggs & Peat, 1990; Gleick, 1987). Although chaos theory found its initial development in mathematics and the physical sciences in the work of Poincaré, Lorenz, Thom, and Mandelbrot (Briggs & Peat, 1990), it has more recently begun to be employed in educational research related to cognitive development (Lindsay, 1991), teacher education (Rockler, 1990-1991), and educational administration (Ennis, 1992; Griffiths, Hart & Blair, 1991). The unpredictable and indeterminate nature of human behavior called into serious question the efficacy of both positivist, linear methodologies and nonpositivist, particularistic methodologies, and recent examinations of chaos theory have argued for its utility in the study of complex educational systems such as schools and classrooms (Bobner, Newman & Wessinger, 1989; Cziko, 1989;

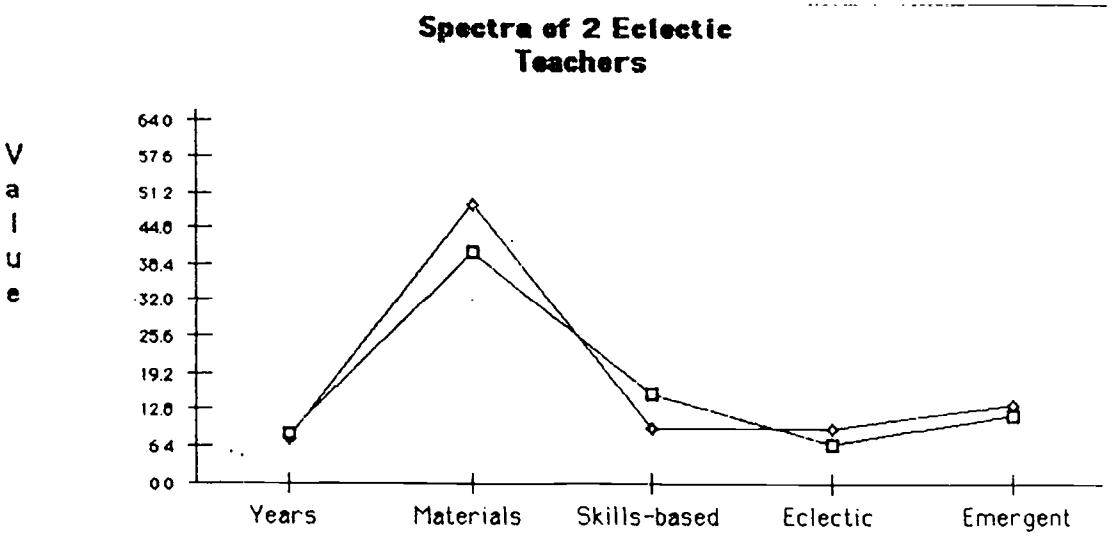
Griffiths, et al., 1991). Literacy researchers have just begun to explore its implications for reading research (Guthrie, Dacey, & Meter, 1994; Robinson, 1994; Robinson & Yaden, 1993: Yaden, 1994). [Some1994 NRC papers here!]

