ELEMENTARY TEACHERS' CONCEPTIONS OF MATHEMATICS STAFF DEVELOPMENT AND THEIR ROLES AS WORKSHOP LEADERS

by

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This study was designed to investigate the effects on elementary teachers when they assumed roles as mathematics workshop leaders. The subjects were 45 elementary teachers who participated in Statistics Educators Institutes (SEIs) at five university sites in North Carolina during spring and summer of 1994. The SEIs were designed to prepare the teachers to become workshop leaders in TEACH-STAT, a professional development program designed to improve instruction of statistical concepts for elementary children.

Three survey instruments comprised of Likert-type and open-ended items were used to collect information about teachers' (a) conceptions of effective staff development and teaching adults, (b) pedagogical content knowledge, and (c) concerns about TEACH-STAT and their roles as change facilitators. Each survey was administered three times: (a) before the SEI, (b) at the conclusion of the SEI but before the teachers taught a TEACH-STAT workshop, and (c) after teaching a two-week summer TEACH-STAT workshop. Interviews conducted with some participants at the same three times provided additional information for four case studies.

Overall there were no significant differences across administrations for the Likert-style survey items. Post hoc analysis indicated that participants shared a perception of effective mathematics workshops characterized by conceptual instructional approaches (e.g., solving problems in a variety of ways and providing explanations for solutions). In their roles as workshop leaders, many teachers were concerned about handling off-task or reluctant adults in workshops and about collaborating with other workshop leaders. Case study results indicated that teachers believed effective workshop leaders should possess strong content knowledge and be sensitive to prior knowledge, different experiences, and various needs of workshop participants.

The results suggest that staff development programs designed to help teachers become workshop leaders should provide opportunities for teachers to develop strong content knowledge, try out workshop materials in their classrooms, develop their conceptions of staff development, and confront their expectations about adult learners.

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CHAPTER I

INTRODUCTION

Staff development for teachers is widely recognized as a critical component for improving teaching and learning. Once viewed as occasional workshop offerings designed to remediate teacher deficiencies, staff development is currently conceived as a complex interplay of at least four aspects present in the staff development process--purpose, content, process, and context. This broader conception of staff development is informed by what is currently known about adult learning theory, teacher cognition, the change process, school improvement, and various staff development models.

The most widely researched staff development model is the training model (Joyce & Showers, 1988). The training model includes four components: (a) developing theoretical understanding, (b) modeling and demonstration, (c) guided practice in the workshop setting, and (d) feedback about the performance (Showers, Joyce, & Bennett, 1987; G. M. Sparks, 1983). A fifth component, coaching, is often recommended as important for supporting classroom implementation (Joyce & Showers, 1982, 1988). The training model has been used primarily to help teachers transfer general instructional skills (e.g., role playing, nondirective teaching, advance organizers, cooperative learning structures) into classroom practice.

Alternatives to the training model are currently being examined in an effort to understand their effects on teachers (D. Sparks & Loucks-Horsley, 1990). Little (1993) argued that the training model has been effective for introducing technically replicable teaching skills but is inadequate for addressing the complex demands on teachers in light of current reform efforts. She suggested that four professional development forums--

teacher networks and collaboratives, subject matter associations (e.g., National Council of Teachers of Mathematics [NCTM]), school reform collaboratives (e.g., Coalition of Essential Schools), and special summer institutes--are promising in their capacity to "engage teachers in the pursuit of genuine questions, problems, and curiosities, over time, in ways that leave a mark on perspectives, policy, and practice" (p. 133). To date, little is known about the impact of such alternatives on teachers' thinking and instruction.

Current reform efforts in mathematics have been propelled by NCTM's publication of *Curriculum and Evaluation Standards for School Mathematics* (1989). In the *Curriculum and Evaluation Standards for School Mathematics*, NCTM presented a vision for school mathematics designed to meet the needs of students preparing to live and work in the 21st century. This vision called for changes in curriculum (e.g., broadening the notion of mathematics to include more than arithmetic and computation), instruction (e.g., emphasizing teaching for understanding and having students actively engaged in solving problems, reasoning, communicating, and connecting ideas), and evaluation (e.g., assessing student understanding in a variety of ways). These standards, combined with an emerging view of constructivism as a cognitive foundation for mathematics education, have generated a great deal of activity aimed at reforming teacher education (Cooney, 1994).

Recognizing the critical role that teachers play in realizing the vision set forth in the *Curriculum and Evaluation Standards for School Mathematics*, NCTM followed its publication with an accompanying document describing professional standards for teaching mathematics (NCTM, 1991). This document, *Professional Standards for Teaching Mathematics*, contains standards for teaching mathematics, evaluation of the teaching of mathematics, professional development of teachers of mathematics, and support and development of mathematics teachers and teaching. In particular, the six standards for the professional development of teachers of mathematics focus on what teachers need to know about mathematics teaching and learning in order to carry out a new view of mathematics teaching. This new view is characterized by teachers who are able to:

> •select mathematical tasks to engage students' interests and intellect;
>
> •provide opportunities to deepen [students'] understanding of the mathematics being studied and its applications;
>
> •orchestrate classroom discourse in ways that promote the investigation and growth of mathematical ideas;
>
> •use, and help students use, technology and other tools to pursue mathematical investigations;
>
> •seek, and help students seek, connections to previous and developing knowledge; [and]
>
> •guide individual, small-group, and whole-class work. (NCTM, 1991, p. 1)

Because this new view of teaching mathematics is different from what most teachers have themselves experienced as mathematics students, professional development (both pre-service and inservice staff development) has become critical.

The standards for the professional development of teachers of mathematics are founded on several assumptions, one of which is that teachers continue to grow and learn across the span of their careers. The six standards for professional development articulated by NCTM focus on the essential elements for continued growth and development by mathematics teachers. The first standard specifies that within all professional learning situations teachers should experience good mathematics teaching. Four major components of mathematics teaching are identified in the *Professional Standards for Teaching Mathematics* (NCTM, 1991)--selecting worthwhile tasks, orchestrating classroom discourse, creating a supportive learning environment, and analyzing classroom teaching and student learning--and the same four components are expected to be included in staff development situations. In other words, mathematics educators and staff developers must model the vision for what mathematics is and how it is learned.

The second, third, and fourth standards identify three critical domains of knowledge needed by mathematics teachers: (a) knowledge of mathematics and school mathematics, (b) knowledge of students as learners of mathematics, and (c) knowledge of mathematics pedagogy. Knowing mathematics content has long been accepted as important for mathematics teachers. It is only recently that the neglected pedagogical domain has received attention and become an important focal point in teacher education research (e.g., Carpenter, Fennema, Peterson, & Cary, 1988; Cooney, 1994; Fennema & Franke, 1992). Additional lines of research are needed to pursue questions such as how teachers' pedagogical content knowledge changes over time and how staff development experiences contribute to teachers' pedagogical content knowledge throughout their careers.

The fifth standard recommends that mathematics teachers be provided opportunities to continue their development through examination of their teaching practices and their beliefs and assumptions about teaching and learning mathematics. The sixth standard advocates that mathematics teachers take an active role in their own professional development. Together these two standards emphasize the ongoing nature of learning within the teaching profession and place the responsibility on teachers for participating as partners in the change process.

Participating as partners in mathematics reform efforts requires that teachers assume more complex professional roles. Among the various roles that teachers can assume throughout their careers are roles as learners, knowledge producers, coaches, teacher educators, mentors, and leaders (Fessler & Christensen, 1992). Driscoll and Lord (1990) described the changing roles and responsibilities of mathematics teachers in three domains: (a) the classroom, (b) the profession, and (c) the broader community. In the classroom, mathematics teachers must continuously examine their views of mathematics and their perceptions of the teaching and learning processes. In the profession, mathematics teachers need to develop collegial relationships, problem-solving skills, leadership, and sustained reflective dialogue with others. And in the broader community, teachers' shifting roles include becoming partners, critics, designers, and political advocates in reform efforts.

Much is currently expected of mathematics teachers in their professional lives. Little, however, is known about the dilemmas teachers face as they assume these new roles and responsibilities or about the impact of assuming these new roles on teachers' thinking. Exploration of these issues, including identifying the experiences that contribute to teachers' successfully assuming these new roles, can help provide new insights into the challenges of reforming mathematics education.

This study investigated the effects on elementary classroom teachers when they assumed roles as mathematics workshop leaders. The 45 elementary teachers in the study participated in a five-day Statistics Educators Institute specifically designed to help them assume roles as workshop leaders in the TEACH-STAT project. The TEACH-STAT project was a professional development program designed to improve mathematics instruction by preparing teachers in North Carolina to teach statistical concepts to children in grades K-6.

Four research questions framed this investigation: (a) How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' conceptions of effective staff development? (b) How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' conceptions about teaching adults (as opposed to teaching children)? (c) How does becoming a TEACH-STAT workshop leader affect the pedagogical content knowledge of the Statistics Educators? and (d) How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' concerns about the workshop content/innovation and their roles as change facilitators?

This study is important for several reasons. First, current recommendations advocate that mathematics teachers should experience "good mathematics teaching" within all professional learning situations (NCTM, 1991). In other words, mathematics staff developers should model the vision for mathematics teaching by selecting worthwhile tasks, orchestrating classroom discourse, creating a supportive learning environment, and analyzing teaching and learning. This study was designed to provide information about teachers' conceptions of the characteristics of effective mathematics staff development. Understanding these conceptions may help to further articulate the workshop processes and strategies that teachers believe should be present in the most effective mathematics workshops.

Second, a widely used and supported staff development process is to involve classroom teachers in new professional roles such as workshop leaders (Lambert, 1988; Maeroff, 1988; McBride, Reed, & Dollar, 1994; McLaughlin & Marsh, 1978; Pink & Hyde, 1992). When teachers become workshop leaders, their roles shift from teachers of children to teachers of adults and from workshop "customers" to workshop planners, providers, and facilitators. Little is known about the critical issues that accompany such role shifts. A deeper understanding of the dilemmas and concerns that teachers face as well as the knowledge teachers believe they need when they assume roles as workshop leaders is needed. This study was designed to illuminate some of the concerns teachers have when they become workshop leaders and teachers of adults. Additionally, the study was designed to gather information about the characteristics teachers believe effective mathematics workshop leaders should possess. From knowledge of teachers' dilemmas, concerns, and views of effective workshop leaders, it may be possible to gain insight into the interventions needed to assist teachers in successfully assuming such roles.

Third, pedagogical content knowledge is currently viewed as a significant, yet often neglected, domain of teacher knowledge needed to carry out NCTM's (1991) vision of good teaching (Brown & Borko, 1992). Shulman's (1986) description of pedagogical content knowledge includes understanding "what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them" (p. 9). This description implies that teachers of adults should understand the conceptions and preconceptions that adults bring with them to learning situations. This study was designed to reveal the workshop leaders' expectations of the processes adults would use to solve problems about the statistical concept of "average." Understanding these expectations may provide information about the kinds of interventions needed for classroom teachers to successfully assume roles as statistics educators of adults.

In the next chapter the staff development research and theoretical literature will be reviewed. Four aspects of staff development will be considered (purpose, content, process, and context) and common themes will be identified for each aspect. Chapter II concludes with a discussion of staff development in a specific content area (elementary mathematics) highlighted by profiles of two prominent staff development programs in elementary mathematics.

CHAPTER II

REVIEW OF THE LITERATURE

Staff development was once viewed as occasional workshop offerings or courses often designed to remediate deficiencies in teachers. In this view it was often assumed that the most important teaching knowledge was found outside the classroom, that the best way to teach teachers was by telling, and that one measure of teacher effectiveness was the number of workshops and courses completed (Shanker, 1990). What we currently know about adult learning theory, teacher career stages and concerns, training, and school improvement (e.g., Caldwell, 1989; Fessler & Christensen, 1992; Fullan, 1990; Hall & Loucks, 1978; Joyce & Showers, 1988; Joyce, Wolf, & Calhoun, 1993; Little, 1993; Oja, 1980; Pink & Hyde, 1992; D. Sparks & Loucks-Horsley, 1990; G. M. Sparks, Nowakowski, Hall, Alec, & Imrick, 1985; Wood & Thompson, 1993) suggests that the assumptions Shanker described are too narrow to adequately support today's view of staff development.

An alternative view of effective staff development assumes that there are multiple aspects present in the staff development process. Either intentionally or unintentionally, all staff development by its very nature encompasses at least four aspects: (a) purpose, (b) content, (c) process, and (d) context. If common themes based on current research and theoretical perspectives can be identified for each aspect of this view of staff development, then the interrelations among aspects can be explored. Further, we can isolate for additional study those themes we know little about.

What is Staff Development?

The first hurdle in making sense of the staff development research is to formulate a clear definition of staff development itself. There are many definitions or descriptions in the literature.

> Staff development is a process designed to foster personal and professional growth for individuals within a respectful, supportive, positive organizational climate having as its ultimate aim better learning for students and continuous, responsible self-renewal for educators and schools. (Dillon-Peterson, 1981, p. 3)
>
> Staff development is the facilitation of growth. (McCarthy, 1982, p. 20)
>
> Staff development is defined as the provision of activities designed to advance the knowledge, skills, and understandings of teachers in ways that lead to changes in their thinking and classroom behavior. (Fenstermacher & Berliner, 1983, p. 4)
>
> Staff development is evolving . . . into a system ensuring that education professionals regularly enhance their academic knowledge and professional performance. (Joyce & Showers, 1988, p. 1)
>
> Staff development is conceived broadly to include any activity or process intended to improve skills, attitudes, understandings, or performance in present or future roles. (Fullan, 1990, p. 3)

Collectively, the inferred purposes of staff development suggested by these definitions and descriptions are complex--to improve teaching performance by effecting changes in teachers' attitudes, skills, and knowledge; to ultimately improve student achievement; and to develop both individual and organizational capacities for growth. One can quickly see the magnitude of considering all of these staff development purposes simultaneously. Of most interest in this study is the impact of staff development on teachers. Therefore, staff development shall be defined as **a process designed to affect teachers' cognitions in order to improve instruction** (and ultimately student achievement).

The discussion grows wider as practitioners and researchers try to determine the most effective staff development practices. What is meant by *effective* staff development? Nearly two decades of study in this area have produced a response generally agreed upon by those in the field--for staff development to be effective it must improve professional practice and ultimately student achievement (Dillon-Peterson, 1981; Joyce & Showers, 1988; Wood, Thompson, & Russell, 1981). However, agreement as to how to measure this standard of effectiveness is not quite so readily attained.

The Purpose and Goals of Effective Staff Development

Theme 1: The purpose of effective staff development is to affect teachers' cognitions in order to improve instruction.

If effective staff development improves professional practice by affecting a teacher's beliefs, skills, and knowledge about teaching, then at this point the staff development literature must intersect with the knowledge base about learning to teach. Behavioristic traditions dominated earlier studies of teaching (Carter, 1990), perhaps because traditional scientific inquiry more readily accommodated itself to coding observable behaviors or skills of teachers rather than to delving into what teachers know or are thinking. Recent developments have shifted the emphasis from studying what teachers need to *do* to a concern with what teachers need to *know*. In response to this growing concern for cognition, researchers are now attempting to study the knowledge and beliefs of teachers as well as the mental processes in which they engage.

Cognitive psychology plays a central role in contemporary views about learning to teach. A fundamental assumption underlying current research from a cognitive psychology perspective is that knowledge is represented internally in the human mind in organized structures (Brown & Borko, 1992; Hiebert & Carpenter, 1992). Cognitive psychologists assume that teachers' knowledge influences their thinking which, in turn, influences classroom actions.

Shulman (1987) tried to describe the knowledge base for teachers by subdividing it into seven distinct categories: content knowledge, general pedagogical knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners, knowledge of educational contexts, and knowledge of educational aims and purposes. Shulman (1986) first described pedagogical content knowledge as a subcategory within content knowledge. In his plea to teacher educators and policy makers to swing the pendulum back toward more content knowledge expectations for teacher certification, Shulman (1986) described three categories of content knowledge for teachers: (a) subject matter content knowledge, (b) pedagogical content knowledge, and (c) curriculum knowledge. Shulman (1986) defined pedagogical content knowledge as:

> For the most regularly taught topics in one's subject area, the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations--in a word, the ways of representing and formulating the subject that make it comprehensible to others. . . . [It] also includes an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons. (p. 9)

Subject matter content knowledge refers to the teacher's knowledge and organization of specific subject matter (e.g., mathematics, science, music) and its structures. Curricular knowledge refers to the teacher's working awareness of the different programs and materials available for teaching particular topics and subjects, as well as an understanding of the vertical and horizontal components of the K-12 curriculum.

Shulman's (1987) framework for conceptualizing the knowledge base for teachers is frequently acknowledged in the literature. The two overlapping domains of subject matter knowledge and pedagogical content knowledge undergird several contemporary studies on learning to teach (e.g., in the field of mathematics--Eisenhart, Borko, Underhill, Brown, Jones, & Agard, 1993; Even, 1993; Peterson, Fennema, Carpenter, & Loef, 1989). Work by Ball (1988) and her associates at the Center for Research on Teacher Education at Michigan State University has focused on developing measures of teachers' knowledge of subject matter, learners, teaching and learning, and context. Both Ball (1988) and Brown and Borko (1992) have suggested longitudinal studies of teachers to increase our understanding of how teachers' knowledge in different domains changes over time.

Another aspect of teachers' knowledge that has not been deeply explored in the literature is the correspondence between the different knowledge bases in Shulman's framework as staff development goals and effective staff development processes. For example, which staff development processes are most effective if the goal of staff development is to affect teachers' subject matter knowledge? Which staff development processes are most effective if the goal is to affect teachers' pedagogical content knowledge? What staff development processes are most effective if the goal is to affect teachers' knowledge of learners?

Descriptions of effective staff development processes that correspond to staff development goals related to teachers' knowledge in specific domains are rare. Moss (1994) described key staff development processes that were found to be successful when the staff development goals were to affect elementary teachers' pedagogical content knowledge and content knowledge about the writing process. Planners of the week-long summer workshop identified three specific workshop goals: (a) to raise teachers' awareness about the stages of the writing process, (b) to provide classroom strategies for using the writing process, and (c) to impact teachers' knowledge about appropriate writing techniques (Moss, 1994).

A qualitative study (Moss, 1994) conducted eight months after the workshop focused on four teachers' classroom implementation of the writing process. The teachers in the study identified three important aspects of the summer workshop that they perceived were critical for their classroom implementation: "linking theory to practice; reflecting upon and planning for change; and collaborating with other teachers" (Moss, 1994, p. 51). Specific workshop strategies included involving teachers in the writing process, using journals for reflection and response to literature, scoring student writing samples, and rehearsing and critiquing instructional strategies such as webbing and free writing. Small group problem-solving activities were used to brainstorm possible solutions to anticipated problems teachers might face when they implemented the writing process in their classroom situation. Collaboration took on many forms both within the workshop and afterwards as teachers in the study informally shared ideas with other workshop participants.

Results of the study suggested that the workshop processes had been successful in helping the four teachers implement the writing process in their classroom. Two workshop processes needing further attention were also identified: (a) helping teachers find ways to assist children with revision and editing, and (b) formalizing follow-up efforts.

An earlier attempt to link staff development goals (such as knowledge acquisition, skill acquisition, or behavior change) with corresponding staff development processes was proposed by Korinek, Schmid, and McAdams (1985). Those authors conducted a review of the inservice literature from 1957-1985 and selected 17 documents from a review of more than 100 articles for identifying common inservice practices. From their review, three inservice types emerged. Type I was described as information transmission with its purpose being to increase the knowledge of a specific group. Lecture, demonstration, passive audience participation, and a short time frame (1-3 hours) were features of the information transmission inservice type. Type II inservice was skill acquisition with a purpose of strengthening existing skills or imparting new ones. In this type, a series of sessions with a presentation style involving demonstration, practice, feedback, and active participation culminate in the participants' demonstration of the skill. Type III inservice was defined as behavior change, and was intended to change teaching behaviors. This type of inservice was most effective when it was conducted in the participants' school and involved multiple sessions of varying lengths. It was the most costly and time consuming, and it was the least used.

A tally of the number of times specific practices were mentioned in the 17 reports resulted in a list of 14 practices presented with the inservice types to which they apply (Figure 1). Though this study is noteworthy in its effort to link staff development purposes with corresponding practices, underlying assumptions of the literature reviewed reflect a behavioristic paradigm. Changing behaviors and acquiring skills are recognized as legitimate staff development purposes, but efforts to affect teachers' thinking and cognition go unrecognized.

An image of teachers as thinkers, not just skilled technicians, is supported by the literature on teachers' knowledge (e.g., Brown & Borko, 1992; Fennema & Franke, 1992). The challenge is to understand the process of knowledge acquisition and to discover the experiences that contribute to this growth. The purpose of staff development should be to affect teachers' thinking in ways that result in improved instruction. Within this broad purpose, specific goals for the staff development process should be clearly identified. One possible framework for labeling staff development goals is Shulman's (1987) categories of the teaching knowledge base (i.e., content knowledge, general pedagogical knowledge, knowledge of learners, pedagogical content knowledge, curriculum knowledge, etc.).

Figure 1. Best practices and inservice types to which they apply (Korinek, Schmid, & McAdams, 1985).

Best Practice	Type*
1. Effective inservice is usually school-based rather than college-based.	2, 3
2. Administrators should be involved with the training and fully support it.	1, 2, 3
3. Inservice activity should be offered at convenient times for participants.	1, 2, 3
4. Inservice should be voluntary rather than mandatory.	1
5. Rewards and reinforcement should be an integral part of an inservice program.	1, 2, 3
6. Inservice programs should be planned in response to assessed needs.	1, 2, 3
7. Activities which are a general effort of the school are more effective than "single shot" presentations.	2, 3
8. Participants should help plan the goals and activities of the inservice training.	2, 3
9. Goals and objectives should be clear and specific.	1, 2, 3
10. Inservice activity should be directed at changing teacher behavior rather than student behavior.	3
11. Individualized programs are usually more effective than those using the same activities for the entire group.	2, 3
12. Participants should be able to relate learning to their back home situations.	1, 2, 3
13. Demonstrations, supervised practice, and feedback are more effective than having teachers store ideas for future use.	2, 3
14. Evaluation should be built into inservice activity.	1, 2, 3

*Types:
1. Information transmission
2. Skill acquisition
3. Behavior change

The Content of Effective Staff Development

Theme 2: The content of effective staff development should be research-based.

One common theme throughout the staff development literature is the necessity for research-based content (e.g., Joyce, Showers, & Rolheiser-Bennett, 1987; Joyce, Wolf, & Calhoun, 1993; Pink & Hyde, 1992; Wood & Thompson, 1993). Generally what is meant by research-based content is research-based instructional strategies. Researchers in the staff development field urge staff developers to select content that research evidence suggests holds promise for student learning.

Joyce, Showers, and Rolheiser-Bennett (1987) used effect sizes to try to identify content that had known potential for increasing student learning. The content under scrutiny in this case was a collection of teaching approaches (general pedagogical knowledge). In their synthesis of the research, Joyce et al. chose experimental studies that calculated effect sizes by comparing treatment effects of instructional practice with "*the conventional ways that instruction is carried out*" (p. 13 [Italics in the original]). A number of models of teaching were identified as having positive effect sizes: cooperative learning, advance organizers, mnemonics, synectics, nondirective teaching, wait-time, mastery learning, and Teacher Expectations and Student Achievement (TESA). Joyce et al. recommended that staff development programs be designed around these models of teaching.

The staff development literature would possibly lead one to believe that teaching strategies comprise the only research-based content available, but certainly the content for effective staff development is not limited to teaching strategies. The National Staff Development Council (1994) recommended several content options for staff development for middle school teachers: adolescent developmental needs, safe and orderly learning environments, teacher-based guidance, diversity, curriculum, interdisciplinary teaming, service learning, research-based instructional strategies, high expectations, family involvement, and student performance assessment. Notice that this array represents knowledge across most of Shulman's (1987) categories (i.e., knowledge of learners, curriculum knowledge, pedagogical knowledge, content knowledge, pedagogical content knowledge, knowledge of educational contexts, and knowledge of educational aims and purposes).

Consistent with a staff development purpose of affecting teachers' thinking, G. M. Sparks and Simmons (1989) suggested an inquiry approach when using research-based findings in staff development settings. Sparks and Simmons recommended that teachers participating in staff development examine information about how the research was conducted as well as descriptions of the teachers, students, and schools involved in the study. Staff developers are encouraged to avoid using the phrase "research says," and to facilitate discussion and classroom-based investigation, validation, and adaptation of research-based findings. Others (Hirsh & Ponder, 1991; Lambert, 1988; Little, 1993; National Staff Development Council, 1994; Tafel & Bertani, 1992) support providing teachers with research-based content options and involving teachers in examining the options in light of their current classroom situations. In this way teachers participate in the construction of new knowledge through action research rather than merely acting as consumers of research-based findings.

The Process of Effective Staff Development

Theme 3: Multiple models for effective staff development are available.

Many staff development models exist both in theory and in practice. Pink and Hyde (1992) advised that the search for one best way to design staff development is illusive and that there is no such thing as a one-size-fits-all model. Depending on the goals of the staff development process and contextual factors, it appears that several staff development models can be effective. In this section several staff development models (D. Sparks & Loucks-Horsley, 1990) will be described in terms of their goals, their core practices, and the research supporting their effectiveness in reaching their goals.

The training model. There have been more studies related to the training process or design than any other model of staff development. Staff development goals generally sought through this model include affecting teachers' knowledge and skill development. In addition, Joyce and Showers (1988) cite transfer of skills to the classroom as a desirable outcome of the training model. Most of the research on the training model has been conducted with staff development initiatives that attempted to affect teachers' knowledge of alternative instructional strategies (again, pedagogical knowledge).

Two research syntheses (Showers, Joyce, & Bennett, 1987; G. M. Sparks, 1983) provide support for the core practices used in the training model. For teachers to develop a level of skill needed to use a new procedure in the classroom, training activities should include four components: (a) development of theoretical understanding, (b) modeling and demonstrations, (c) guided practice in the workshop setting, and (d) feedback about the performance. In her meta-analysis, Wade (1984) used effect sizes to identify four instructional techniques that were significantly more effective than others. The instructional methods identified were observation of actual classroom practices (e.g., videotapes of teachers and children in classrooms), micro teaching, video/audio feedback, and practice.

Holly (1982) found that teachers consider collegial sharing of information and ideas a valuable staff development activity. G. M. Sparks (1983) also emphasized the productivity of providing teachers opportunities for small-group discussions to share concerns and discuss application of new instructional techniques. Multiple training sessions spaced apart were found to be more effective than one-shot workshops because of the opportunity for classroom practice, problem-solving, and adaptation of new instructional techniques (McLaughlin & Marsh, 1978; G. M. Sparks, 1983).

The training model has been effective in its impact on teachers' knowledge and behavior. In Wade's (1984) meta-analysis of 91 studies published or presented between 1968 and 1983, she found the training model to be highly effective in increasing participants' knowledge as measured by pre- and post-tests (.90 mean effect size), moderately effective in changing teachers' behaviors (.60 mean effect size), and mildly effective in its impact on student outcomes (.37 mean effect size). Joyce and Showers (1988) determined that if the four critical training components (explanation of theory, demonstration or modeling, practice under simulated conditions, and feedback) were present, the effect size for participants' skill development was .39. However, with the addition of a workplace coaching component, the effect size reported was 1.68. Joyce and Showers (1982) considered the coaching component important for transferring newly learned skills to the classroom. Coaching involves teachers "coaching one another as they work the new model into their repertoire, providing companionship, helping each other learn to teach the appropriate responses to their students, figuring out the optimal uses of the model in their courses, and providing one another with ideas and feedback" (Joyce & Showers, 1982, p. 5).

Though the training model could be considered a traditional view of staff development, school-based practitioners may not incorporate the important elements of the model into actual staff development practice. Cook and Pankake (1992) randomly surveyed 166 of 304 school districts in Kansas to determine the degree to which staff developers used the training components proposed by Joyce and Showers (1988). They found that only 30% of those surveyed indicated familiarity with the Joyce and Showers model of effective training practices (presentation of theory, modeling or demonstration, practice and feedback, coaching). Those familiar with the model did not use the practices significantly more than staff developers who were not familiar with the model.

D. Sparks and Loucks-Horsley (1990) described the training model as one of five effective staff development models having an individual teacher orientation. Use of the other four models described by Sparks and Loucks-Horsley (individually guided staff development, observation/assessment model, inquiry model, and development/ improvement process) is less widespread, and scientific research supporting their potency is thin. Briefer summaries of these models appear next.

Individually guided staff development. The individually-guided staff development model allows teachers to self-select their learning goals and design learning activities to pursue their goals. The model acknowledges the uniqueness of teachers in terms of their developmental stages, experiences, learning styles, interests, and concerns. Four phases are present either formally or informally in the individually-guided staff development model: (a) identification of a need or interest, (b) development of a plan to meet the need or interest, (c) implementation of the planned learning activity, and (d) assessment of the outcome. Illustrations of the model are generally anecdotal and consist primarily of self-reports from teachers who received mini-grant funding to carry out classroom-oriented projects (D. Sparks & Loucks-Horsley, 1990).

Observation/assessment model. The observation/assessment model is derived primarily from models of supervision and teacher evaluation, and is based on the assumption that feedback about classroom performance can promote reflection that influences instruction. Activities used in this model follow a coaching cycle that includes a pre-observation conference, an observation with a specified data collection focus, analysis of the data, and a post-observation conference. The role of the coach could be assumed by an evaluator, mentor, project consultant, or peer. The work of Joyce and Showers (1988) indicates that the use of coaching has a positive impact on improving instruction and student achievement.

Inquiry model. The inquiry model places the teacher in the role of researcher and is based on an assumption that teachers are self-reflective individuals capable of critically examining their own practice. The classroom becomes a real world for experimentation and systematic inquiry. The goal of the inquiry model is to improve practice and deepen teachers' understanding of the teaching and learning process. Following identification of a problem or issue of interest, core practices of the inquiry model follow a recurring cycle of data collection and analysis, planning, implementation in the classroom, evaluation, and revision. Taking on the role of teacher-as-researcher can influence teachers to change their instructional practices. Neil Hunt's (Miller & Hunt, 1994) account of his first experience as a teacher-researcher studying the benefits of reading students' written responses to mathematics prompts in a beginning calculus class offers one example of what teachers can learn when engaged in this model.

Development/improvement process model. Involving teachers in curriculum development, program development, and school improvement initiatives appears promising in terms of the potential for teachers' learning. Projects in this model are often initiated to solve a problem, so commitment among school staff members to solve the problem may already exist and enhance the effectiveness of this model. The phases of the development/improvement process model generally include identification of the problem, planning a response to the problem (including identification of resources and training needed), implementation, and evaluation. Wood, Thompson, and Russell (1981) developed a research-based approach to school improvement through staff development and referred to it as the RPTIM (Readiness, Planning, Training, Implementation, and Maintenance) model (Wood, McQuarrie, & Thompson, 1982) (see Figure 2).

A specific example of the development/improvement process model is described by G. M. Sparks, Nowakowski, Hall, Alec, and Imrick (1985). Teachers in two elementary schools in Michigan selected reading as the instructional issue they wished to address.

Figure 2. Summary of the RPTIM model for an effective staff development program (Wood, Thompson, & Russell, 1981).

THE RPTIM MODEL FOR STAFF DEVELOPMENT

Stage I: READINESS
Mobilize broad-based support through awareness and vision. The results of the readiness stage are:
•written set of inservice goals that the faculty of a school helps select, understands, and is committed to implement,
•a description of the specific programs and practices selected to achieve these goals, and
•a broad four or five-year long range plan for implementing the desired change in the ongoing program.

Stage II: PLANNING
The design of the inservice programs is the focus of the planning stage. During this stage, the goals are refined into specific inservice objectives, a needs assessment is conducted, inservice activities are planned, resources are identified, and the details of the training design and implementation stages are identified.

Stage III: TRAINING
In the training stage, the inservice plan is conducted and the content, skills, and attitudes needed to implement the changes in professional behavior are learned. Critical training activities include orientation activities, development of learning groups, choices for participants, experiential learning, and feedback.

Stage IV: IMPLEMENTATION
The implementation stage deals with making sure what is learned in inservice training becomes a part of the activity and behavior of educators in the school. Follow-up assistance and administrative support are addressed in this stage.

Stage V: MAINTENANCE
The maintenance stage of inservice programs establishes continuous monitoring to determine whether new behaviors are still being practiced and goals met. Techniques include self-monitoring via video or audiotape, student feedback, and peer supervision.

Guided by a university facilitator, the problem of low reading achievement was addressed in one school through an analysis of the existing reading curriculum, training in more effective teaching techniques, and individually designed professional growth activities. After two years the percent of students performing above the average on the state reading test rose from 72% to 100%. Similar improvements in achievement resulted at the other elementary school. Both faculties attributed the improvement in student reading achievement to the staff development program. G. M. Sparks et al. (1985) identified a six-step process that was used in this model: (a) development of readiness, awareness, and commitment, (b) needs assessment, (c) planning, (d) implementation, (e) evaluation, and (f) reassessment and continuation.

Little (1993) offered additional examples of professional development activities that engage teachers in the study and investigation of "genuine questions, problems, and curiosities, over time, in ways that leave a mark on perspectives, policy, and practice" (p. 133). She argued that four alternatives to the training model--teacher networks and collaboratives, subject matter associations (e.g., National Council of Teachers of Mathematics), school reform collaboratives (e.g., Coalition of Essential Schools), and special summer institutes--hold much promise for professional development, especially in light of current reform efforts. This strand of teacher development activity has received little more than descriptive attention in the literature. Little (1993) observed that

> judging by teachers' accounts, such [summer] institutes . . . offer substantive depth and focus, adequate time to grapple with ideas and materials, the sense of doing real work rather than being "talked at," and an opportunity to consult with colleagues and experts. (p. 137)

Yet there is virtually no body of work directed toward learning more about the impact of collaboratives, subject matter associations, and summer institutes on teachers' thinking and instruction.

Conclusion. The training model has a solid research base, especially when the goals of staff development are to affect teachers' instructional skill development and knowledge. Broadening the concept of staff development to include other models such as curriculum/program development, inquiry, observation/assessment, and individually guided development, through such avenues as teacher study groups and collaboratives, subject matter associations, mentoring/coaching, and summer institutes is heartily recommended (e.g., Hirsh & Ponder, 1991; Little, 1993; D. Sparks & Loucks-Horsley, 1990). However, much remains to be learned about how well-suited other models are to impact teachers' cognitions and effectively achieve different staff development goals.

Theme 4: Effective staff development processes are designed to accommodate adult learning and development.

The topic of adult development is very broad and encompasses research and theoretical literature in a wide range of disciplines. Comprehensive summaries of the field exist (e.g., Cross, 1981; Knowles, 1980, 1984a, 1984b; Merriam & Caffarella, 1991) and introductory seminal works focusing on the processes of adult learning are widely cited (Houle, 1961; Tough, 1971). Integrated within the field of adult development are theories of learning; motivational theories; theories of moral development, ego development, and conceptual development; developmental age theories; and developmental stage theories. Also, the adult development field covers a variety of activities with very different learning goals ranging from adult basic literacy to hobby and craft learning projects to professional development.

Given the size of the literature knowledge base, it has been necessary to be highly selective. Two conclusions that can be derived from the adult development literature appear to be important when considering the nature of effective staff development for teachers. First, adults bring a rich background of diverse and unique experiences to the learning situation (Cross, 1981; Knowles, 1980, 1984a, 1984b; Richardson & Prickett, 1994; Wood & Thompson, 1993). Second, teachers at different career stages have different developmental needs (Fessler & Christensen, 1992; Huberman, 1989; McLaughlin & Marsh, 1978; Wilsey & Killion, 1982). Each of these conclusions will be considered briefly with attention given to their influence on staff development processes.

The adult learner. Some writers in the field of adult education (e.g., Richardson & Prickett, 1994) claim that the process of learning is different for adults than for children because of certain presumed psychological, social, and experiential factors associated with adulthood not present in childhood. Knowles' (1980, 1984a, 1984b) work has both exposed these presumed factors and introduced the theory of andragogy. Knowles first heard the term andragogy in 1967 when a Yugoslavian adult educator in one of his summer courses on adult learning claimed that what Knowles was describing was andragogy (Knowles, 1980). Knowles immediately began using the term in articles describing his theoretical framework for thinking about adult learning. Knowles defined andragogy as "the art and science of helping adults learn" and contrasted it with pedagogy, defined as "the art and science of teaching children" (Knowles, 1980, p. 6).

Knowles (1984a) drew distinctions based upon five assumptions that he identified as inherent in pedagogical and andragogical models. First, Knowles claimed that in a pedagogical model the teacher assumes full responsibility for what should be learned, how it should be learned, when it should be learned, and whether it has been learned. In other words, the learner is completely dependent on the teacher. In contrast, the andragogical model assumes that learners are self-directing and responsible for themselves. Knowles acknowledged that when this view is translated into practice without alerting adult students that the mode of operation is self-directed, there can be anxiety and confusion because of the contrast with adults' traditional school experiences. Knowles recommended that adult learners be oriented toward self-directed learning principles early in the process.

Second, Knowles believed that the experiences the learner brings to a learning activity in a pedagogical model are of little value. Again in contrast, the andragogical model assumes that adult learners bring a great volume and qualitatively different experiences to the learning situation. These experiences are a source of personal identity and value and often define the different adult roles of the learner (e.g., spouse, worker, parent, citizen). Furthermore, the experiences adults bring to learning provide resources for others that can be tapped through activities such as group discussions, field experiences, and problem solving projects.

Third, Knowles contrasted the readiness to learn assumptions in both models. In the pedagogical model, readiness to learn is largely a function of age. For example, children are taught cursive writing because they are in the third grade. In the andragogical model, readiness to learn is based on a need to know. This need to know can be triggered by a variety of influences and life stages.

Fourth, in a pedagogical model learning is a process of acquiring subject matter content. In an andragogical model, adults take on orientations toward learning that are either life-centered, task-centered, or problem-centered. In other words, adult learners most often learn something for pragmatic and practical reasons--because they want to be able to live in a more satisfying way, perform a task, or solve a problem.

Finally, Knowles noted that in a pedagogical model the pressures that motivate students to learn are largely external (e.g., parents, grades, consequences of failure). Antithetically, Knowles assumed that in an andragogical model the strongest motivators are internal (e.g., self-esteem, recognition, self-actualization).