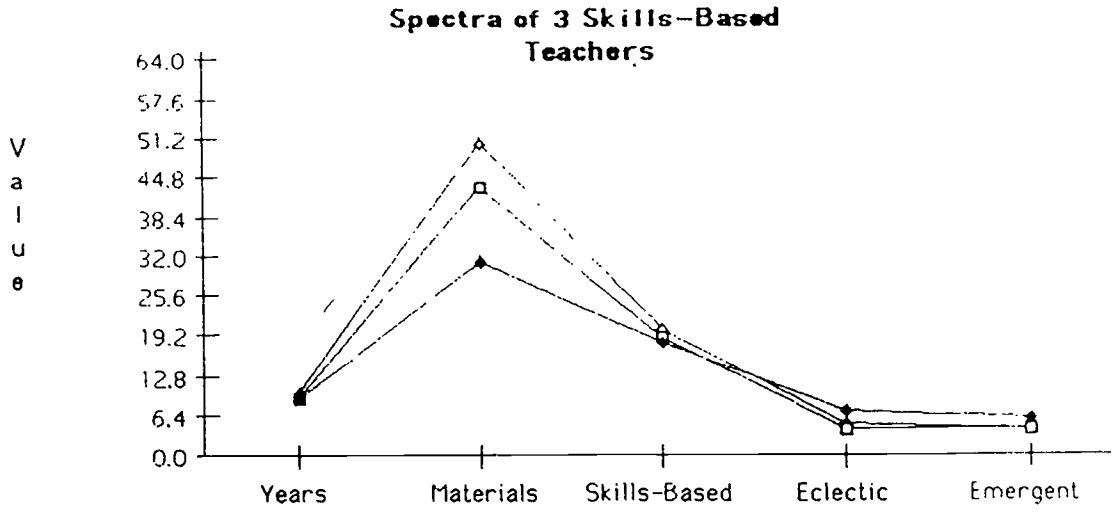
Several discussions of the application of chaos theory to educational contexts provide the researcher with an overview of the tenets of nonlinear dynamics (see Bobner, Newman & Wessinger, 1989; Guess & Sailor, 1993; Lindsay, 1989; Peca, 1992). Cziko (1989) argued that the unpredictable and indeterminate nature of human behavior called into serious question the efficacy of positivist and linear methodologies because these reductionist designs attempt to minimize or eliminate error in an attempt to eliminate "noise in the data" (Lindsay, 1989, p. 12). As an alternative, nonlinear methodologies and metaphors such as chaos theory seek to incorporate and capitalize on "noisy data" as a significant part of the system (Bobner, et al., 1989). Reductioninst methods frame phenomena as composed of small parts, indeed often by design fragment reality into minutia; in opposition, chaos theory assumes reality functions as a whole which must be studied as more than the sum of its parts, ever changing and unpredictable. Rather than attempting to reduce complexity, chaos methodology embraces complexity as the nature of reality and the key to understanding both the parts and the whole (Peca, 1992). In addition, Peca argues that the assumptions of chaos theory, including unpredictability, lack of generalizability and a holistic view of reality, lead to an epistemological stance most congruent with interpretive methodologies based on data from phenomenology and ethnomethodology. But through the lens of chaos theory, one can go even further into the interpretation and unification of both major research paradigms. The object of research becomes description and undestanding of complex educational systems such as those which represent teacher thought processes and beliefs as they operate within the literacy classroom (Peca; Robinson & Yaden, 1993).

CONCLUSIONS AND IMPLICATIONS

Despite all of the studies reviewed in this domain, it is obvious that, at the present time, we do not have, as Ruddell and Sperling (1988) suggest is needed, a "contextualized profile" of how teacher knowledge and decision making construct literacy classrooms; indeed, we should not try to construct a single such profile. Instead, we should build a collection of contextualized profiles which show clusters of characteristic spectral patterns along a variety of multidimensional continua as research gradually identifies these continua (see Scharer, et al., 1993, for some examples of possible continua). Understanding the ideas of chaos theory and spectra of teachers' beliefs about literacy provides one additional method of examining, organizing and interpreting the complex research findings in this area.


Spectra of 3 Emergent Teachers
Value
64.0
57.6
51.2
44.8
38.4
32.0
25.6
19.2
12.8
6.4
0.0
Years
Materials
Skills-based
Eclectic
Emergent


Spectra of 2 Eclectic Teachers
Value
64.0
57.6
51.2
44.8
38.4
32.0
25.6
19.2
12.8
6.4
0.0
Years
Materials
Skills-based
Eclectic
Emergent