The term "andragogy" was only introduced in the United States in 1968, yet it has led to a flurry of debate. Critics of Knowles questioned the empirical support for the model's assumptions and charged that his definition of andragogy was faulty (Cross, 1981; Davenport, 1993). If the literal definition of pedagogy is "the art and science of teaching children," then, as Davenport (1993) contended, the definition of andragogy should be "the art and science of teaching adults." Knowles (1980) tried to downplay his original dichotomy between learning in childhood and adulthood after teachers in elementary and secondary schools had reported the successful application of andragogy in their classrooms. Moreover, Knowles confessed to the realization that adult learners confronted by totally new content required more direct instruction than andragogy implied. Finally, Knowles admitted that he was

> at the point now of seeing that andragogy is simply another model of assumptions about learners to be used alongside the pedagogical model of assumptions, thereby providing two alternative models for testing out the assumptions as to their 'fit' with particular situations. (Knowles, 1980, p. 43)

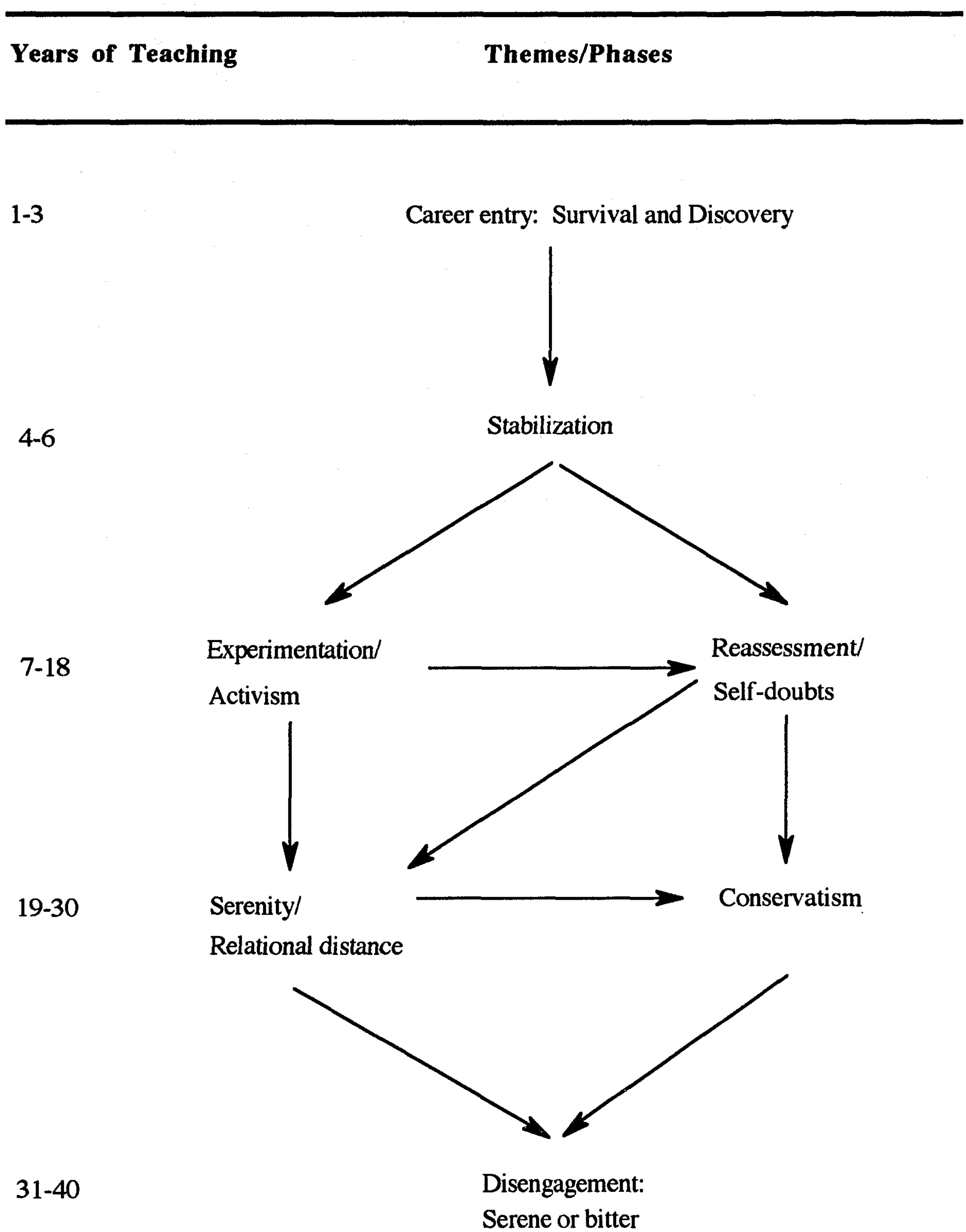
Despite its critics, andragogy is one of the better-known theories in adult education. In practice it has produced some implications for program design that are appropriate for staff development. Knowles (1984a) contended that seven process elements are important to facilitate learning within an andragogical model: (a) a supportive physical environment and climate of mutual respect, collaborativeness, trust, supportiveness, openness, pleasure, and humanness; (b) involving learners in mutual planning; (c) involving participants in diagnosing their own needs for learning; (d) involving learners in formulating their learning objectives; (e) involving learners in designing learning plans; (f) helping learners carry out their learning plans; and (g) involving learners in evaluating their learning.

Though the term "andragogy" does not often appear in the staff development research and theoretical literature, recommendations for staff development practices purportedly based on adult learning theory frequently do appear. Common observations include: (a) adults are pragmatic learners who need to perceive that what is to be learned is relevant and useful in their professional settings; (b) adults learn through concrete experiences followed by opportunities for reflection, dialogue, and sharing about their experiences; (c) adults learn best in an informal atmosphere of collegial trust and openness where they are treated as professional adults and the fear of judgment during learning is reduced; and (d) adults bring rich and diverse experience bases to the learning situation that should be valued and accommodated (McBride, Reed, & Dollar, 1994; Nowak, 1994; Oja, 1980; Richardson & Prickett, 1994; Wood & Thompson, 1993).

Teacher career stages. Viewing the teaching career as a developmental process raises questions regarding effective staff development experiences for teachers at different career stages. The Rand study (McLaughlin & Marsh, 1978) highlighted the possibility that more experienced teachers may need different and more personal approaches to their professional development. Since then, research efforts to understand teachers' careers have flourished.

Huberman's (1989) study utilizing clinical and ethnographic interviews of 160 secondary teachers in Geneva, Switzerland, resulted in a schematic model describing the general themes underlying each successive stage of a teacher's career (Figure 3). Career entry is characterized by themes of survival and discovery, followed eventually by a stabilization phase that accompanies a definitive commitment to the teaching profession and greater mastery of instructional techniques. The stabilization phase may then give way to either growth or stagnation. Those who pursue growth enter a phase of experimentation or diversification. In this phase teachers may be ready to take on new challenges for growth and stimulation. In addition to experimentation in their pedagogical techniques, teachers in this phase often become actively involved in the school or district and take on new positions of leadership and responsibility. For other teachers, a sense of monotony may set in. Some respond to this stagnation by questioning and reassessing their career selection.

Figure 3. Successive themes of the teacher career cycle (Huberman, 1989).



What follows is a more relaxed phase characterized by either a theme of serenity or one of conservatism and relative rigidity. When following a phase of reassessment, this phase can take on either aspects of resolution (renewal, "a second wind") or nonresolution (career crisis, "it's too late to change careers," "it's the system"). Teachers in this career stage become considerably less active, but this is compensated for by greater confidence and self-acceptance. Energy may now be expended more on outside interests as teachers search for self-definition beyond the workplace. The career paths converge into a final phase of disengagement as teachers approach retirement.

Howser (1989) was particularly interested in those teachers in middle career stages who fail to learn and grow. She hypothesized that experienced, middle-aged teachers identified by their administrators as reluctant would have different personalities, learning preferences, behaviors, and attitudes than growth-seeking teachers. The data gathered in Howser's study did not fully support her hypotheses, but did reveal some differences between reluctant and growth-seeking teachers. In particular, she found that the preferred learning styles of growth-seeking teachers were characterized by long-term assignments, self-directed activities, and less structured situations. In contrast, the reluctant teachers learned best with short-term assignments, frequent feedback, and uncomplicated tasks. A second finding revealed that growth-seeking teachers valued collegial relationships and viewed curriculum changes and professional growth as positive opportunities for change. Reluctant teachers viewed curriculum changes and professional growth as resented mandates. Howser concluded her study with a list of recommendations for motivating reluctant teachers to learn and grow: (a) provide opportunities for teachers to self-reflect, (b) encourage experimentation without fear, (c) provide opportunities for renewal through different job assignments, (d) promote teacher leadership, (e) address learning on a personal individual basis, and (f) study further the difference between male and female teachers in terms of their growth-seeking disposition.

Theme 5: Effective staff development requires follow-up and support for 3-5 years.

What is currently known about the change process (Guskey, 1986; Hall & Loucks, 1978; McLaughlin & Marsh, 1978) for teachers as they implement new programs in schools has led staff developers to rethink the notion of time. Long-range planning efforts of several years should be considered to allow adequate time for programs, people, and practices to progress through initialization, implementation, and institutionalization stages (Fenstermacher & Berliner, 1983; Loucks-Horsley, 1989; Matthews, 1993; National Staff Development Council, 1994; Pink & Hyde, 1992; Wood & Thompson, 1993; Wood, Thompson, & Russell, 1981) .

Considering staff development as a developmental process of individual change rests largely on the earlier teacher training stage theory of Fuller (1969). Fuller found that pre-service teachers proceeded through a predictable pattern of personal concerns about self, task, and impact. Expanding on Fuller's work, Hall and Loucks (1978) developed the Concerns-Based Adoption Model (CBAM) to describe how individuals undergo the change process when adopting new programs. One aspect of the CBAM model elaborated on Fuller's three general areas of concern (self, task, and impact) and proposed seven stages of concern as described in Figure 4.

Being able to predict the progression of concerns allows workshop leaders or program disseminators to plan sequences of activities that support individuals throughout the change process (e.g., Matthews, 1993; McCarthy, 1982). Hall and Loucks (Loucks, 1983) found that most individuals progress through the stages over time depending on the program being initiated, the level of support for the program, and the design of implementation efforts. The process, however, can often take as long as three to five years (Loucks-Horsley, 1989).

Figure 4. Seven stages of concern from CBAM model (Loucks, 1983).

Stage of Concern		Typical Expression of Concern
6	Refocusing	I have some ideas about something that would work even better.
5	Collaboration	I am concerned about relating what I am doing with what other instructors are doing.
4	Consequence	How is my use affecting students?
3	Management	I seem to be spending all my time in getting material ready.
2	Personal	How will using it affect me?
1	Informational	I would like to know more about it.
0	Awareness	I am not concerned about it.

The Rand Change Agent study (McLaughlin & Marsh, 1978) underscored the significant contribution of well-conducted staff support activities to promoting teacher change. Rand's study of federal programs supporting educational change found that an effective implementation process was one of mutual adaptation. The mutual adaptation process occurs when teachers modify their classroom practices using what they learned in training sessions, and at the same time project goals and concepts presented in training sessions are adapted to the daily realities of the classroom and school. Mutual adaptation cannot occur without follow-up activities that allow opportunities for teachers to receive feedback on the impact of their change efforts and staff developers/program planners to receive feedback from classroom practitioners.

Guskey (1986) described the process of teacher change in a slightly different way. He argued that staff developers should take into consideration a critical factor reported by

McLaughlin and Marsh (1978). "A primary motivation for teachers to take on the extra work and other personal costs of attempting change is the belief that they will become better teachers and their students will benefit" (p. 75). Based on this assumption as well as the staff development and teacher change research, Guskey posited that significant changes in teachers' beliefs and attitudes *follow* evidence that changes in teaching practices are producing positive learning outcomes for their students. For this reason, Guskey insisted that teachers be provided with ongoing information about the impact of their efforts on student outcomes and that this aspect be built into the evaluation of staff development programs (Guskey & Sparks, 1991). Furthermore, since changes in beliefs and attitudes follow implementation and evidence of improved student outcomes, continuing follow-up support is crucial.

Support activities for teachers can occur in a variety of ways. Activities such as classroom assistance from project personnel, using outside consultants to assist in the problem-solving process, and frequent meetings to discuss implementation were identified by McLaughlin and Marsh (1978) as having potential to significantly contribute to program outcomes. Personal support could also include study groups, support teams, video/audio feedback, peer observations, in-classroom coaching/mentoring, journal dialogues, or informal opportunities to share ideas and/or concerns.

A recent survey of 500 randomly selected Texas teachers (McBride, Reed, & Dollar, 1994) indicated that teachers perceive that the support system necessary to sustain classroom implementation needs strengthening. While nearly 62% of those responding (N = 270) agreed or strongly agreed that administrators support implementation of inservice program activities, only 12.6% of the respondents agreed or strongly agreed that administrators follow up to determine the success of inservice activities. Furthermore, only 24.9% of those responding indicated that materials and assistance needed to implement what was learned in training were provided.

There is strong evidence that support and technical assistance as an accompaniment to training are necessary to assure implementation and maintain classroom practices. Administrative support should reinforce program initiatives for an adequate length of time measured in years, not months. Resources including materials, time, and personal support should be provided in an effective staff development program. It appears from the results of the survey of Texas teachers (McBride, Reed, & Dollar, 1994), however, that what is known about support for the teacher change process does not always translate into practice. There is still much to learn about factors that promote, erode, or prevent follow-up efforts.

Theme 6: Effective staff development is accompanied by shifting roles and relationships.

The success of staff development activities to support changes in the classroom may be tied to the degree of teacher involvement in the change activities. The importance of developing new leadership and professional roles for teachers to effect change is receiving increasing attention (Lambert, 1988; Maeroff, 1988; McBride, Reed, & Dollar, 1994; McLaughlin & Marsh, 1978; Pink & Hyde, 1992). In response, the variety of opportunities for teachers to take on more complex professional roles has increased over the past few years.

Fessler and Christensen (1992) described six different role-option categories that teachers can assume throughout their careers: (a) learners, (b) knowledge producers, (c) coaches, (d) teacher educators, (e) mentors, and (f) leaders. All of these roles are related to staff development models described earlier, and each requires new skills and knowledge for teachers. For example, teachers who assume roles as knowledge producers by participating in collaborative or action research need knowledge of data gathering and analysis techniques. Teachers who assume leadership or change facilitator roles may be more effective if they have some understanding of the change process, conflict resolution, and group processes and dynamics. Teachers who assume roles as workshop leaders and teacher educators need knowledge about effective staff development practices and adult learners.

Fullan (1994b) tried to conceptualize a transformation of the teaching profession based on the assumption that teacher leadership in this age "is not for a few; it is for all" (p. 246). He articulated six domains of knowledge and commitment that would be required by teacher leaders immersed in the role of achieving quality learning for all students while simultaneously improving their profession: (a) knowledge of teaching and learning, (b) knowledge of collegiality, (c) knowledge of educational contexts, (d) knowledge through continuous learning, (e) knowledge of the change process, and (f) moral purpose. It is interesting to compare Fullan's domains to those posited by Shulman (1987)--content knowledge, general pedagogical content knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners, knowledge of educational contexts, and knowledge of educational aims and purposes. While Shulman's pedagogical and content knowledge domains could be considered subsumed in Fullan's teaching and learning domain, Fullan makes at least three noteworthy additions to Shulman's list in including knowledge of collegiality, knowledge through continuous learning, and knowledge of the change process. These additional domains of knowledge are indicative of the shifting roles and responsibilities expected of teachers in the current climate of professional reform and school improvement.

Kilcher's (1990) case study of Sara Nickerson, a teacher learning to be a change facilitator, provided insights into an educator's first year in her new role in a Canadian province school district. Sara was one of 13 facilitators selected and trained to provide external assistance and facilitation to a school leadership team within the district. The school leadership team at St. Joseph's school was involved in learning to use a problem-solving approach to school improvement.

Sara's case study indicated that she faced at least two difficult challenges in her first year of becoming a change facilitator. The first challenge was negotiating and clarifying exactly what the role of change facilitator involved. Her conception of the role evolved over the year. She initially had difficulty removing herself from the school leadership team's decision-making process and often struggled with balancing directive and facilitative functions. As the year ended her perception of the change facilitator role was much clearer. She described her role as being primarily a participant-observer and resource person, but mentioned multiple roles she was involved in throughout the year (e.g., learner, coach, mentor, friend, listener, ambassador, planner, presenter, organizer, researcher, morale booster). Sara indicated that she had learned to allow people to make their own decisions and to lead "people to discover things for themselves" (Kilcher, 1990, p. 30).

A second challenge and concern for Sara was time. She repeatedly mentioned time as an issue in interviews and journal reflections. She recognized the importance of process in a problem-solving school improvement setting, but also noted how time consuming the process could be. Sara also wanted more personal reflection time to make sense of what she was experiencing and learning. Other roles for Sara placed competing demands on her time. In addition to her role as a facilitator for St. Joseph's school, she faced family crises, was involved on district level committees, was a participant in a research study, maintained full responsibilities as an enrichment teacher for gifted and talented students, and was completing work for her master's degree. Sara read exhaustively in these diverse areas of professional interest and often felt unfocused because of the variety and complexity of her many roles.

While Kilcher (1990) described a teacher negotiating and clarifying a new role over a period of one year, Killion (1988) assessed the evolution of her role as a staff development trainer over a period of 10 years. Killion (1988) suggested that those who assume roles as staff development trainers progress through recognizable stages of development. Chronicling her personal history as a staff development trainer in a Colorado school district, she hypothesized that staff development trainers move toward higher cognitive complexity in four stages paralleling those described by Harvey, Hunt, and Schroder (1961; as cited in Killion, 1988). In the earliest stage of her career as a staff development trainer, Killion delivered a packaged staff development program on thinking skills. She was most concerned about what was practical, wanted specific instructions about how to deliver the training, relied on authorities for new information, and responded more to external conditions than to a well-developed internal conceptualization of the training content. Killion compared this stage to Level I (unilateral dependence) of the Conceptual Systems Theory (Harvey, Hunt, & Schroder, 1961) of adult developmental stages. Level I is characterized by a fairly rigid view of options from which to choose (i.e., absolutes) and a lack of problem-solving flexibility.

In her second stage, Killion began to explore her independence and test her limits as a staff development trainer, often opposing external control and suggestions from "critics" about her teaching behaviors. She believed that this stage paralleled Level II (negative independence) as it was characterized by a period of questioning authority, resisting rules, and avoiding dependence on others.

Killion soon learned that she could think about, analyze, and evaluate her teaching behaviors and moved to the third stage. Those who had been mentors and critics in the second stage became colleagues in this third stage. She described herself as more thoughtful and reflective about her training and more interested in learners. She believed that she had moved to Level III (conditional dependence and mutuality) as she became more reflective and responsible for her own behaviors and began to appreciate others' points of view.

In the final stage, Killion began to experiment with numerous alternatives for accomplishing training objectives and examining the effects of each alternative on learners.

She described herself as more comfortable and confident, able to respond to learners in a more thoughtful manner, able to make adaptations naturally and easily, and trusting of herself, her experience, and her knowledge base when making training decisions. Her discussions with colleagues centered on the meaning of their training activities, not just the mechanical aspects of delivering training. She believed that these characteristics were representative of Level IV (interdependence). Level IV learners are able to synthesize information, select from and create new alternatives, and establish their own means of regulating and evaluating their behaviors.

Killion (1988) concluded from her self-analysis that staff development trainers need professional support that is aligned with their current stage of development. She recommended that only those with "a thorough understanding and broad background of experience in training and the developmental stages of adult learners" (p. 10) serve as mentors for those becoming staff development trainers. Such mentors recognize that adult development is continuous and can provide support for staff development trainers in experimenting with and reflecting on new and more complex training behaviors.

Involving teachers meaningfully in the decision-making and leadership roles in staff development is widely supported (Dillon-Peterson, 1981; Showers et al., 1987; G. M. Sparks, 1983). Little is known, however, about the processes involved when teachers assume new roles or about how teachers learn to assume new roles. What are critical issues and dilemmas that teachers face when they assume new roles? What influences motivate teachers to assume new roles? Are there some roles that have a greater impact on teachers' cognitions (and ultimately student achievement) than others? How does the process of becoming a workshop leader affect teachers' pedagogical content knowledge? How does becoming a workshop leader affect teachers' views about effective staff development practices? How does becoming a knowledge producer affect teachers' views about research? How does becoming a peer coach affect teachers' efficacy? The theme of shifting and more complex roles for teachers recommended in the staff development literature provides fertile ground for additional research.

The Context of Effective Staff Development

Theme 7: Effective staff development acknowledges systemic influences.

The importance of systems thinking is a relatively new theme appearing in the staff development literature (Clarke, 1994; Joyce, Wolf, & Calhoun, 1993; Schmuck, 1994; D. Sparks, 1994; Tafel & Bertani, 1992; Wood & Thompson, 1993). Underpinning this theme is the notion that individuals do not develop within contextual voids; instead, individuals develop within organizations (in this case, schools) that are concurrently evolving and changing. Much of the language and recommendations associated with this theme seem to have been heavily influenced by quality improvement efforts in business and industry during the last decade (e.g., Senge, 1990) and their application to national school reform efforts. The emphasis in this theme is on an integration of individual and organizational development as staff development is viewed as a key component of school improvement and restructuring efforts.

Systems thinking acknowledges the interdependent relationships among the complex variables that make up the various parts of a system. D. Sparks (1994) defined systems thinkers as "individuals who are able to see how these parts constantly influence one another in ways which can support or hinder improvement efforts" (p. 27). The specific "parts" of the system are not well-defined in the literature; however, overlapping aspects that often surface in relation to staff development include school culture, school organization, authority relationships, leadership, teacher evaluation, student grouping practices, student assessment, use of resources, decision-making processes, and the role of the school district. Writing from an even broader vantage point than the staff development perspective, Anderson (1993) identified six key elements, or "parts," to consider and monitor throughout the stages of systemic change in educational systems: (a) vision, (b) public and political support, (c) networking, (d) teaching and learning changes, (e) administrative roles and responsibilities, and (f) policy alignment.

As examples of the interdependent relationships between different parts of the educational system, consider the following potential systemic tensions: (a) workshop leaders advocate using graphing calculators for teaching algebra, but the statewide algebra assessment does not allow students to use a graphing calculator; (b) school district officials require teachers to learn about and use cooperative learning strategies, yet the teacher evaluation process in the district values fundamentally different student management practices; (c) school administrators profess that classroom teachers are instructional "experts," yet all staff development experiences are planned and conducted by administrators or outside consultants; or (d) a school staff selects an improvement goal to develop several integrated curriculum units, but the only time scheduled for teachers to plan with one another is after school. While it may seem impossible to orchestrate coordinating changes in all parts of the system at once, systems thinking in its minimal form encourages processes that allow identification of systemic influences that are not in sync and require further attention.

Systems thinking places staff development in the larger context of school improvement. Those who advocate systems thinking generally view a school's organizational development equally as important as individual development (e.g., Joyce, Wolf, & Calhoun, 1993; D. Sparks, 1994). In this stance it is assumed that changes in the norms, structures, and processes of the school organization can remove impediments that inhibit professional growth or school improvement. For example, Clarke (1994) cited two impediments to teachers' growth related to school organization and administration:

1. The lack of time for individual reading and reflection, the lack of joint planning time with other teachers, and the lack of work together in classrooms--all leading to a feeling of professional isolation, [and]

2. Student-assessment and teacher-evaluation methods that are not in harmony with the proposed changes. (p. 40)

Anderson (1993) described six stages of systemic change along a continuum that appear to somewhat parallel the seven stages of concern in the Concerns-Based Adoption Model discussed earlier (see Figure 4), a model for describing where individuals are in their own processes of change with regard to an innovation. The six stages that characterize systemic change are: (a) maintenance of the old system, (b) awareness that the current system is not working, (c) exploration of new approaches, (d) transition toward the new system, (e) emergence of a new infrastructure, and finally, (f) predominance of the new system. In her work with systemic change initiatives at the Educational Commission of the States, Anderson organized a matrix to pair each of the six stages of systemic change with six key elements of change. The matrix provided a conceptual picture of the complexity of systemic change as well as a framework for assessing progress toward educational restructuring efforts.

Systems thinking has generated several recommendations for creating school-based contexts in which effective staff development can take place. First, school-based (rather than district-wide) improvement goals or program development should provide the focus of staff development (McBride, Reed, & Dollar, 1994; McLaughlin & Marsh, 1978; Wood & Thompson, 1993). Second, the principal and the school district leadership must be actively involved in school improvement initiatives by working collaboratively with teachers to establish goals and plan staff development, by participating in learning, and by providing technical and follow-up assistance (Glickman, 1992; Joyce, Wolf, & Calhoun, 1993; McLaughlin & Marsh, 1978; Wood & Thompson, 1993). Third, teachers must be authentically involved in collaborative problem-solving and planning (McBride, Reed, & Dollar, 1994; McLaughlin & Marsh, 1978). Fourth, the school culture must support risk-taking, continuous improvement, and shared decision-making (Wood & Thompson, 1993). Fifth, school improvement and related staff development initiatives should be closely linked with curriculum, instruction, and teacher evaluation; furthermore, these aspects should support one another (D. Sparks, 1994; Wood & Thompson, 1993). Finally, involve groups of teachers from the same school (rather than individuals from a number of schools) in staff development so that contextual issues can be addressed and norms of collegiality can be built (Clarke, 1994; Schmuck, 1994).

D. Sparks (1994) identified systems thinking (along with results-driven education and constructivism) as one of three potentially powerful ideas for transforming the field of staff development. At this point, however, models of staff development that blend individual and organizational development are in their infancy. The link between staff development and school improvement requires further study, as does the relationship between staff development and collaborative work cultures (Fullan, 1994a).

Staff Development in a Specific Content Area

Up to this point, the broad field of staff development has been reviewed in an effort to identify common themes in the research and theoretical literature. Seven major themes have been identified within the multiple aspects present in the staff development process: (a) purpose, (b) content, (c) process, and (d) context (Figure 5). In this section staff development will be approached from a different angle by moving away from the broad field of staff development into a specific content area--elementary mathematics.

Viewing staff develoment through the lens of elementary mathematics (or other specific content areas) raises new questions about the effectiveness of staff development. Are staff development programs and practices that are evolving from this specific content

Figure 5. Seven themes of effective staff development.

PURPOSE: ***Theme 1:*** The purpose of effective staff develompent is to affect teachers' cognitions in order to improve instruction.
CONTENT: ***Theme 2:*** The content of effective staff development should be research-based.
PROCESS: ***Theme 3:*** Multiple models for effective staff development are available. ***Theme 4:*** Effective staff development processes are designed to accommodate adult learning and development. ***Theme 5:*** Effective staff development requires follow-up and support for 3-5 years. ***Theme 6:*** Effective staff development is accompanied by shifting roles and relationships.
CONTEXT: ***Theme 7:*** Effective staff development acknowledges systemic influences.

area aligned with what is known in the staff development field? Do the goals of staff development for elementary mathematics teachers differ from the goals of staff development in the broader field? Does effective staff development in a specific content area require consideration of aspects that have not been raised in the staff development literature? In this section the current state of affairs in staff development for elementary mathematics teachers will be briefly discussed, highlighted by profiles of two prominent staff development programs in elementary mathematics.

Staff Development and Elementary Mathematics

The National Council of Teachers of Mathematics (NCTM) has long recognized the importance of professional development in the improvement of mathematics education. A position statement first published by NCTM in 1985, and still in effect, recommended that professional development programs for mathematics teachers be developed according to five broad guidelines: (a) a strong commitment to professional growth as evidenced in allocated personnel, time, and funds; (b) careful planning based on assessed needs with significant input from teachers for whom the program is planned during the planning process; (c) recognition of individual differences, needs, and experiences among teachers; (d) effective staff development features such as actively involving participants, blending content and pedagogy, integrating theory and practice, and support and follow-up practices; and (e) systematic evaluation for improving programs and determining if needs have been met (NCTM, 1994).

The current national wave of reform in mathematics education propelled by NCTM's publication of the *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989) has intensified the role of staff development in mathematics. The *Curriculum and Evaluation Standards for School Mathematics* presented a vision for school mathematics designed to meet the needs of students preparing to live and work in the 21st century. Called for in the document were changes in curriculum (e.g., broadening the notion of mathematics to include more than arithmetic and computation), instruction (e.g., emphasizing teaching for understanding and having students actively engaged in solving problems, reasoning, communicating, and connecting ideas), and evaluation (e.g., assessing student understanding in a variety of ways). These standards, combined with an emerging view of constructivism as a cognitive foundation for mathematics education, have generated a great deal of activity aimed at reforming teacher education (Cooney, 1994).

Recognizing the critical role that teachers play in realizing the vision set forth by the *Curriculum and Evaluation Standards for School Mathematics*, NCTM followed its publication with an accompanying document describing professional standards for teaching mathematics (NCTM, 1991). This document, the *Professional Standards for Teaching Mathematics*, contains standards for teaching mathematics, evaluation of the teaching of mathematics, professional development of teachers of mathematics, and support and development of mathematics teachers and teaching. In particular, the six standards for the professional development of teachers of mathematics focus on what teachers need to know about mathematics teaching and learning in order to carry out a new view of mathematics teaching. This new view is characterized by teachers who are able to:

> •select mathematical tasks to engage students' interests and intellect;
>
> •provide opportunities to deepen [students'] understanding of the mathematics being studied and its applications;
>
> •orchestrate classroom discourse in ways that promote the investigation and growth of mathematical ideas;
>
> •use, and help students use, technology and other tools to pursue mathematical investigations;
>
> •seek, and help students seek, connections to previous and developing knowledge; [and]
>
> •guide individual, small-group, and whole-class work. (NCTM, 1991, p. 1)

Because this new view of teaching mathematics is different from what most teachers have themselves experienced as mathematics students, professional development (both pre-service and inservice staff development) has become critical.

A closer examination of the standards for professional development (NCTM, 1991) will enable a comparison between the prescribed knowledge base required of teachers in the broad sense and in the specific content area of mathematics. The professional development standards are founded on several assumptions, one of which is that teachers continue to grow and learn across the span of their career. The six standards for professional development articulated by NCTM focus on the essential elements for continued growth and development by mathematics teachers.

The first standard specifies that within all professional learning situations teachers should experience good mathematics teaching. Four major components of mathematics teaching are identified in the *Professional Standards for Teaching Mathematics* (NCTM, 1991)--selecting worthwhile tasks, orchestrating classroom discourse, creating a supportive learning environment, and analyzing classroom teaching and student learning--and the same four components are expected to be included in staff development situations. In other words, mathematics educators and staff developers must model the vision for what mathematics is and how it is learned. In reality there is great distance between this standard and common staff development practice. Descriptions of staff development efforts that narrow the distance between theory and practice of this standard have only begun to appear (e.g., Schifter & Fosnot, 1993).

The second, third, and fourth standards identify three critical domains of knowledge needed by mathematics teachers: (a) knowledge of mathematics and school mathematics, (b) knowledge of students as learners of mathematics, and (c) knowledge of mathematics pedagogy. Knowing mathematics content has long been accepted as important for mathematics teachers. It is only recently that the neglected pedagogical domain has received attention and become an important focal point in teacher education research (e.g., Carpenter, Fennema, Peterson, & Cary, 1988; Cooney, 1994; Fennema & Franke, 1992). These three domains are not clearly defined in mathematics, however, nor are they mutually exclusive (Marks, 1990). The connections between teachers' knowledge in these domains and the impact of such knowledge on instruction and student learning are only beginning to be explored in research projects like the Cognitively Guided Instruction project (to be discussed later). Additional lines of research are needed to pursue questions such as how teachers' pedagogical content knowledge changes over time and how staff development experiences contribute to teachers' pedagogical content knowledge throughout their careers.

The fifth standard recommends that mathematics teachers be provided opportunities to continue their development through examination of their teaching practices and their beliefs and assumptions about teaching and learning mathematics. The sixth standard advocates that mathematics teachers take an active role in their own professional development. Together these two standards emphasize the ongoing nature of learning within the teaching profession and place the responsibility on teachers for participating as partners in the change process.

Figure 6 provides a comparison of the prescribed knowledge bases for teachers in general (Fullan, 1994b; Shulman, 1987) and for mathematics teachers as outlined in *Professional Standards for Teaching Mathematics* (NCTM, 1991). The emphasis on what teachers need to *know* in all three presentations reflects similar efforts to conceptualize the cognitive aspects of teaching. The purpose of effective staff development in mathematics education, as in general (***Theme 1***), is to affect teachers' cognitions in order to improve instruction. However, similar questions may be posed from the mathematics vantage point as were raised for staff development programs in general. Are there staff development experiences that are most effective if the goal of the staff development process is to affect teachers' content knowledge? Are there staff development experiences that are most effective if the goal of the staff development process is to affect teachers' pedagogical content knowledge? Are there staff development experiences that are effective if the goal is to affect *both* teachers' content knowledge and pedagogical content knowledge? The correspondence between the goals of staff development in mathematics education and effective staff development processes for teachers is yet unclear.

Figure 6. Comparison of prescribed domains of teacher knowledge in general (Shulman, 1987; Fullan, 1994b) and for teachers of mathematics (NCTM, 1991).

<table>
<tr><th>Shulman's (1987) Domains of Teacher Knowledge Base</th><th>Fullan's (1994b) Domains of Commitment and Knowledge for Teacher Leaders</th><th>NCTM (1991) Professional Development Standards</th></tr>
<tr><td>•Content knowledge</td><td rowspan="5">•Knowledge of teaching and learning</td><td rowspan="2">•Knowledge of mathematics and school mathematics</td></tr>
<tr><td>•Curriculum knowledge</td></tr>
<tr><td>•Pedagogical content knowledge</td><td rowspan="2">•Knowledge of mathematics pedagogy</td></tr>
<tr><td>•General pedagogical content knowledge</td></tr>
<tr><td>•Knowledge of learners</td><td>•Knowledge of students as learners of mathematics</td></tr>
<tr><td>•Knowledge of educational contexts</td><td>•Knowledge of educational contexts</td><td></td></tr>
<tr><td>•Knowledge of educational aims and purposes</td><td>•Moral purpose</td><td></td></tr>
<tr><td rowspan="3"></td><td>•Knowledge through continuous learning</td><td rowspan="3">•Developing as a teacher of mathematics;
•Assuming an active role in professional development;
•Experiencing good mathematics teaching</td></tr>
<tr><td>•Knowledge of collegiality</td></tr>
<tr><td>•Knowledge of the change process</td></tr>
</table>

The content of typical elementary mathematics staff development programs is probably best described as "activity-based" rather than "research-based" (***Theme 2***), with some notable exceptions (e.g., Carpenter, Fennema, Peterson, Chiang, & Loef, 1989). Contemporary staff development program content for elementary mathematics teachers is usually derived from the vision set forth by NCTM (1989, 1991)--to cultivate mathematics classrooms focused on problem solving and conceptual understanding. With respect to the knowledge required to do this, elementary mathematics teachers need a deep understanding of the mathematical concepts they teach (content knowledge). They must also be able to select meaningful tasks for students and understand how a variety of tools (calculators, models, manipulatives) can enhance the learning of mathematical concepts (pedagogical content knowledge). And finally, they must have some understanding of how students mentally construct mathematical concepts (knowledge of learners). Any one of these areas can provide a focus for staff development content in elementary mathematics. Indeed, one sees advertised workshops and summer institutes with course titles such as "Using Calculators to Teach Problem Solving," "Geometry in the Intermediate Grades," "Using Manipulatives to Teach Fractions," and so forth. Broader goals are reflected in titles such as "Improving Elementary Mathematics" and "Elementary Mathematics Summer Leadership Institute." Mathematics teachers that participate in these workshops often hope to return to their classrooms armed with a collection of activities that they can use directly with their students.

In fact, the specific purpose for many mathematics staff development programs is sharing exemplary instructional materials. For example, the focus of a two-week summer workshop on the Middle Grades Mathematics Project (Lappan et al., 1988) was to present detailed instructional units for middle grades students that modeled a conceptual approach to the teaching of mathematics. One finding from the research associated with the Middle Grades Mathematics Project was that teachers did not transfer the approach to other parts of the curriculum without substantial long-term support and follow-up of at least two years (***Theme 5***) (Brown, Cooney, & Jones, 1990).

A variety of models (***Theme 3***) are currently being applied to the staff development of mathematics teachers. Summer institute models appear to prevail (e.g., Bush, 1994; Lappan et al., 1988; Schifter & Fosnot, 1993; Wick, Westegaard, & Wilson, 1994), and they are often integrated with features from other models such as training, curriculum development, leadership development, observation/assessment, and school-based follow-up and support activities (e.g., Jones, Lubinski, Swafford, & Thornton, 1994). The teacher-as-researcher model is only beginning to receive attention (e.g., Miller & Hunt, 1994; Tinto, Shelly, & Zarach, 1994). In general there appears to be agreement among mathematics educators that there is no single ideal approach, but that a full range of approaches other than one-shot workshops can be effective (Lovitt, Stephens, Clarke, & Romberg, 1990). Furthermore, opportunities for teachers to try activities with students, followed by sharing and discussing classroom trials with colleagues, is a highly regarded process in all models.

Clarke (1994) identified ten important principles of effective staff development programs designed for lasting changes in the teaching and learning of mathematics:

1. Address issues of concern and interest, largely (but not exclusively) identified by the teachers themselves, and involve a degree of choice for participants.

2. Involve groups of teachers rather than individuals from a number of schools, and enlist the support of the school and district administration, students, parents, and the broader school community.

3. Recognize and address the many impediments to teachers' growth at the individual, school, and district level.

4. Using teachers as participants in classroom activities or students in real situations, model desired classroom approaches during in-service sessions to project a clearer vision of the proposed changes.

5. Solicit teachers' conscious commitment to participate actively in the professional development sessions and to undertake required readings and classroom tasks, appropriately adapted for their own classroom.

6. Recognize that changes in teachers' beliefs about teaching and learning are derived largely from classroom practice; as a result, such changes will follow the opportunity to validate, through observing positive student learning, information supplied by professional development programs.

7. Allow time and opportunities for planning, reflection, and feedback in order to report successes and failures to the group, to share "the wisdom of practice," and to discuss problems and solutions regarding individual students and new teaching approaches.

8. Enable participating teachers to gain a substantial degree of ownership by their involvement in decision making and by being regarded as true partners in the change process.

9. Recognize that change is a gradual, difficult, and often painful process, and afford opportunities for ongoing support from peers and critical friends.

10. Encourage participants to set further goals for their professional growth. (p. 38)

Echoed throughout these principles are notions related to several of the themes of effective staff development described earlier in this chapter, such as accommodating adult learning and development (***Theme 4***), understanding the change process, providing follow-up and support (***Theme 5***), and acknowledging contextual and systemic influences (***Theme 7***).

Reconceptualized roles for teachers (***Theme 6***) are also evident in Clarke's references to teacher commitment, peer support, and further professional growth. The *Professional Standards for Teaching Mathematics* (NCTM, 1991) place new responsibilities on mathematics teachers for assuming an active role in professional development activities. Driscoll and Lord (1990) described the changing roles and responsibilities of mathematics teachers in three domains: (a) the classroom, (b) the profession, and (c) the broader community. In the classroom, mathematics teachers must continuously examine their view of mathematics and their perceptions of the teaching and learning processes. In the profession, mathematics teachers need to develop collegial relationships, problem-solving skills, leadership, and sustained reflective dialogue with others. And in the broader community, teachers' shifting roles include becoming partners, critics, designers, and political advocates in reform efforts. Much is expected of mathematics teachers in their professional lives; little, however, is known about the processes involved as teachers begin to assume these new roles and responsibilities. Exploration of these processes, including how teachers' knowledge changes as they assume these new roles and the experiences that contribute to successfully assuming these new roles, can help provide new insights into the challenges of reforming mathematics education.

Next, descriptions of two prominent elementary mathematics staff development programs will allow a brief analysis of their specific purposes, content, processes, and contexts.

Two Examples of Elementary Mathematics Staff Development Programs

Cognitively Guided Instruction. The fact that the Cognitively Guided Instruction (CGI) project at the University of Wisconsin was not originally conceived as a staff development program sets it apart from most projects described in the staff development literature. Yet the features of the CGI research and development project link it quite remarkably to the themes of effective staff development identified earlier (see Figure 5). The project is also distinguishable in its focus on impacting teachers' understanding of children's *learning* rather than prescribing strategies for *instruction.* CGI is a multi-year project designed to investigate the hypothesis that teachers' knowledge of children's thinking could influence instruction and student achievement (Carpenter, Fennema, Peterson, & Cary, 1988).

In the first phase of the project, the researchers conducted baseline studies to determine the relationship among teachers' pedagogical content knowledge, their pedagogical content beliefs, and their students' achievement in addition and subtraction. To assess teachers' pedagogical content knowledge, several techniques were used (Carpenter et al., 1988). In one assessment, teachers were given pairs of word problems and asked to identify which of the two problems was more difficult for first graders. In a second assessment, teachers were shown a videotape of children solving different word problems. Teachers were then asked to show how these same children might solve related problems. In a third assessment, teachers' knowledge of their own students was assessed by asking them to demonstrate how six randomly selected children would solve given word problems. Each teacher's prediction was then compared to the actual problem solving strategy used by the child. In a fourth assessment, teachers were tested on their ability to distinguish between different types of addition and subtraction problems. Teachers were asked to write word problems that could be best represented by given number sentences (e.g., 3 + 4 = ?, 12 - ? = 8). The teachers' pedagogical content beliefs were assessed using a Likert-type questionnaire and a structured interview to determine their beliefs along four continua representing assumptions about cognitively based instruction (Peterson, Fennema, Carpenter, & Loef, 1989). Student performance was assessed on two measures--a test of 20 number facts and a problem solving test consisting of 17 word problems.

Among other conclusions, project staff concluded from this first phase that the teachers in the study could distinguish between basic types of addition and subtraction problems and the primary strategies that children use in solving these problems. However, the teachers' pedagogical content knowledge was not generally organized into a coherent framework that might be helpful in making instructional decisions. Furthermore, teachers' knowledge of their own students' problem-solving processes was significantly correlated with student achievement in both problem-solving and number facts (Carpenter et al., 1988). Evidence from this phase of the research suggested that teachers' knowledge of children's thinking could influence instruction and student achievement.