Spectra of 3 Skills-Based Teachers
Value
64.0
57.6
51.2
44.8
38.4
32.0
25.6
19.2
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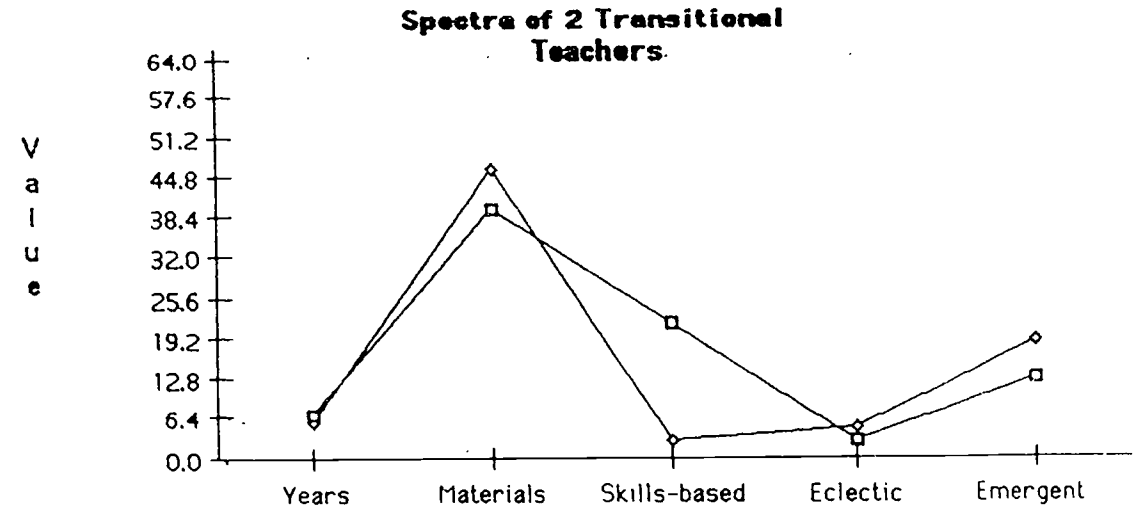