The first phase of the project was followed by a study with the same 40 first-grade teachers randomly assigned by school to either an experimental or control treatment (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989). Teachers in the experimental group (n = 20) participated in a four-week summer workshop. The **purpose/goal** of the workshop was to affect teachers' cognitions by providing them access to knowledge of recent findings from cognitive research on children's problem solving strategies. This cognitive view of the teacher is reflective of current perspectives on learning to teach (***Theme 1***). Control teachers participated in a workshop of short duration (two 2-hour sessions) on nonroutine problem solving, but were provided the same four-week CGI workshop the following summer.

A framework on the nature of children's thinking in solving addition and subtraction problems provided the **content** for the workshop. The content represented a well-defined, bounded knowledge base supported by research (***Theme 2***). Similar knowledge bases about children's thinking in other content areas are not yet available or are only currently unfolding (Fennema, Franke, Carpenter, & Carey, 1993).

The staff development approach taken was to help teachers gain knowledge of the research-based framework of children's thinking and then to provide opportunities for teachers to think about how they could apply this knowledge in their own classrooms. Lecture, discussion, readings, numerous videotapes of children solving problems, interviewing children to validate research findings, and various instructional materials available for review were utilized in the staff development **process**. Teachers were not trained to use specific instructional practices, nor was a specific curriculum provided. Descriptions of CGI workshop processes indicate that the processes were designed to accommodate adult learning and development (***Theme 4***):

> Teachers were given a great deal of freedom to monitor their own progress and to select and work on activities that facilitated their own learning. (Carpenter et al., 1989, p. 506)
>
> The format was based on the assumption that teachers are thoughtful professionals who construct their own knowledge and understanding. (Brown & Borko, 1992, p. 218)
>
> In the same way that children's learning of mathematics in the classroom builds on their previous understanding, the activities of a CGI workshop are designed to build on the previous understanding of the teachers who participate. (Chambers & Hankes, 1994, p. 288)

The teachers in the experimental group were expected to plan an instructional program based on their knowledge of children's problem solving strategies in addition and subtraction. During the following school year the teachers and their students were observed by trained observers for 16 days to determine how the teachers' knowledge impacted instruction and student performance. However, formal follow-up between staff developers and the teachers was limited (***Theme 5***). A meeting in October to discuss what teachers were doing in their classrooms with respect to CGI and a staff resource person available to respond to CGI teachers' questions comprised the only formal follow-up structure (Carpenter et al., 1989).

The researchers concluded that teachers who had knowledge of childrens' thinking and held cognitive-based beliefs about teaching and learning taught differently than teachers with less knowledge and different beliefs. Specifically, the experimental teachers taught problem solving more and number facts less, listened to their children more, allowed their students to use a variety of strategies to solve a particular problem more, and knew more about individual students' problem-solving processes than control teachers. They also believed that instruction should build on a student's prior knowledge more than control teachers did. Also, children in experimental classrooms achieved more than the control group, though differences were modest.

A case study of one of the experimental teachers (Ms. J.) and her classrooms over a period of four years was conducted to attempt to understand how a teacher uses children's thinking to make instructional decisions (Fennema et al., 1993). The researchers found Ms. J.'s pedagogical knowledge to be complex and extensive and her beliefs about learning cognitively-based. She established a classroom climate where students were expected to enage in mathematics, persist in their work, be able to tell how they solved problems, and listen to one another's solutions respectfully. The majority of her curriculum consisted of word problems augmented with other activities that she felt developed her students' number sense.

What her students were learning motivated Ms. J. to continue using CGI principles. In the first week of the school year following the four-week summer workshop, she discovered that her children could already solve many simple problems with small numbers. After that, she continually used her knowledge of children's thinking to broaden her expectations of students and challenge their thinking. They learned to do problem solving at a remarkable level reportedly exceeding the standards outlined in NCTM's *Curriculum and Evaluation Standards* (1989) (Fennema et al., 1993).

Ms. J.'s role as a knowledge producer was enhanced by the experience of being involved in the case study. The researchers described their case study approach with Ms. J. and others as follows:

> We made a point of communicating that we regarded them as professionals who were making instructional decisions, and that our role was to help them understand what we knew from research about children's thinking. We told them that their role was to help us understand how the research knowledge about children's thinking could be used in instruction. (Fennema et al., 1993, p. 562)

Ms. J.'s expert use of CGI led her to new roles as mathematics resource teacher for her school district and lead teacher working with the researchers to implement CGI in three primary schools. For Ms. J., the CGI experience was certainly accompanied by shifting roles and relationships (***Theme 6***).

Another follow-up study (Knapp & Peterson, 1991) indicated that not all CGI teachers experienced the same degree of change as Ms. J. Hour-long telephone interviews with 20 teachers three or four years after they had experienced the CGI workshop (10 from the experimental group, 10 from the control group) were conducted to determine the extent to which teachers continued to use knowledge of children's strategies for solving addition and subtraction problems. Knapp and Peterson found that 19 of the 20 teachers continued to use CGI regularly in their mathematics teaching, but the patterns of use varied widely.

Analyses of the transcripts of the telephone interviews indicated that the teachers fell into three groups. The first group (n = 8) had steadily continued to develop their use of CGI, and CGI constituted the primary basis for their mathematics teaching. For teachers in the first group, CGI had a conceptual meaning founded on a philosophy that teachers should try to build on and understand the knowledge that children bring to the classroom. The importance of substantial subject matter knowledge in order to teach mathematics well to young children was a common idea among teachers in the first group.

The second group of teachers (n = 4) had never used CGI more than occasionally and seemed at ease with this stance. Their concept of CGI was primarily procedural; they saw mathematics and mathematics teaching as a collection of techniques, strategies, and procedures. They added their perceived CGI techniques (e.g., using manipulatives, doing word problems) to their existing repertoire without conceptually transforming their beliefs about mathematics teaching and learning.

The third group of teachers (n = 6) was characterized by an incongruity between what they said was important about mathematics teaching and what they reported they were actually doing in their mathematics teaching. Their use of CGI fell somewhere in between the use of teachers in groups one and two. Teachers in the third group reported more barriers that prevented them from teaching the way they thought they should (e.g., lack of planning time, immature students, concern about student performance on standardized tests, concern about expectations from teachers at the next grade level, lack of a prescribed CGI curriculum, etc.). Perhaps **contextual** factors played a role in the changes the teachers in the third group were willing or able to make in their classroom practice; perhaps not. Systemic influences may not have been considered to a degree necessary for these teachers to use CGI as they wished (***Theme 7***), though curriculum supervisors did attend the workshop with the teachers and there was evidence of strong administrative support from some principals. Teachers in this third group left the researchers wondering "what types of support might have enabled these teachers to continue their development of CGI" (Knapp & Peterson, 1991, p. 40).

SummerMath for Teachers. SummerMath for Teachers is a professional development program for K-12 teachers in existence since 1983 and based at Mount Holyoke College in Massachusetts. The primary **purpose** of the program was "to help teachers develop a constructivist view of learning as a foundation for classroom practice" (Schifter & Simon, 1992, p. 188) (***Theme 1***). SummerMath for Teachers focused on impacting teachers' understanding of *learning* and the learning process. Summer institutes were combined with intensive, ongoing follow-up support.

Constructivist theory influenced by Cobb, Confrey, and von Glasersfeld (Cobb et al., 1991 [as cited in Simon & Schifter, 1993]; Confrey, 1985; von Glasersfeld, 1983 [as cited in Schifter & Fosnot, 1993]) among others provided the primary philosophical underpinning of the SummerMath for Teachers program. Program staff described their constructivist perspective as embracing the notion that understanding is constructed by learners as they try to make sense of their experiences in light of the prior knowledge they bring to the learning situation; learners do not develop understanding by absorbing clear explanations (Simon & Schifter, 1993). A second major influence for the program design was teachers' insufficient knowledge of mathematics concepts and the nature of mathematics as a socially constructed web of interrelations (Ball, 1989). These two research-based influences (***Theme 2***) provided the foundation for the program design.

The SummerMath for Teachers program included several staff development **models** (***Theme 3***). The primary model was a two-week summer institute accompanied by weekly classroom follow-up support for one academic year. Additional offerings for teachers evolved from the experiences and needs of those who had participated in the summer institutes. These additional offerings provided opportunities for teachers to remain involved in the program for several years. Among the additional program offerings were semester-long mathematics courses, advanced summer institutes, resource teacher leadership development seminars, and courses to help teachers write about their individual experiences in transforming their classroom instruction based on constructivist principles (Schifter & Fosnot, 1993).

The **content** of the summer institutes was based on the elementary and middle school mathematics curriculum (whole number operations, fractions, decimals, exponents, place value, division, etc.) but designed for adults. Activities were designed to challenge teachers' conceptions and open them up for reflection (***Theme 4***). The primary **processes** utilized were mathematical explorations, reading assignments, and journals. Reading assignments addressed various aspects of classroom practice based on constructivist principles. The journals were used to provide teachers opportunities for both reflection and dialogue.

One example of a mathematical exploration utilized in the SummerMath for Teachers summer institutes is Xmania, an investigation about number systems (Schifter & Fosnot, 1993). In the Xmania exploration, teachers were told a hypothetical story about another civilization (Xmania) developing its number system. A mathematician in the story who died before publishing a full description of her newly developed number system left behind information about the system. Specifically, the new number system used only the symbols *0, A, B, C,* and *D*; any number could be represented, no matter how large; and operations of addition, subtraction, multiplication, and division could be performed in this system. The mathematician left behind objects that were going to be used to explain the system. The teachers were challenged to use the objects, which consisted of base-five blocks, to develop a possible number system for Xmania that fit the mathematician's description.

Mathematics explorations such as this one were designed to be accessible to everyone, to help teachers confront the lack of depth in their own conceptual understandings, and to reinforce the idea that mathematics is a human endeavor. Schifter and Fosnot (1993) described their own reflections on this exploration based on experiences as institute instructors:

> First, many teachers hit upon the same kinds of ideas, and make the same kinds of errors, as children who are learning the base-ten place-value system. Second, the systems that the teachers initially design usually resemble those of ancient civilizations. (p. 59)

The follow-up aspect of the SummerMath for Teachers program is especially notable (***Theme 5***). There was no prescribed curriculum that teachers were expected to take back to their classrooms and implement after the summer institute. Instead, participants were invited to develop their own plan for implementing constructivist principles in their classrooms. Ongoing and intensive classroom-based support was provided to help teachers implement their personal agendas. Weekly classroom visits for one full academic year by project staff (and later by classroom teachers who had been associated with the program for several years and who had been involved in learning how to be a resource teacher for others) provided opportunities for co-teaching, problem solving, dialogue, and reflection on what was happening in the classroom.

Assessment of the impact of the SummerMath for Teachers professional development program on teaching and learning has taken two directions. Qualitative data (e.g., interviews, journals, synthesis papers) gathered over a period of several years have provided the primary source of information about the program's impact on teachers. Case studies of teachers who have been participants in the program offer insightful stories of teachers coming to grips with a different vision of teaching and learning (Schifter and Fosnot, 1993). In particular, the case study of Jill Lester chronicles her motion through several stages of development: (a) at first focusing primarily on procedural aspects of constructivist teaching, (b) then routinizing new procedures such as using manipulatives and providing nonjudgmental feedback to children during problem-solving sessions, (c) beginning to think about teaching in relation to students rather than in terms of techniques and materials, and (d) finally, solidifying the shift in focus from her own teaching behaviors to her children's conceptual development. When she had succeeded in shifting the focus of her instruction to her students, Jill also began to find the "big ideas" in mathematics around which she could organize her curriculum.

> As the nature of her instruction changed, she began to reconceive the mathematics content she had been teaching, identifying the central, organizing ideas that are embedded in the second-grade curriculum, but that remain largely hidden from both teachers and students in the traditional classroom. (Schifter & Fosnot, 1993, p. 96)

A second effort to determine the impact of the SummerMath for Teachers involved assessing teachers along two dimensions related to their classroom behaviors and their beliefs. The Levels of Use (LoU) instrument (Hall et al., 1975) associated with the Concerns-Based Adoption Model (Hall & Loucks, 1978) was used to determine the teachers' level of implementation of particular classroom strategies (e.g., manipulatives, nonroutine problems, and group work). Analysis of interviews conducted with teachers after completion of the year of classroom follow-up support determined whether the teachers' implementation was at level 0 (non-use), level III (mechanical use; concerned about management), level IVA (routine use; smooth procedures), or level IVB (refocused use based on meeting student needs). Levels I (learning about the strategy) and II (preparing to use the strategy) from the LoU instrument were considered not applicable.

Borrowing from the LoU instrument, the staff developed a similar instrument in 1986 to assess teachers' beliefs about teaching and learning (Schifter & Fosnot, 1993). The Assessment of Constructivism in Mathematics Instruction (ACMI) also consisted of interviews and analysis of teachers' beliefs at four levels. At level 0 there is no evidence of constructivist beliefs. At level III teachers express rudimentary understanding of constructivist beliefs, but these understandings are not generally translated into practice. At level IVA there is evidence of a constructivist epistemology, but the teacher is still primarily focused on teaching behaviors rather than on students' learning (level IVB).

Results of the LoU analysis based on 136 interviews with elementary teachers from 1986 to 1991 indicated that 31% of the teachers were at level III in their implementation of constructivist classroom strategies, 32% of the teachers were at level IVA, and 35% of the teachers were at level IVB. ACMI analysis for the same group of teachers indicated that 34% of the teachers were at level 0, 21% at level III, 16% at level IVA, and 29% at level IVB in their constructivist epistemology. From these results, program staff concluded that it was easier for the teachers to implement certain teaching strategies than to change their views about learning.

Additional analysis was conducted to compare LoU and ACMI levels of teachers who had been involved with the program for two years. Fifteen teachers who had attended the advanced institute and then conducted workshops for colleagues the year after receiving classroom follow-up support were interviewed. While admittedly a self-selected group of subjects, results indicated a much higher percentage of participants at level IVB after the second year.

Evidence from the SummerMath for Teachers case studies indicated that for many teachers involved in the program there were accompanying shifts in their roles (***Theme 6***). Becoming workshop leaders and follow-up resource teachers, enrolling in advanced degree programs, writing and publishing accounts of their experiences, and taking on leadership roles in district-wide and school-based curriculum committees were some of the ways the participants took on more complex professional roles. Some participants (e.g., Lisa Yaffee) recognized that the locus of authority about mathematics pedagogy was shifting from external experts to classroom teachers. With this new autonomy came added responsibility and increased reliance on other teachers to reinvent mathematics education together.

Conclusion

Multiple aspects present in the staff development process (purpose, content, process, and context) have been considered in this review of the literature. Seven themes within these multiple aspects related to effective staff development for teachers have been identified. Though much is currently known about the professional development of teachers, remaining questions challenge the field.

Researchers and theorists agree that the purpose of staff development should be to affect teachers' cognitions in order to improve instruction. One framework for describing the knowledge base for teachers is Shulman's (1987) categories. However, the connection between such a framework and staff development processes has not been adequately explored. What staff development processes are most effective if the goal is to impact teachers' pedagogical content knowledge? What is the relative impact of different kinds of staff development programs on what teachers learn? What experiences contribute to the process of knowledge acquisition among experienced as well as novice teachers?

The content of effective staff development should be supported by research to hold promise for student learning. However, in the literature reviewed the content options supported by research are limited mainly to teaching strategies (general pedagogical knowledge). How can research-based content related to other domains (e.g., knowledge of learners, pedagogical content knowledge, content knowledge) be effectively applied to staff development processes? What are some effective ways to connect research in specific content areas (e.g., mathematics, science) with appropriate staff development processes?

Evidence suggests that it is futile to search for one ultimate staff development model; multiple models for effective staff development are available. Research supporting the potency of different models, however, is thin (except for the training model). Which models are most powerful for different staff development goals or in different contexts? Are new models needed that are more powerful? What factors contribute to models that "embed" staff development experiences in the school- and classroom-based lives of teachers (Loucks-Horsley, 1994)?

Effective staff development processes accommodate adult learning and development, provide follow-up and support for at least three years, and are accompanied by new or shifting roles for teachers. A deeper understanding of the change process indicates the importance of teachers receiving feedback on the impact of their change efforts. Sustained support and technical assistance are often neglected, however, after the implementation process begins. Administrators and staff developers too often fail to follow up to determine the success of staff development activities. What factors prevent follow-up efforts? What follow-up practices are most effective? How can what is known about the change process be more effectively translated into staff development practice?

A highly recommended practice valued by both teachers and staff developers is providing opportunities for teachers to reflect on, discuss, and share their experiences. Such opportunities allow teachers to take on more complex and less isolated professional roles. Assuming new roles such as knowledge producers, teacher educators, or leaders requires new knowledge and commitment. Little is known, however, about the processes involved when teachers assume such roles. What dilemmas do teachers face when they assume these roles? How does the process of becoming a workshop leader affect teachers' pedagogical content knowledge? Do some roles have a greater impact on teachers' cognitions than others?

The importance of context in staff development programs has been overlooked until very recently. Recognition that teachers develop both individually and within established, yet changing, organizations (schools) has led to a new staff development emphasis on systems thinking. The interdependence of staff development and its relation to supervision, teacher evaluation, curriculum development, and school improvement requires further study. What is the right blend of individual and organizational development? What organizational impediments prevent or slow teachers' growth? How do individuals impede organizational development? What processes promote systems thinking?

Evidence suggests that neglecting any of these aspects results in staff development programs that often fail to bring about lasting changes in instructional practice or student achievement. Yet for each aspect, unanswered questions remain. This study will focus on questions related to the effects of teachers assuming new professional roles (***Theme 6***). Specifically, becoming a mathematics workshop leader will be investigated to explore how it affects teachers' pedagogical content knowledge, conceptions of effective staff development processes, and conceptions of adult learners.

CHAPTER III

METHODOLOGY

The research and theoretical literature reviewed in Chapter II was organized around four aspects present in the staff development process: (a) purpose, (b) content, (c) process, and (d) context. For each aspect, common themes from the literature were identified to provide a framework for further exploring the characteristics of effective staff development (Figure 7). Evidence suggests that the effectiveness of staff development to support sustained classroom changes may be tied to the degree of teacher involvement in the staff development process (Lambert, 1988; Maeroff, 1988; McBride, Reed, & Dollar, 1994; McLaughlin & Marsh, 1978; Pink & Hyde, 1992). Involving teachers in meaningful ways in staff development places demands on teachers to assume more complex professional roles. Little empirical evidence exists, however, to describe the effects of teachers assuming new roles such as workshop leaders, change facilitators, peer coaches, or action researchers. The purpose of this study was to investigate the effects of teachers becoming workshop leaders.

When teachers become workshop leaders, their roles shift from staff development customers to staff development planners, providers, and facilitators. Their roles also shift from teachers of children to teachers of adults. Several broad areas of investigation could provide information to help understand the process involved when teachers assume the role of workshop leader. For example, what dilemmas do teachers face when they assume these new roles? What concerns do teachers have about their roles as workshop leaders? How does becoming a workshop leader affect teachers' conceptions of effective staff development? How does becoming a workshop leader affect teachers' knowledge about teaching adults? How does becoming a workshop leader affect teachers' pedagogical content knowledge?

Figure 7. Seven themes of effective staff development.

PURPOSE:
Theme 1: The purpose of effective staff develompent is to affect teachers' cognitions in order to improve instruction.
CONTENT:
Theme 2: The content of effective staff development should be research-based.
PROCESS:
Theme 3: Multiple models for effective staff development are available.
Theme 4: Effective staff development processes are designed to accommodate adult learning and development.
Theme 5: Effective staff development requires follow-up and support for 3-5 years.
Theme 6: Effective staff development is accompanied by shifting roles and relationships.
CONTEXT:
Theme 7: Effective staff development acknowledges systemic influences.

Background

The subjects for this study were elementary classroom teachers who participated in Statistics Educators Institutes to become workshop leaders in the TEACH-STAT project. The goal of the TEACH-STAT project was to improve mathematics instruction by preparing teachers in North Carolina to teach statistical concepts to children in grades K-6.

Specifically, the goal of TEACH-STAT was to influence both teachers' content knowledge and pedagogical content knowledge for teaching statistical concepts. The purpose was consistent with ***Theme 1*** identified in the literature review--to influence teachers' cognitions.