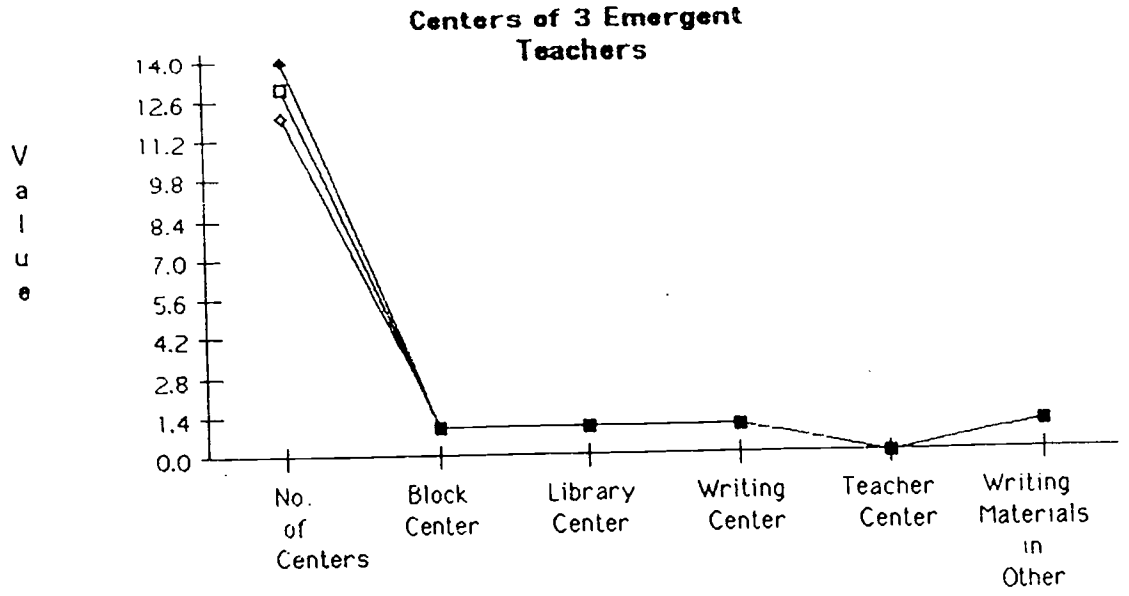
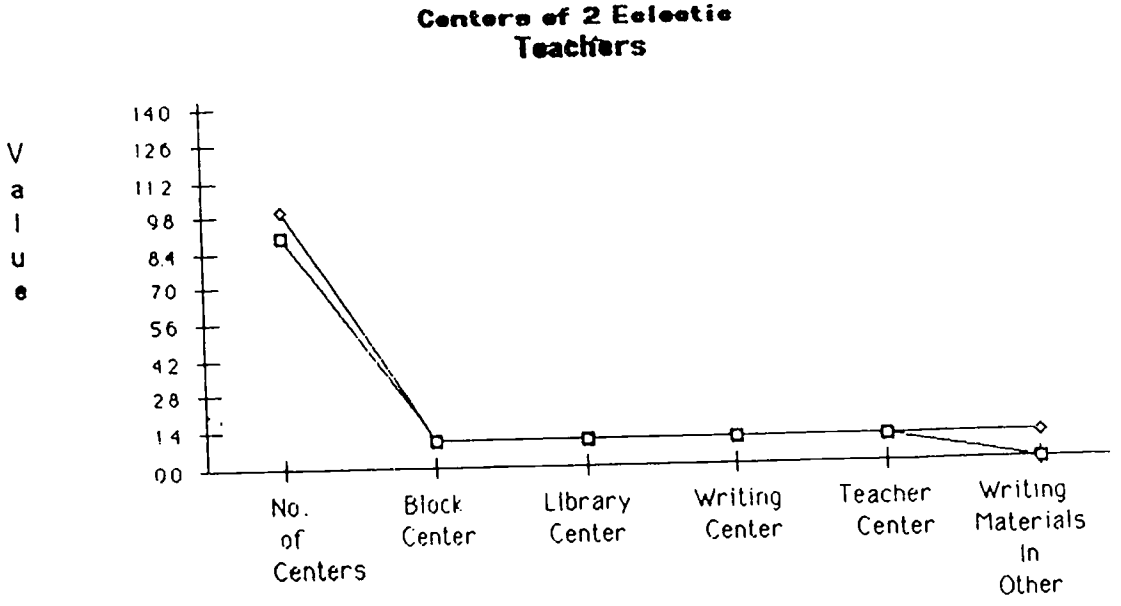
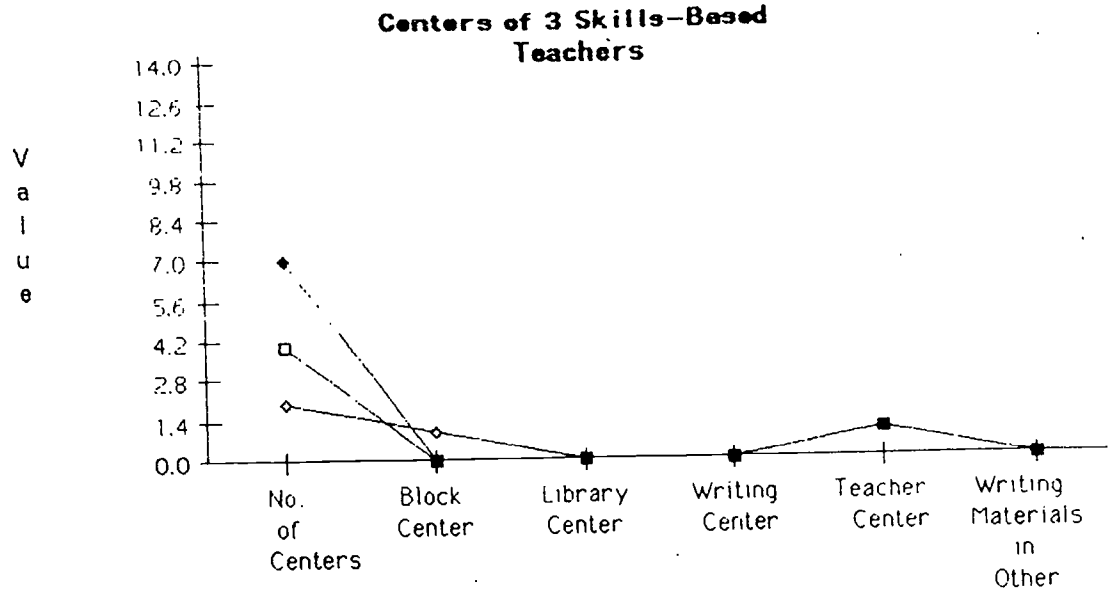
6.4
0.0
Years
Materials
Skills-Based
Eclectic
Emergent