The TEACH-STAT professional development program, funded primarily by the National Science Foundation, was a collaborative project involving nine of the University of North Carolina Mathematics and Science Education Network (MSEN) centers located at university sites across the state. The nine sites participating in the project were Appalachian State University (ASU), East Carolina University (ECU), North Carolina State University (NC State), Pembroke State University (Pembroke), the University of North Carolina at Chapel Hill (UNCCH), the University of North Carolina at Charlotte (UNCC), the University of North Carolina at Greensboro (UNCG), the University of North Carolina at Wilmington (UNCW), and Western Carolina University (WCU). A faculty member who was a teacher educator at each site served as the site coordinator for the TEACH-STAT project.

The nine faculty members together with three consulting statisticians developed the inservice curriculum for the TEACH-STAT project. The content for the curriculum evolved throughout the project as the faculty negotiated what was important in the teaching of statistics. See Appendix A for the table of contents from the revised Professional Development Manual (Friel, in press). There was initial agreement that the primary purpose of the project was to increase teachers' content knowledge relative to statistics education. There were also lengthy discussions among the faculty members regarding the role of probability in the workshop and how far teachers could or should be pushed beyond the elementary statistics curriculum. Additional details regarding the development of the TEACH-STAT curriculum can be found in Friel and Bright (in press).

After much deliberation, the faculty members agreed on a framework for the teaching of statistics that was highly influenced by Moore (1990), the NCTM *Curriculum and Evaluation Standards for School Mathematics* (1989), and the North Carolina Standard Course of Study for elementary mathematics (***Theme 7***). The framework emphasized a four-step model for statistical investigations--the **PCAI** model:

- Pose the question.
- Collect the data.
- Analyze the data.
- Interpret the data.

  (Rephrase, extend, or ask new questions.)

The main purpose of the model was to provide structure for statistical investigations, though it was recognized that the steps of the model are not always in strict sequence nor are the four steps completely self-contained. The teaching faculty felt that typical textbook treatment of statistics emphasized mainly the third step (analyzing the data), and consequently workshop activities were designed to emphasize the other steps in the model as well.

The TEACH-STAT workshop activities and statistical investigations were specifically intended to be adult learning activities and not to be directly transportable to the elementary classroom (***Theme 4***). In keeping with one of the professional development standards established by NCTM (1991), TEACH-STAT program staff wanted the workshop participants to experience good mathematics teaching. Selecting worthwhile tasks, orchestrating discourse, and creating a supportive learning environment were important components in the design of the TEACH-STAT workshops.

A summer institute model was selected as the staff development model (***Theme 3***) to allow workshop participants adequate time to become immersed in the workshop content and processes. From each of the nine sites, approximately six elementary teachers from local school systems (57 teachers total) were selected for participation in the first TEACH-STAT summer workshop. The twelve teaching faculty members associated with the project jointly conducted a three-week residential institute in Raleigh, North Carolina, in the summer of 1992. Follow-up during the 1992-93 academic year consisted of an average of two classroom visitations and limited on-campus support by the teaching faculty (***Theme 5***). Efforts were also made to involve each teacher's school principal in awareness meetings and follow-up sessions.

The following summer (1993) the 57 teachers in cohort one teamed with the faculty at each site to help plan and deliver a revised version of the TEACH-STAT workshop. They assumed new roles (***Theme 6***) by becoming involved as part-time teaching faculty in presenting the workshop material to a larger cohort. An additional 24 participants were selected at each of the nine sites to participate in three-week regional workshops. These teachers (approximately 220 teachers in all) were collectively referred to as cohort two. Follow-up support during the 1993-94 academic year for teachers in cohort two consisted of group meetings in the fall and spring to share "success stories"; however, project funds were not sufficient to support classroom visitations to all teachers. Some visits were made by site faculty and by cohort one teachers.

In the third year of the TEACH-STAT project, the university faculty conducted five-day Statistics Educators Institutes (SEIs) at each of the nine sites in the spring and early summer of 1994. The goal of the SEIs was to prepare teachers to become TEACH-STAT workshop leaders. Teachers from cohorts one and two were selected based on an application process. Each site director selected a group of six to twelve teachers to participate in the SEIs. An incentive for applicants to participate was that their names would be included in a database of Statistics Educators that would be distributed to school districts statewide. The database could be used by school district personnel to identify potential TEACH-STAT workshop leaders. Participants were also paid a stipend for each day they participated in the SEI and for each day they taught in the subsequent summer TEACH-STAT workshop.

The **purpose** (***Theme 1***) of the Statistics Educators Institutes (SEIs) was to develop the skills and cognitions of classroom teachers to assume new roles as Statistics Educators (i.e., staff developers/workshop leaders in statistics education for elementary teachers). Specifically, the goal of the SEIs was to support the development of the teachers along three desired shifts in roles (***Theme 6***):

From:		***To:***
•Inservice "customer"	------------->	Inservice planner, provider, and facilitator
•Classroom teacher	------------->	Teacher of teachers
•Statistics educator of children	----->	Statistics educator of adults

The SEI sessions included **content** on adult learning, the change process, and statistics pedagogical content knowledge. Time was also provided for guided working sessions for these teacher-leaders to collaboratively plan to conduct two-week 1994 TEACH-STAT summer workshops. The Institutes were organized around nine modules that were combined in various ways at each site according to the experiences and needs of the Statistics Educators:

Module 1: *Setting Goals*

Module 2: *Planning for TEACH-STAT Workshops*

Module 3: *Teachers as Learners*

Module 4: *Issues in Teaching Statistics*

Module 5: *Planning the Details*

Module 6: *Teaching Vignettes*

Module 7: *Presentation Skills*

Module 8: *Preparing the Site*

Module 9: *After the Workshop*

Module 2 content included various criteria for effective TEACH-STAT workshops based on the experiences of the university faculty associated with the project. Suggestions for effective TEACH-STAT workshops included sequencing activities developmentally, building in time for participants to reflect on and connect activities with goals and objectives, organizing activities to promote a variety of participant involvement levels, and providing opportunities for participant feedback.

Research findings about adult learning and teacher change provided the basis for Module 3 (***Theme 2*, *Theme 4***). Readings and discussion in this module reinforced the notion that adults learn by doing followed by reflection, talk, and sharing. The prior knowledge and experiences that adult learners bring to the workshop were emphasized as important aspects for the workshop leader to consider, as were the pragmatic characteristics of adult learners (Wood & Thompson, 1993). Building a collegial, supportive learning environment was also emphasized. The seven stages of concern about innovation in the Concerns-Based Adoption Model (Figure 4) (Hall & Loucks, 1978) were included in the content of Module 3 to help the Statistics Educators anticipate and respond to workshop participants' concerns about TEACH-STAT.

Module 6, *Teaching Vignettes*, was designed to develop the Statistics Educators' skills in orchestrating workshop discourse (pedagogical content knowledge). Vignettes that demonstrated developing conceptions about statistics were used as a basis for discussion of how teachers' conceptual errors could be used as opportunities for learning. Role-play processes were used to help Statistics Educators listen actively for teachers' conceptions and respond by using questions rather than telling answers.

The **processes** used in the SEIs were designed to involve the participants in team-building, decision-making, problem-solving, self-evaluation and reflection, and collaborative planning. The Statistics Educators engaged in processes such as self-assessment of their understanding of statistics content, group discussion to determine the goals and activities of the TEACH-STAT workshop, creating lists of the things they love and hate about workshops in general, and guided rehearsals on giving and receiving constructive criticism. Establishing ownership in the success of the TEACH-STAT workshop while, at the same time, creating a supportive climate for assuming roles as workshop leaders were considerations in the design of the SEIs processes. Focusing on their prior experiences with TEACH-STAT activities in their own classrooms helped the Statistics Educators gain confidence in anticipation of teaching adults.

A follow-up session (Module 9) held after the summer TEACH-STAT workshop allowed the Statistics Educators to reflect on changes in their knowledge and the experience of teaching the TEACH-STAT workshop. The follow-up session also allowed discussion of future workshop delivery. A final state-wide meeting was held in October, 1994, at the state mathematics conference to celebrate and recognize the 81 participants who had become Statistics Educators.

Research Questions and Instrumentation

The specific purpose of this study was to investigate the effects of classroom teachers becoming TEACH-STAT workshop leaders. Four research questions were chosen as areas of study to indicate the extent to which participating in the Statistics Educators Institute and conducting the summer TEACH-STAT workshops influenced the teachers' conceptions.

1. How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' conceptions of effective staff development?
2. How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' conceptions about teaching adults (as opposed to teaching children)?
3. How does becoming a TEACH-STAT workshop leader affect the pedagogical content knowledge of the Statistics Educators?
4. How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' concerns about the workshop content/innovation and their roles as change facilitators?

Three survey instruments were used to collect information about the Statistics Educators involved in the process of becoming TEACH-STAT workshop leaders: (a) a *Staff Development Style Inventory*, (b) a *Pedagogical Content Knowledge Questionnaire*, and (c) the *Change Facilitator Stages of Concern Questionnaire*. The crosswalk in Figure 8 links the research questions with the instruments that were used.

Staff Development Style Inventory

The *Staff Development Style Inventory* was adapted from the *Mathematics Teaching Style Inventory* (Madsen, Gallagher, & Lanier, 1991). The *Mathematics Teaching Style Inventory* was used to assess changes in teachers' perceptions about their classroom teaching practices over a 15-month period as a result of workshops in the Science and Mathematics Support Teacher Program (SMSTP). The program was a collaborative project involving the College of Education at Michigan State University, the American Federation of Teachers, and the Toledo Public Schools. The goals of the SMSTP were to (a) increase teachers' mathematics knowledge, (b) improve instructional

Figure 8. Crosswalk linking research questions with survey instruments.

Research Questions:	**Survey Instruments:** *Staff Development Style Inventory*	*Pedagogical Content Knowledge Questionnaire*	*Change Facilitator Stages of Concern Questionnaire*
1. Conceptions of effective staff development	x		
2. Knowledge about adult learners	x		
3. Pedagogical content knowledge		x	
4. Concerns about innovation and change facilitator role			x

practices, and (c) prepare teachers to conduct staff development activities in their schools with their colleagues. This third goal of SMSTP overlapped with the goal of the Statistics Educators Institutes.

Parts I and II of the *Mathematics Teaching Style Inventory* were designed to elicit teachers' thinking about instructional practices in their own mathematics classrooms. Analysis of an individual's responses on the *Mathematics Teaching Style Inventory* suggested conceptual/nontraditional vs. procedural/traditional approaches to instruction (Madsen et al., 1991). Scores for individual teachers (n = 7) represented the sum of the differences in their responses from the "ideal" responses on all items in Parts I and II. Ideal responses were not explicitly identified by Madsen et al. (1991). Based on the vision of mathematics teaching described in the *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989), it appeared that 11 of the 17 items in Part I of the *Mathematics Teaching Style Inventory* were constructed so that the "ideal" response was described on one end of the Likert-type scale and the remaining six items were constructed so that the "ideal" response was described on the other end of the Likert-type scale.

The *Mathematics Teaching Style Inventory* was used with a very small sample (n = 7). Scores over 15 months on four different administrations of the instrument led Madsen et al. (1991) to conclude that the teachers' perceptions of their classroom instruction had changed to a more conceptual-based approach. However, no information regarding the instrument's reliability or validity was provided by Madsen et al. (1991).

The *Staff Development Style Inventory* (Appendix B) was designed to elicit teachers' perceptions about instructional practices in mathematics workshops. Items 1-12 in Part I (Workshop Procedures) of the *Staff Development Style Inventory* were adapted directly from the *Mathematics Teaching Style Inventory.* The other five items in Part I were constructed to represent views of effective staff development supported in the research and theoretical literature on adult learning and the training model. Item 13 reflects recommendations from the knowledge base on adult learning that adults need to perceive that what is being learned is relevant and useful in their professional settings (Nowak, 1994; Wood & Thompson, 1993). Item 16 reflects involving learners in the planning process and is based on Knowles' (1984a) model of adult learning. Items 14 and 15 represent two components of the training model (Showers, Joyce, & Bennett, 1987)--development of theoretical understanding and guided practice in the workshop setting. Items 13-16 are also in accordance with guidelines for professional development programs for mathematics teachers from the National Council of Teachers of Mathematics (NCTM, 1994). Item 17 (workshop goals clearly communicated) is supported by Korinek et al.'s (1985) study of best staff development practices.

For each Likert-style item in Part I, two endpoints of a five-point scale were described. A sample item is displayed in Figure 9. The Statistics Educators selected a point along the five-point scale that most accurately described the workshop procedures

Figure 9. Sample item from *Staff Development Style Inventory.*

When workshop participants have trouble, the workshop leader asks them leading questions.			When workshop participants have trouble, the workshop leader explains how to do it.	
1	**2**	**3**	**4**	**5**

they believed take place in the most effective mathematics workshops. Nine of the 17 items in Part I were worded such that a response of "1" on the five-point scale indicated beliefs corresponding with effective workshop procedures and adult learning. Five items were worded so that a response of "5" on the five-point scale indicated beliefs corresponding with effective workshop procedures and adult learning. For three items the expected response was uncertain.

In Part II (Workshop Strategies) respondents indicated how frequently (very frequently, frequently, sometimes, seldom, or never) they would use eight different workshop strategies (e.g., whole group discussion, small group investigations, etc.). Six items were identical to items in Part II of the *Mathematics Teaching Style Inventory.* Two different items were included on the *Staff Development Style Inventory*--small group investigations and using technology--because of their role in the TEACH-STAT workshop.

Part III of the *Staff Development Style Inventory* contained three open-ended questions to determine Statistics Educators' opinions about the most important characteristics of effective staff development and effective classroom teaching, and the differences between teaching children and adults.

The *Staff Development Style Inventory* was field-tested with five mathematics education doctoral students at UNCG in March, 1994. The field test was designed to assess item clarity. Internal consistency reliability for the three administrations of the instrument in this study ($N = 45$) on Parts I and II of the inventory was assessed using Cronbach's alpha. The Cronbach alphas for Part I (Items 1-17) were .83, .68, and .73 on administrations 1, 2, and 3, respectively. The Cronbach alphas for Part II (Items 18-25) were .72, .69, and .78 on administrations 1, 2, and 3, respectively. The Cronbach alphas for Parts I and II (Items 1-25) were .79, .73, and .72 on administrations 1, 2, and 3, respectively.

Data analysis for Items 1-25 (Parts I and II) consisted of first determining the median and range for each item by site and for the entire group of participants. Each of the 25 items was then analyzed for potential item significance across administrations using an arbitrary decision-point test based on exploratory analysis of sample data. That is, if the item median differed by more than one point from one administration to another, or if the item range differed by more than two points from one administration to another, then the item was further analyzed. Together these two criteria identified relatively small changes in responses along the five-point scale beyond what might typically be expected. Items identified through the arbitrary decision-point test were further analyzed using the Kruskal-Wallis distribution-free test (Hollander & Wolfe, 1973) to determine if the difference was significant.

For the open-ended items in Part III of the *Staff Development Style Inventory* (Items 26-28), tables of responses were created for individual participants across all three administrations. The responses were first read to determine common response categories. After the first reading, 15 common response categories were identified for Items 26-27; 10 common response categories were identified for Item 28. The responses were read a second time to refine and clarify the descriptions of each category. On the third reading, individual responses were coded by category and frequencies of responses in each category were tallied for administrations 1, 2, and 3.

A second person coded all responses using the common response category descriptions. Interrater agreement for Item 26 across all three administrations resulted in matched codes on 322 of 382 responses (or 84% interrater reliability). Sixty additional codes (16%) were reconciled after discussion between the two raters. One additional response category resulted from the discussion. There were no response codes that were irreconcilable.

Interrater agreement for Item 27 across all three administrations resulted in matched codes on 311 of 366 responses (or 85% interrater reliability). Fifty-four additional codes (15%) were reconciled after discussion between the two raters. Again, one additional response category resulted from the discussion. There were no response codes that were irreconcilable.

Interrater agreement for Item 28 across all three administrations resulted in matched codes on 182 of 215 responses (or 85% interrater reliability). Thirty-three additional codes (15%) were reconciled after discussion between the two raters. No additional response categories resulted from the discussion. There were no response codes that were irreconcilable.

Pedagogical Content Knowledge Questionnaire

The *Pedagogical Content Knowledge Questionnaire* (Appendix C) was designed to provide a measure of the Statistics Educators' views of other teachers' knowledge of statistics. The questionnaire consists of three items. Each item involves a display of data and a question related to the data. See Figure 10 for a sample item.

On the first two items, the Statistics Educators were asked what percent of the elementary teachers who would be in the TEACH-STAT workshop would be able to answer the question correctly and to describe the process they predicted the teachers would most commonly use. On the third item the Statistics Educators were asked to describe how

Figure 10. Sample item from *Pedagogical Content Knowledge Questionnaire.*

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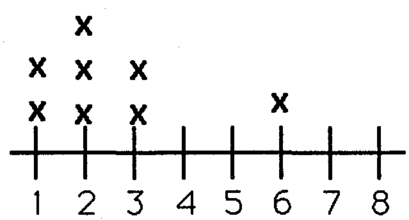
2. Suppose you asked a group of elementary teachers on the first day of a TEACH-STAT workshop to solve this problem:

   Eight students counted the number of pets in their homes. Their data are shown below:



   What is the average number of pets in their homes?

a. About what percentage of the teachers do you think would be able to answer the question correctly (circle one)?

   10%   30%   50%   70%   90%

b. Describe the process for solving the problem that you think would be most commonly used by those teachers.

TEACH-STAT participants would most commonly represent a set of data on the first and then the last day of the TEACH-STAT workshop. Though the questionnaire was not validated, it was developed to provide insight into the Statistics Educators' expectations of the processes adults would use to solve problems about the statistical concept of "average" (pedagogical content knowledge).

Data analysis techniques for the *Pedagogical Content Knowledge Questionnaire* were similar to those used for the *Staff Development Style Inventory*. The median and range for each item by site and for the entire group of participants were determined for Items 1(a) and 2(a). These items were then analyzed for potential item significance across administrations using the same arbitrary decision-point test. If the item median differed by more than one point from one administration to another, or if the item range differed by more than two points from one administration to another, then the item was further analyzed. Items identified through the arbitrary decision-point test were further analyzed using the Kruskal-Wallis distribution-free test (Hollander & Wolfe, 1973) to determine if the difference was significant.

Tables of responses were created for individual participants across all three administrations for Items 1(b), 2(b), and 3. Based on the work of Mokros and Russell (1995), individual responses to Items 1(b) and 2(b) were coded as to whether they indicated (a) an algorithmic representation of average (e.g., "add and divide"), (b) a modal representation of average (e.g., "find the frequency that appears most often"), (c) a midpoint representation of average (e.g., "looking at the middle), (d) a balance point representation of average (e.g., "balancing spaces"), or (e) other. Typical responses that were coded in the "other" category were "guess," "would not answer the question," or responses such as "by collecting data" and "looking at the total X's over each number." Frequencies of responses for each code were tallied for administrations 1, 2, and 3.

Individual responses to Items 3(a) and 3(b) were coded as to whether they indicated one of the following representations of average:

Numerical Representations

N1 = Average as algorithmic procedure

(Singular view; only one way to measure center of data implied)

N2 = Average as mean, mode, midpoint, and/or balance point

(Expanded view; more than one measure of center considered to determine representativeness)

Graphical Representations

G1 = "Traditional" graphing strategies

(Primarily bar graphs and line graphs)

G2 = Expanded graphing strategies

(Includes stem and leaf plots, box and whisker plots, or scatter plots)

Response codes for Items 3(a) and 3(b) were viewed as pairs to determine patterns of change (e.g., N1---> G2) or no change (e.g., G1 ---> G1).

A third person with mathematics teaching experience and a statistics background coded a sample of individual responses (n = 15) for Items 1(b), 2(b), 3(a), and 3(b). Interrater agreement for Item 1(b) across all three administrations resulted in matched codes on 44 of 45 responses (or 98% interrater reliability). One additional code (2%) was reconciled after discussion between the two raters. There were no response codes that were irreconcilable.

Interrater agreement for Item 2(b) across all three administrations resulted in matched codes on 44 of 45 responses (or 98% interrater reliability). One additional code (2%) was reconciled after discussion between the two raters. There were no response codes that were irreconcilable.

Interrater agreement for Items 3(a) and 3(b) across all three administrations resulted in matched codes on 88 of 90 responses (or 98% interrater reliability). Two additional codes (2%) were reconciled after discussion between the two raters. There were no response codes that were irreconcilable.

Change Facilitator Stages of Concern Questionnaire

The *Change Facilitator Stages of Concern Questionnaire* (CFSoCQ) developed by Hall, Newlove, George, Rutherford, and Hord (1991) was designed to determine the stages of concern of those who will be responsible for facilitating an innovation with other professional educators. The CFSoCQ (see Appendix D) was selected for its potential to contribute to understanding the change process as the Statistics Educators assumed the role of TEACH-STAT workshop leaders. The instrument is based on Hall et al.'s previous work with teachers' stages of concerns (e.g., Hall & Loucks, 1978) and has its roots in Fuller's (1969) identification of teachers' changing concerns with increasing experience and maturity. Out of Fuller's work came the idea that teacher's concerns tend to move through a predictable pattern from concerns about self to concerns about task and finally to concerns about their perceived impact on others.

The questionnaire consists of 35 items which individuals rate using an eight-point Likert scale. Analysis of the 35 items results in an individual profile indicating the relative concerns of an individual about both an innovation (in this case, TEACH-STAT) and their role as a change facilitator. Seven Change Facilitator Stages of Concern (CFSoC) have been identified (Figure 11). Five items for each stage are included on the questionnaire.

The internal reliability of the CFSoCQ was assessed with a sample of 589 questionnaires collected in 1981, and subsequently reassessed with a set of 750 responses collected after 1981. The 1981 sample included a broad range of different roles (e.g., principal, staff developer, university faculty, etc.), innovations, and experiences as a change facilitator. In both samples the assessment of internal reliability of all scales produced alpha coefficients greater than .60 (Hall et al., 1991).

The *Change Facilitator Stages of Concern Questionnaires* from all three administrations were handscored using procedures developed by Hall et al. (1991). Raw scores were converted to percentiles for each individual. Profiles for each site were developed using mean percentiles for each of the seven stages of concern. A pooled profile for all participants ($N = 45$) was also developed. Frequencies of the highest concern stage were also determined.

Figure 11. Change Facilitator Stages of Concern (Hall et al., 1991).

Stage of Concern		Typical Expression of Concern
6	Refocusing	I have some ideas about alternatives to the innovation that may increase effectiveness.
5	Collaboration	I am concerned about coordinating with other change facilitators.
4	Consequence	I am concerned about the effects of my change facilitation style on others.
3	Management	I am concerned about the time, logistics, resources, and energy involved in my role as a change facilitator.
2	Personal	I am uncertain about my abilities to be an effective change facilitator.
1	Informational	I would like to know more about the innovation.
0	Awareness	My concerns are focused elsewhere.

Procedure

The three survey instruments (*Staff Development Style Inventory, Pedagogical Content Knowledge Questionnaire,* and *Change Facilitator Stages of Concern Questionnaire*) were administered to the Statistics Educators at each site by the university faculty conducting the Statistics Educators Institutes. Each instrument was administered at three different points in time: (a) prior to or very early in the Statistics Educators Institute, (b) at the close of the Statistics Educators Institute but prior to the 1994 summer TEACH-STAT workshop, and (c) after the two-week 1994 summer TEACH-STAT workshop.

In addition, phone interviews with nine of the ten Statistics Educators at one site (UNCG) and four selected Statistics Educators at another site (UNCCH) were conducted prior to the Statistics Educators Institute by the researcher using a structured interview (Appendix E). The interview questions (along with possible probes) were designed to assess the Statistics Educators' notions of effective staff development, to determine what knowledge the Statistics Educators believed they needed to be effective TEACH-STAT workshop leaders, and to understand the Statistics Educators' notions about their roles as change facilitators. Each telephone interview was recorded with a duration of approximately 10-20 minutes.

A second set of recorded face-to-face interviews was conducted with the ten UNCG Statistics Educators at the end of the Statistics Educators Institute but prior to the TEACH-STAT workshop. The face-to-face interviews tended to be longer in duration than the phone interviews though the same interview questions and probes were used. Recorded telephone interviews were conducted with two of the original four UNCCH Statistics Educators, again using the same set of interview questions. Attempts to reach the other two UNCCH Statistics Educators by phone were unsuccessful during the short time frame between the end of the Statistics Educators Institute and the beginning of the TEACH-STAT workshop.

A third round of recorded telephone interviews was conducted with the ten UNCG Statistics Educators and one of the original UNCCH Statistics Educators in July and August (approximately six weeks after the TEACH-STAT workshop). The other UNCCH Statistics Educator who had participated in the second phone interview decided not to participate in the third interview.

Subjects

The subjects in the study were 45 classroom teachers (44 females and 1 male) who participated in the Statistics Educators Institute at five of the nine sites (see Table 1). Since the unit of analysis in most cases was the group of Statistics Educators at a particular site, four of the original sites were excluded from the data analysis because of a large proportion of incomplete data sets. The incomplete data sets resulted primarily from absenteeism or participants who chose not to participate in the instrument administration.

Table 1

Participants and Sites Included and Not Included in the Data Analysis

Site	No. of Statistics Educators	No. of complete data sets
	Sites included	
ASU	9	9
UNCC	11	10
UNCG	10	10
UNCW	8	7
WCU	10	9
Total	48	45
	Sites not included	
ECU	12	4
NC State	8	0
Pembroke	6	3
UNCCH	7	4
Total	33	11

Participant information gathered from the self-reported data on the first administration of the *Staff Development Style Inventory* and the *Change Facilitator Stages of Concern Questionnaire* indicated that the mean number of years of teaching experience for the 45 Statistics Educators included in the analysis was 13.7 years (range = 3 to 25). The grade levels taught in 1993-94 by these Statistics Educators ranged from kindergarten to grade 8, with the mode being grade 5. Data for all 45 participants are included in Appendix F.

Seventeen of the participants reported participating in the TEACH-STAT workshop in 1992. The remaining 28 participated in the 1993 summer TEACH-STAT workshop. Only nine participants reported that they had never taught any workshops before. The workshop experiences of those who reported having taught workshops before varied widely. Workshop topics reported included examples such as Teacher Expectations and Student Achievement (TESA), science, cooperative learning, reading textbook adoption, math manipulatives, and word processing. Nineteen participants reported having previously taught TEACH-STAT or statistics topics in workshops.

Case Study Analysis

Case study analysis was applied to four Statistics Educators selected from those who completed all telephone interviews and the complete battery of survey instruments. The four participants were selected to provide additional understanding of the teachers' conceptions as represented by different grade levels taught and the year of initial involvement in the TEACH-STAT project. Case study individuals included two fifth-grade teachers who taught at the same elementary school and participated at the UNCG site, one from cohort one and the other from cohort two; a first-grade teacher from cohort one who participated at the UNCCH site; and a second-grade teacher from cohort two who participated at the UNCG site. Fictitious names are used in the case studies.

Summary

The purpose of this study was to investigate the effects of classroom teachers becoming TEACH-STAT workshop leaders. The subjects for the study were 45 elementary classroom teachers who participated in Statistics Educators Institutes at five university sites in North Carolina during the spring and summer of 1994. Three survey instruments were used to collect data about the teachers' conceptions of effective staff development and teaching adults, the teachers' pedagogical content knowledge, and the teachers' concerns about TEACH-STAT and their roles as change facilitators. Each of the 45 subjects completed all survey instruments at three points in time: (a) at the beginning of the Statistics Educators Institute, (b) at the conclusion of the Statistics Educators Institute, and (c) after teaching the two-week 1994 summer TEACH-STAT workshop. Interviews conducted with some of the participants at the same three points in time provided additional information for four case studies.

CHAPTER IV

RESULTS

Data analysis results for each of the survey instruments are reported in this chapter. The chapter is organized around the four research questions and concludes with case studies of four Statistics Educators.

Research Question #1

The first research question was: How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' conceptions of effective staff development? Data were collected from the three administrations of the *Staff Development Style Inventory* (Appendix B). The median and range for Items 1-25 for the entire group of participants are displayed in Tables 2 and 3. Frequencies of responses for each item are reported by site in Appendix G.

Each of the 25 items was analyzed for potential item significance across administrations using an arbitrary decision-point test. As a result of the arbitrary decision-point test, six items were determined to be potentially significant. The test-statistic values (H-values) based on the Kruskal-Wallis distribution-free test (Hollander & Wolfe, 1973) for each potentially significant item are reported in Table 4. There were no significant differences across administrations with the exception of Item 3 at the UNCC site (H = 8.26, $\chi^2 = 5.99, p < .05$, df = 2).

Table 2

Summary Data from *Staff Development Style Inventory* (Part I)

	Administration 1		Administration 2		Administration 3	
	Median	Range	Median	Range	Median	Range
Item 1.	4	3	3	4	3	3
Item 2.	1	4	1	4	1	4
Item 3.	3	4	4	3	4	4
Item 4.	4	4	4	2	4	4
Item 5.	3	3	3	4	3	4
Item 6.	4	3	4	2	5	4
Item 7.	2	3	1	3	1	3
Item 8.	5	3	5	4	5	2
Item 9.	1	3	1	2	1	2
Item 10.	2	4	1	3	1	3
Item 11.	1	2	1	3	1	3
Item 12.	4	3	4	4	4	4
Item 13.	3	4	3	4	3	4
Item 14.	4	3	4	3	4	3
Item 15.	1	3	1	2	1	3
Item 16.	2	3	2	3	2	3
Item 17.	1	2	1	1	1	3

Note: $N = 45$ for each administration.

Table 3

Summary Data from *Staff Development Style Inventory* (Part II)

	Administration 1		Administration 2		Administration 3	
	Median	Range	Median	Range	Median	Range
Item 18.	2	2	3	3	3	2
Item 19.	2	2	2	2	2	2
Item 20.	2	2	2	2	2	2
Item 21.	2	3	2	3	2	2
Item 22.	2	2	2	2	2	2
Item 23.	2	2	2	2	2	2
Item 24.	2	3	2	3	2	3
Item 25.	1	2	2	2	1	2

Note: $N = 45$ for each administration.

Table 4

H-Values for Potentially Significant Items from *Staff Development Style Inventory*

Item	Site	H-value
Item 2	UNCC	2.42
Item 2	UNCG	0.59
Item 3	UNCC	8.26*
Item 7	UNCW	0.28
Item 8	UNCW	0.20
Item 15	UNCC	2.40
Item 17	WCU	0.86

*$p < .05$

Post hoc analysis of data from the *Staff Development Style Inventory* was performed to gain another view of typical responses for each item. The interquartile range of responses was determined for each item for all three administrations. The shaded interquartile ranges displayed in Figure 12 represent the results from the third administration of the *Staff Development Style Inventory.* The interquartile range of responses remained the same across all three administrations for 14 items (Items 1, 4, 6, 7, 10, 11, 12, 17, 18, 19, 20, 22, 23, and 25). For the remaining items the interquartile ranges for administration 1 (prior to the Statistics Educators Institute), 2 (between the Statistics Educators Institute and the TEACH-STAT workshop), and 3 (after the TEACH-STAT workshop) are described in the footnotes of Figure 12.

Figure 12. Interquartile range of responses (shaded) for the *Staff Development Style Inventory* for entire group ($N = 45$) on third administration. [† indicates median.]

1.	Almost always many different activities are going on simultaneously during the workshop.	1	2	3†	4	5	Almost always the participants are all engaged in the same activity during the workshop.
2.[a]	Participants frequently work together on activities.	1†	2	3	4	5	Participants seldom work together on activities.
3.[b]	When learning about a math concept, participants rarely spend time investigating big problems.	1	2	3	4†	5	When learning about a math concept, participants mainly spend time investigating big problems.
4.	Workshop leaders encourage participants to investigate problems the way that was demonstrated.	1	2	3	4†	5	Workshop leaders encourage participants to investigate problems in a variety of ways.
5.[c]	Almost all help is initiated by workshop participants asking for it.	1	2	3†	4	5	Almost all help is initiated by the workshop leader seeing the need for it.
6.	When workshop participants have trouble, the workshop leader explains how to do it.	1	2	3	4	5†	When workshop participants have trouble, the workshop leader asks them leading questions.
7.	When teaching a new topic, workshop leaders spend a lot of time helping participants see similarities and differences between new and previously learned ideas.	1†	2	3	4	5	When teaching a new topic, workshop leaders spend very little time helping participants see similarities and differences between new and previously learned ideas.
8.[d]	Workshop leaders seldom change their instructional approach (e.g., lecture, discussion, discovery, etc.).	1	2	3	4	5†	Workshop leaders regularly change their instructional approach (e.g., lecture, discussion, discovery, etc.).
9.[e]	Almost all questions posed by the workshop leader require the participants to give explanations.	1†	2	3	4	5	Almost all questions posed by the workshop leader can be answered with yes, no, or a number.
10.	Workshop tasks and assignments allow participants to make individual adaptations.	1†	2	3	4	5	Workshop tasks and assignments are the same for all participants.
11.	Workshop content is provided through the context of challenging problems or real-life situations.	1†	2	3	4	5	Workshop content is not provided through the context of challenging problems or real-life situations.

[a] Interquartile ranges were 1-2, 1, and 1-2 on administrations 1, 2, and 3 respectively.
[b] Interquartile ranges were 3-4, 3-5, and 4 on administrations 1, 2, and 3 respectively.
[c] Interquartile ranges were 2-3, 2-4, and 3-4 on administrations 1, 2, and 3 respectively.
[d] Interquartile ranges were 4-5, 4-5, and 5 on administrations 1, 2, and 3 respectively.
[e] Interquartile ranges were 1-2, 1-2, and 1 on administrations 1, 2, and 3 respectively.

Figure 12 (cont.). Interquartile range of responses (shaded) for the *Staff Development Style Inventory* for entire group ($N = 45$) on third administration. [† indicates median.]

12.	New topics are developed through examples and demonstrations.	1	2	3	4†	5	New topics are developed through experiences with problem-solving.
13.[f]	Workshop content is presented in ways that are relevant mainly to participants' classrooms.	1	2	3†	4	5	Workshop content is presented in ways that are relevant mainly to participants' learning.
14.[g]	Workshop leaders do not elaborate on theoretical understanding of new strategies or content.	1	2	3	4†	5	Workshop leaders help participants develop theoretical understanding of new strategies or content.
15.[h]	Opportunities are provided to practice new skills in the workshop setting.	1†	2	3	4	5	Opportunities are not provided to practice new skills in workshop setting.
16.[i]	The workshop leader and the participants cooperatively determine learning process.	1	2†	3	4	5	Workshop leaders determine the learning process.
17.	The goals of the workshop are clearly communicated.	1†	2	3	4	5	The goals of workshop are not clearly communicated.
		Very freq.	Freq.	Some times	Sel-dom	Nev-er	
18.	Whole group instruction	1	2	3†	4	5	
19.	Whole group discussion	1	2†	3	4	5	
20.	Posing open-ended problems	1	2†	3	4	5	
21.[j]	Gathering and organizing participant responses	1	2†	3	4	5	
22.	Encouraging analysis and generalization	1	2†	3	4	5	
23.	Small group investigations	1	2†	3	4	5	
24.[k]	Using technology	1	2†	3	4	5	
25.	Using concrete manipulatives	1†	2	3	4	5	

[f] Interquartile ranges were 2-3, 3, and 3-4 on administrations 1, 2, and 3 respectively.
[g] Interquartile ranges were 3-5, 3-4, and 4-5 on administrations 1, 2, and 3 respectively.
[h] Interquartile ranges were 1-2, 1, and 1 on administrations 1, 2, and 3 respectively.
[i] Interquartile ranges were 1-3, 1-2, and 1-3 on administrations 1, 2, and 3 respectively.
[j] Interquartile ranges were 1-3, 1-2, and 1-2 on administrations 1, 2, and 3 respectively.
[k] Interquartile ranges were 2, 2-3, and 2-3 on administrations 1, 2, and 3 respectively.

Responses for open-ended Item 26 provided information regarding the participants' perceptions of the most important characteristics of effective staff development. Responses for open-ended Item 27 provided information regarding the participants' perceptions of the most important characteristics of effective classroom teaching. Responses for individual participants across all three administrations are displayed in Appendixes H and I.

For Item 26 there were 134, 129 and 119 coded responses for the entire group on administrations 1, 2, and 3, respectively. For Item 27 there were 125, 125 and 116 coded responses for the entire group for administrations 1, 2, and 3, respectively. Table 5 displays the number of participants with zero, one, two, three, or four coded responses on Items 26 and 27 for each administration. For Item 26, 11, 5, and 6 participants had more than one response coded in the same category on administrations 1, 2, and 3, respectively. For Item 27, 4, 5, and 3 participants had more than one response coded in the same category on administrations 1, 2, and 3, respectively.

Tables 6 and 7 display the number of participants who had coded responses in each category for Items 26 and 27. The characteristic of effective staff development coded for the most participants (26, 22, and 19 for administrations 1, 2, and 3, respectively) for every administration was *classroom relevance and usability.* Two characteristics of effective classroom teaching were coded most frequently (n = 17) for administration 1--*activities that involve students (hands-on)* and *variety of instructional approaches and materials used.* For administrations 2 and 3 the characteristic of effective classroom teaching coded most frequently (15 and 16 on administrations 2 and 3, respectively) was *activities that involve students (hands-on).*

Table 5

Frequency of Participants per Number of Responses Coded for Items 26 and 27

	Total Number of Responses Coded (per Participant)				
	0	1	2	3	4
ITEM 26					
Admin. 1	0	1	2	39	3
Admin. 2	0	2	3	39	1
Admin. 3	3	0	8	33	1
ITEM 27					
Admin. 1	2	0	5	37	1
Admin. 2	0	2	8	33	2
Admin. 3	3	1	8	33	0

Note. $N = 45$ for each administration.

Table 6

Number of Participants with Responses Coded in Each Category for Item 26 (Important Characteristics of Effective Staff Development)

Category	Adm 1	Adm 2	Adm 3
A. Relevance to classroom, usable in classroom, ease of use in classroom	26	22	19
B. Interesting topic	4	4	4
C. Clear goals/objectives	6	5	5
D. Assessment of goals/objectives	2	1	0
E. Meets participants' needs; participant gains knowledge/skill	6	8	10
F. Preparation/organization of staff developer	10	8	7
G. Enthusiasm/confidence of staff developer	3	8	5
H. Staff developer's presentation skills	2	4	4
I. Staff developer's subject matter knowledge	9	11	11
J. Pacing/good use of time	7	7	4
K. Activities that involve participants (hands-on)	19	19	15
L. Variety of instructional approaches/materials used	8	4	5
M. Opportunities for participants to solve problems, discuss, think, process, share ideas, work in groups	5	7	8
N. Follow-up	3	1	1
O. Climate conducive to learning (e.g., time of day, comfort, supportive environment, nonthreatening, presenter's rapport with participants)	3	12	12
P. Other	7	2	3

Note. $N = 45$ for each administration.

Table 7

Number of Participants with Responses Coded in Each Category for Item 27 (Important Characteristics of Effective Classroom Teaching)

Category	Adm 1	Adm 2	Adm 3
A. Relevance to students/real world	5	13	9
B. Interesting/fun topic	3	4	5
C. Clear goals/objectives	4	4	6
D. Assessment of goals/objectives	3	4	1
E. Meets students' needs or developmental stages; student gains knowledge	13	5	8
F. Preparation/organization of teacher	7	11	6
G. Enthusiastic teacher/motivator	8	5	8
H. Teacher's presentation skills	1	3	2
I. Teacher's subject matter knowledge	7	13	11
J. Pacing/good use of time	4	3	3
K. Activities that involve students (hands-on)	17	15	16
L. Variety of instructional approaches/materials used	17	10	9
M. Opportunities for students to solve problems, discuss, think, process, share ideas, work in groups	14	7	10
N. Student discipline/classroom management	3	4	3
O. Climate conducive to learning (e.g., mutual respect, love for children, rapport with children, kindness, safety, humor, flexibility)	6	14	11
P. Other	7	5	5

Note. $N = 45$ for each administration.

Research Question #2

The second research question was: How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' conceptions about teaching adults (as opposed to teaching children)? Participant responses for Items 26 and 27 of the *Staff Development Style Inventory* reported in the previous section provided some information for this research question. Responses to Item 28 (Appendix J) provided additional information about the participants' views of teaching adults as compared to teaching children.