Spectra of 2 Transitional Teachers
Value
64.0
57.6
51.2
44.8
38.4
32.0
25.6
19.2
12.8
6.4
0.0
Years
Materials
Skills-based
Eclectic
Emergent


Centers of 3 Emergent Teachers
Value
14.0
12.6
11.2
9.8
8.4
7.0
5.6
4.2
2.8
1.4
0.0
No. of Centers
Block Center
Library Center
Writing Center
Teacher Center
Writing Materials in Other


Centers of 2 Eclectic Teachers
Value
140
126
112
98
84
70
56
42
28
14
00
No. of Centers
Block Center
Library Center
Writing Center
Teacher Center
Writing Materials In Other


Centers of 3 Skills-Based Teachers
Value
14.0
12.6
11.2
9.8
8.4
7.0
5.6
4.2
2.8
1.4
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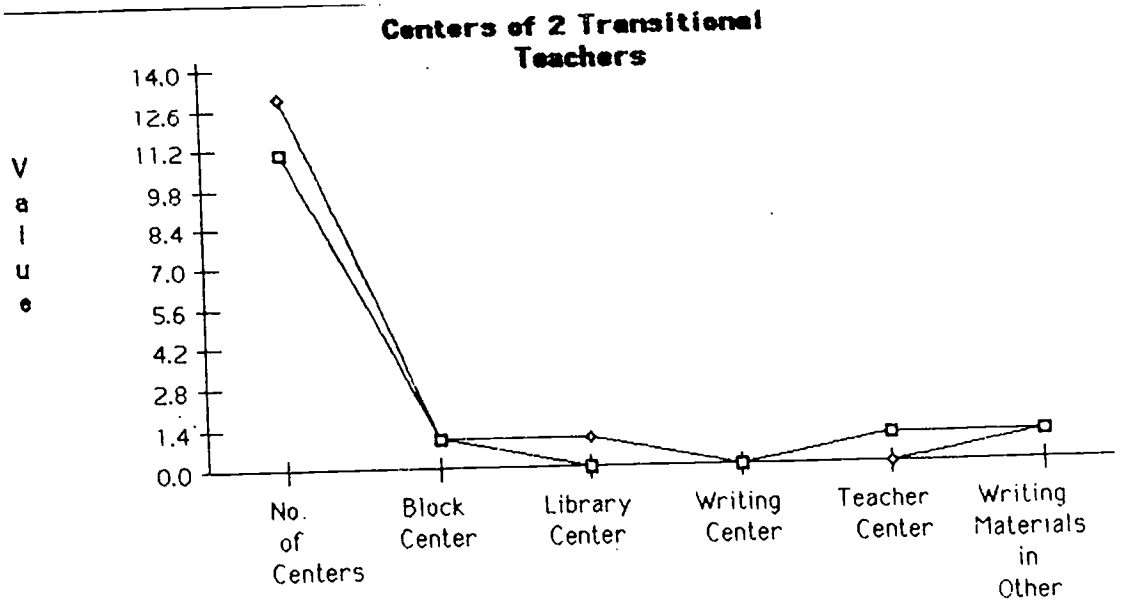
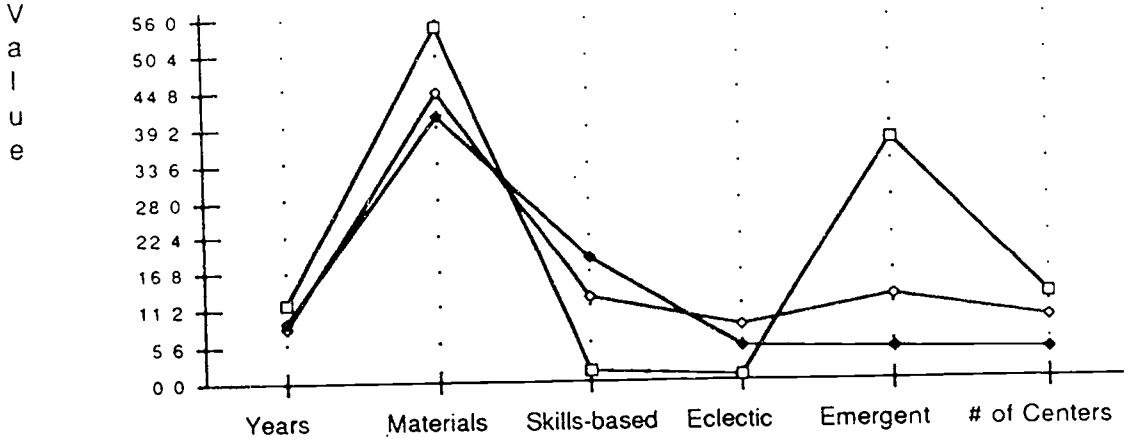
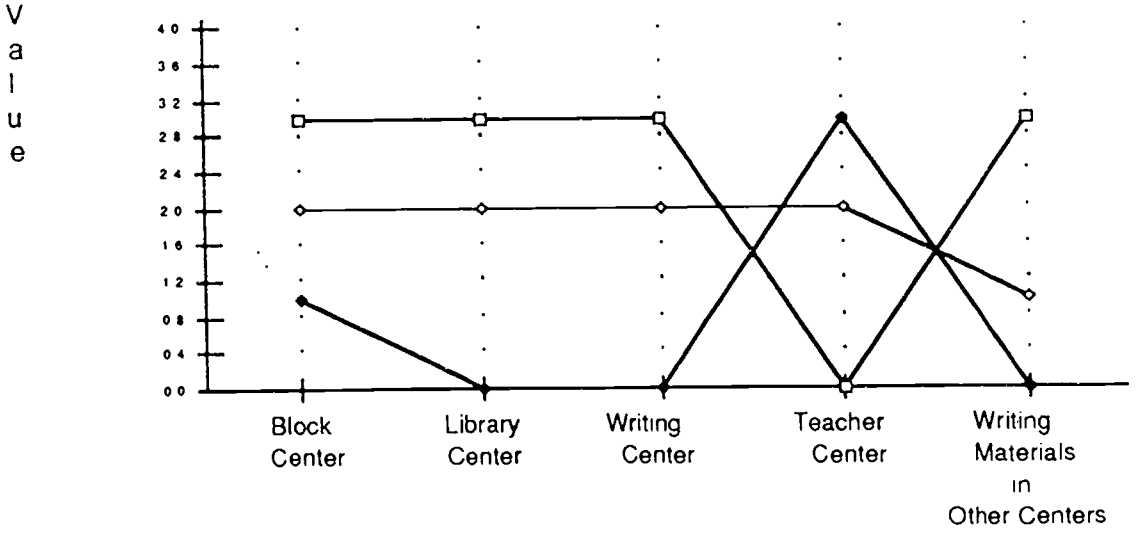
No. of Centers
Block Center
Library Center
Writing Center
Teacher Center
Writing Materials in Other


Centers of 2 Transitional Teachers
Value
14.0
12.6
11.2
9.8
8.4
7.0
5.6
4.2
2.8
1.4
0.0
No. of Centers
Block Center
Library Center
Writing Center
Teacher Center
Writing Materials in Other

Average Emergent, Eclectic, Skills-based Teacher Beliefs



Composite: Total Emergent, Eclectic, Skills-Based Centers



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