For Item 28 there were 77, 75 and 64 coded responses for the entire group on administrations 1, 2, and 3, respectively. Table 8 displays the number of participants having zero, one, two, three, or more coded responses on each administration. For Item 28, 7, 4, and 2 participants had more than one response coded in the same category on administrations 1, 2, and 3, respectively.

Table 9 displays the number of participants who had coded responses in each category for Item 28. On administration 1 the category coded most frequently (n = 14) was *not much or no difference* between teaching children and teaching adults. On administrations 2 and 3 the category coded most frequently (16 and 12 on administrations 2 and 3, respectively) was *adults are harder to discipline/control/keep on task.*

Table 8

Frequency of Participants per Number of Responses Coded for Item 28

	Total Number of Responses Coded (per Participant)					
	0	1	2	3	4	5
ITEM 28						
Admin. 1	2	25	10	5	0	2
Admin. 2	0	23	15	6	1	0
Admin. 3	4	24	11	6	0	0

Note. *N* = 45 for each administration. On administration 1, one participant had 7 coded responses.

Table 9

Number of Participants with Responses Coded in Each Category for Item 28

(Major Differences Between Teaching Children and Teaching Adults)

Category	Adm 1	Adm 2	Adm 3
A. Adults need relevance; children need excitement	6	1	2
B. Adults' level of thinking is more abstract (more theory, less hands-on)	11	4	8
C. Adults have more prior knowledge/range of life experiences	5	8	9
D. Adults are more critical /demanding, less tolerant than children	7	14	5
E. Adults are less open-minded, curious, willing to experiment/try new ideas	8	10	7
F. Adults can move at a faster pace than children	3	1	1
G. Adults are harder to discipline/control/keep on task than children	6	16	12
H. Adults are easier to discipline/control/keep on task than children	3	1	1
I. Not much or no difference	14	7	10
J. Other	7	8	7

Note. $N = 45$ for each administration.

Research Question #3

The third research question was: How does becoming a TEACH-STAT workshop leader affect the pedagogical content knowledge of the Statistics Educator? Data collected from the three items on the *Pedagogical Content Knowledge Questionnaire* provided information for this research question. Items were analyzed by first organizing responses in tables by site (see Appendixes K, L, and M). The median response for Items 1(a) and 2(a) by site are displayed in Table 10. Each item was analyzed for potential item significance across administrations using the same arbitrary decision-point test applied to the items in the *Staff Development Style Inventory*. No items were found to be potentially significant based on the decision-point test. Overall, the median response for the total group (N = 45) indicated a prediction that 70% of the elementary teachers attending a TEACH-STAT workshop on the first day would correctly answer the question in Item 1 and 50% would correctly answer the question in Item 2.

Individual responses to Items 1(b) and 2(b) were coded as to whether they indicated (a) an algorithmic representation of average (e.g., "add and divide"), (b) a modal representation of average (e.g., "find the frequency that appears most often"), (c) a midpoint representation of average (e.g., "looking at the middle"), (d) a balance point representation of average (e.g., "balancing spaces"), or (e) other. Typical responses that were coded in the "other" category were "guess," "would not answer the question," or responses such as "by collecting data" and "looking at the total X's over each number." The frequencies of coded responses across all three administrations for Items 1(b) and 2(b) are displayed in Table 11. The most frequent response for all administrations was average as algorithm.

Table 10

Median Response for Items 1(a) and 2(a) of the *Pedagogical Content Knowledge Questionnaire* by Site

	Administration 1	Administration 2	Administration 3
Item 1(a)			
ASU	50%	70%	70%
UNCC	70%	70%	70%
UNCG	70%	50%	70%
UNCW	70%	70%	70%
WCU	50%	50%	50%
Entire Group ($N = 45$)	70%	70%	70%
Item 2(a)			
ASU	50%	70%	70%
UNCC	30%	50%	50%
UNCG	50%	50%	50%
UNCW	50%	50%	50%
WCU	70%	70%	70%
Entire Group ($N = 45$)	50%	50%	50%

Table 11

Frequencies of Responses for Items 1(b) and 2(b) of the *Pedagogical Content Knowledge Questionnaire* by Category

	Admin 1	Admin 2	Admin 3
Item 1(b)			
Average as algorithm	41	39	42
Average as mode	2	3	1
Average as middle	1	0	0
Average as balance point	0	1	1
Other	1	3	1
Item 2(b)			
Average as algorithm	30	34	35
Average as mode	8	5	5
Average as middle	0	0	0
Average as balance point	0	2	1
Other	9	4	3

Individual responses to Items 3(a) and 3(b) were coded as to whether they indicated one of the following representations of average:

Numerical Representations

N1 = Average as algorithmic procedure

(Singular view; only one way to measure center of data implied)

N2 = Average as mean, mode, midpoint, and/or balance point

(Expanded view; more than one measure of center considered to determine representativeness)

Graphical Representations

G1 = "Traditional" graphing strategies

(primarily bar graphs and line graphs)

G2 = Expanded graphing strategies

(includes stem and leaf plots, box and whisker plots, scatter plots)

In Item 3(a), participants described the representation they predicted elementary teachers would use on the first day of a TEACH-STAT workshop to answer the posed question. No participants predicted that elementary teachers would use expanded graphical representations on the first day of the TEACH-STAT workshop. Only one participant predicted that the elementary teachers would use expanded numerical representations on the first day (administration 3 only). More than 50% of the participants predicted on all three administrations that elementary teachers would use an algorithmic procedure on the first day of the workshop.

In Item 3(b), participants described the representation they predicted elementary teachers would use on the last day of a TEACH-STAT workshop. The majority of the participants predicted on all three administrations that elementary teachers would use expanded graphing strategies on the last day of the workshop.

Reviewing the coded responses of Items 3(a) and 3(b) together provided information about the Statistics Educators' expectations of the data representations elementary teachers would use on the first and then the last day of the TEACH-STAT workshop. Eight response patterns emerged when Items 3(a) and 3(b) were paired. Six of these patterns represent an expected change in the representations teachers would use at the end of the TEACH-STAT workshop and two patterns represent no expected change. Frequencies of responses for each pattern are displayed in Table 12.

Research Question #4

The fourth research question was: How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' concerns about the workshop content/innovation and their roles as change facilitators? Data from the *Change Facilitator Stages of Concern Questionnaires* (CFSoCQ) provided information for research question #4. The CFSoCQ instrument identifies the relative intensity of an individual's concerns about a particular innovation (in this case, TEACH-STAT) and their role as a change facilitator. The seven stages of concern are:

Stage 6:	Refocusing
Stage 5:	Collaboration
Stage 4:	Consequence
Stage 3:	Management
Stage 2:	Personal
Stage 1:	Informational
Stage 0:	Awareness

Table 12

Frequencies of Response Patterns for Items 3(a) and 3(b) of the *Pedagogical Content Knowledge Questionnaire*

	Administration 1	Administration 2	Administration 3
Change Patterns			
N1 ---> N2	4	5	1
N1 ---> G1	3	1	1
N1 ---> G2	17	14	16
N1 ---> N2 + G2	0	2	2
G1 ---> G2	14	20	22
G1 + N2 ---> G2	0	0	1
No Change Patterns			
N1 ---> N1	2	3	2
G1 ---> G1	3	0	0
Can't tell	2	0	0

Note. *N* = 45 for each administration. N1 = Average as algorithmic procedure (singular view); N2 = Average as mean, mode, midpoint, and/or balance point (expanded view); G1 = "Traditional" graphing strategies (primarily bar graphs and line graphs); and G2 = Expanded graphing strategies (includes stem and leaf plots, box and whisker plots, scatter plots).

Stages 1 and 6 represent concerns that are more innovation-related. Stages 2, 3, 4, and 5 represent concerns that are more directly related to the role of change facilitator. Stage 0 concerns are generally unrelated to the innovation or the role of change facilitator. See Figure 11 for descriptions of each stage of concern for the *Change Facilitator Stages of Concern Questionnaire* (Hall et al., 1991).

Individual scores from all three administrations can be found in Appendix N. Profiles for each site were developed using mean percentiles for each of the seven stages of concern. The site profiles are displayed in Figures 13-17 using a graphical representation recommended by Hall et al. (1991). A pooled profile for the entire group ($N = 45$) is displayed in Figure 18.

Frequencies of the highest concern stage (i.e., the stage of highest relative intensity for an individual as determined by percentile scores) were also determined for each site across all administrations. These frequencies are displayed in Table 13. On the first administration, 34 of 45 participants held highest concerns at either Stage 0 (awareness) (n = 18) or Stage 5 (collaboration) (n = 16). On the second administration, most participants (42.5 of 45) showed concerns of highest relative intensity at either Stage 0 (awareness) (n = 11), Stage 2 (personal) (n = 12.5), or Stage 5 (collaboration) (n = 19). On the third administration, most participants (36.5 of 45) showed concerns of highest relative intensity at either Stage 0 (awareness) (n = 10.5) or Stage 5 (collaboration) (n = 26). Five participants still showed concerns of highest relative intensity at Stage 2 (personal) on the third administration of the CFSoCQ. One participant showed concerns of highest relative intensity at Stage 6 (refocusing) on the third administration of the CFSoCQ.

Figure 13. *Change Facilitator Stages of Concern* profile for ASU site.

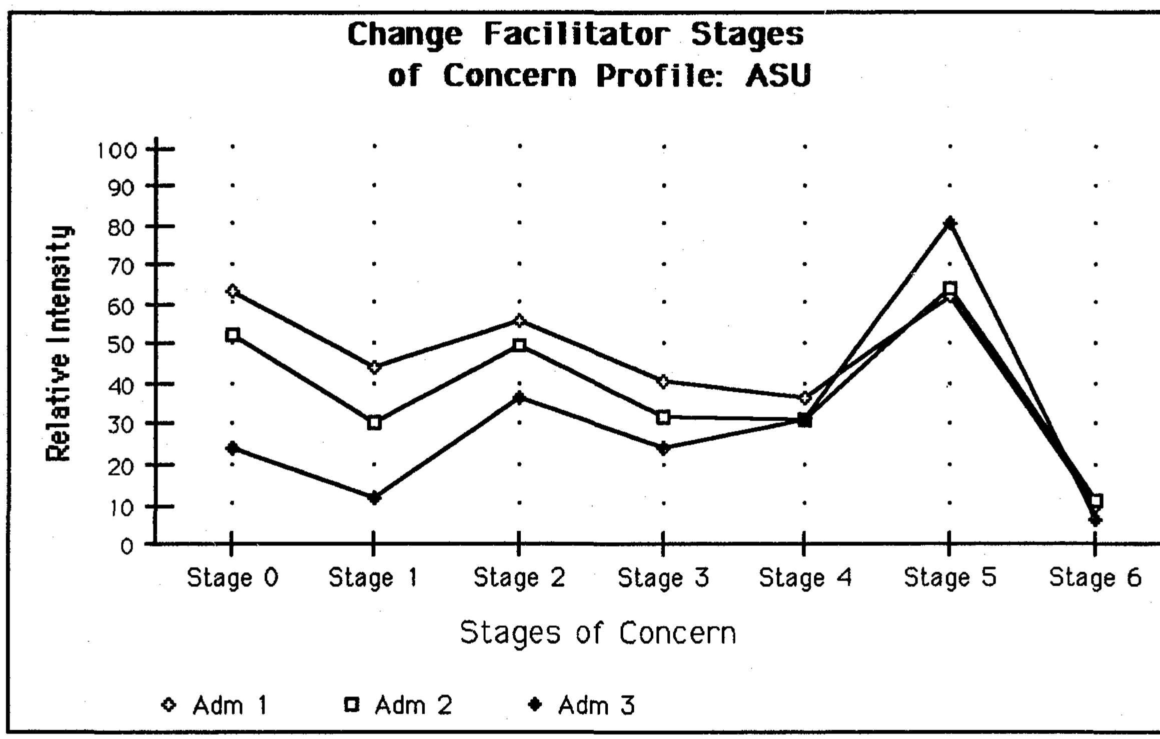


Figure 14. *Change Facilitator Stages of Concern* profile for UNCC site.

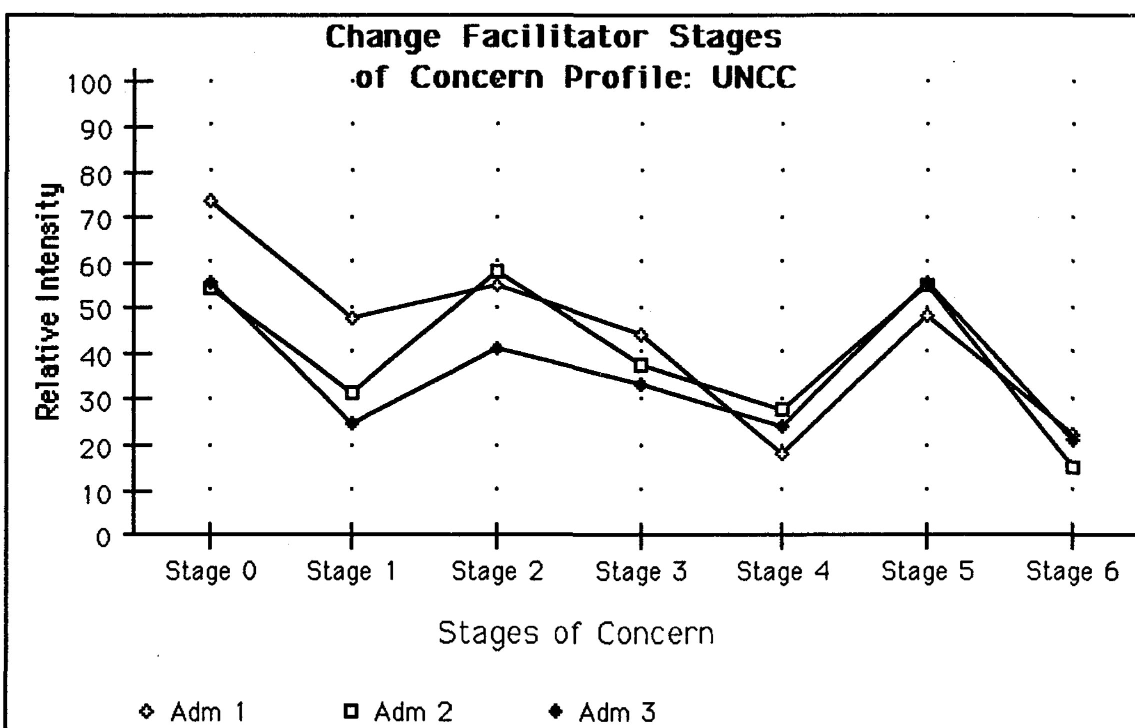


Figure 15. *Change Facilitator Stages of Concern* profile for UNCG site.

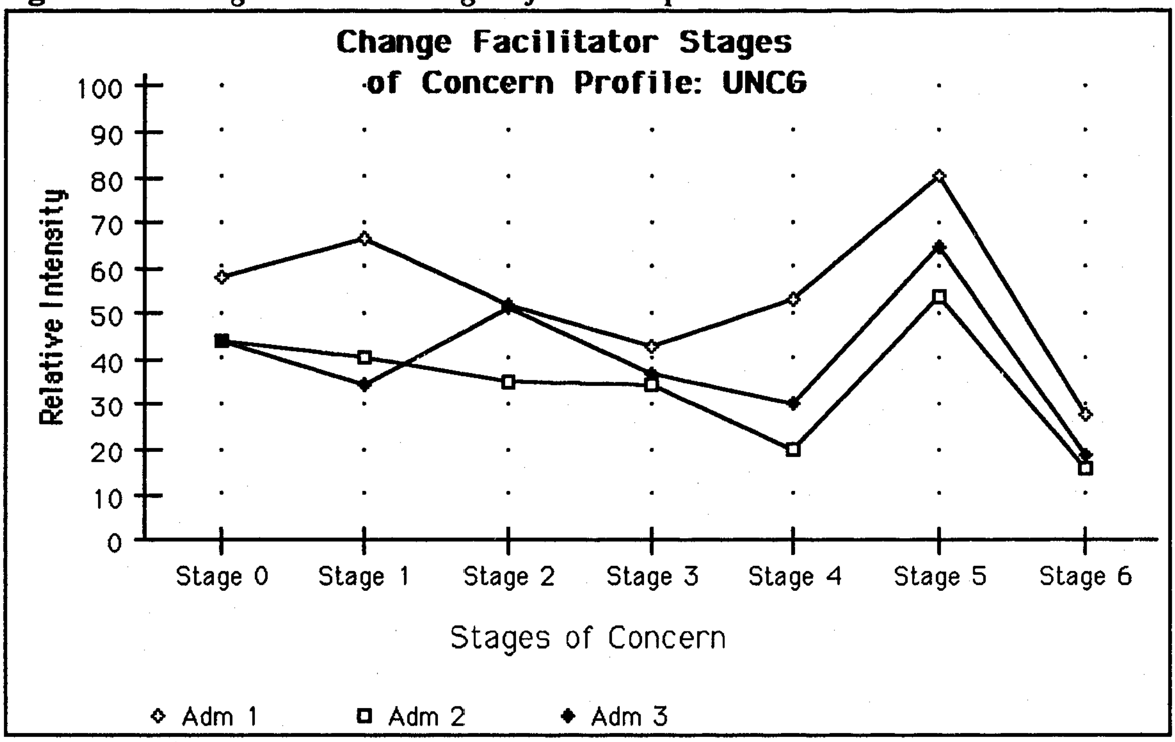


Figure 16. *Change Facilitator Stages of Concern* profile for UNCW site.

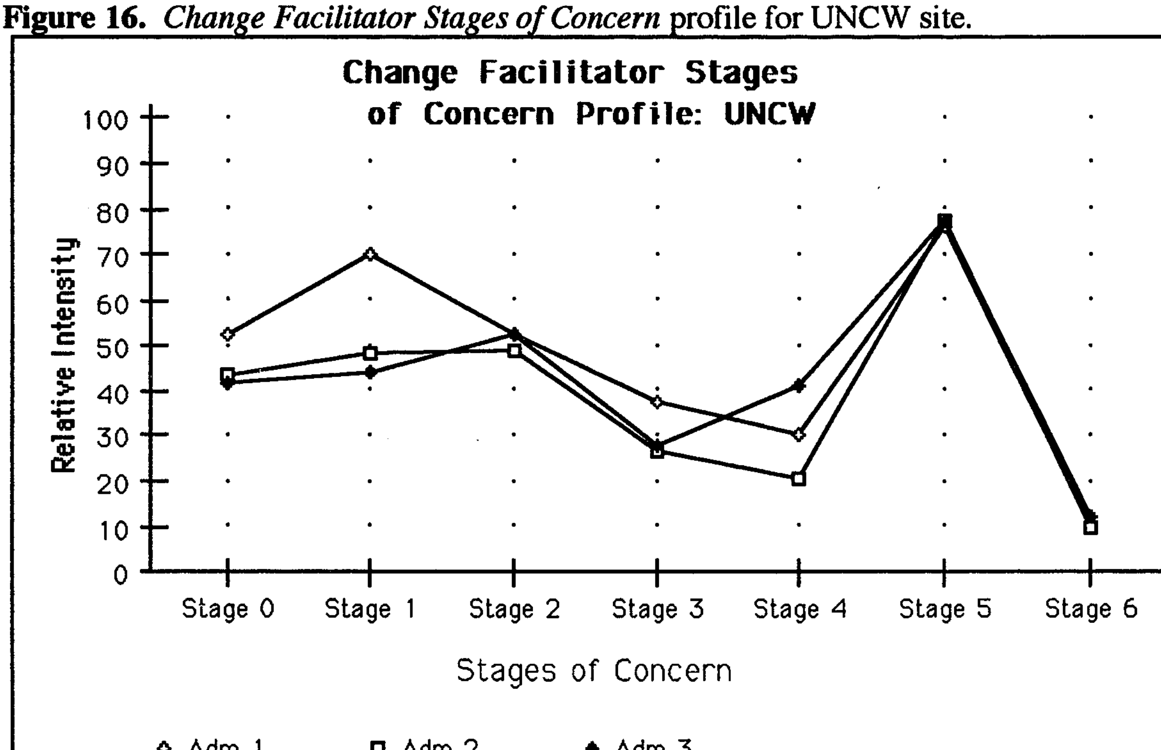


Figure 17. *Change Facilitator Stages of Concern* profile for WCU site.

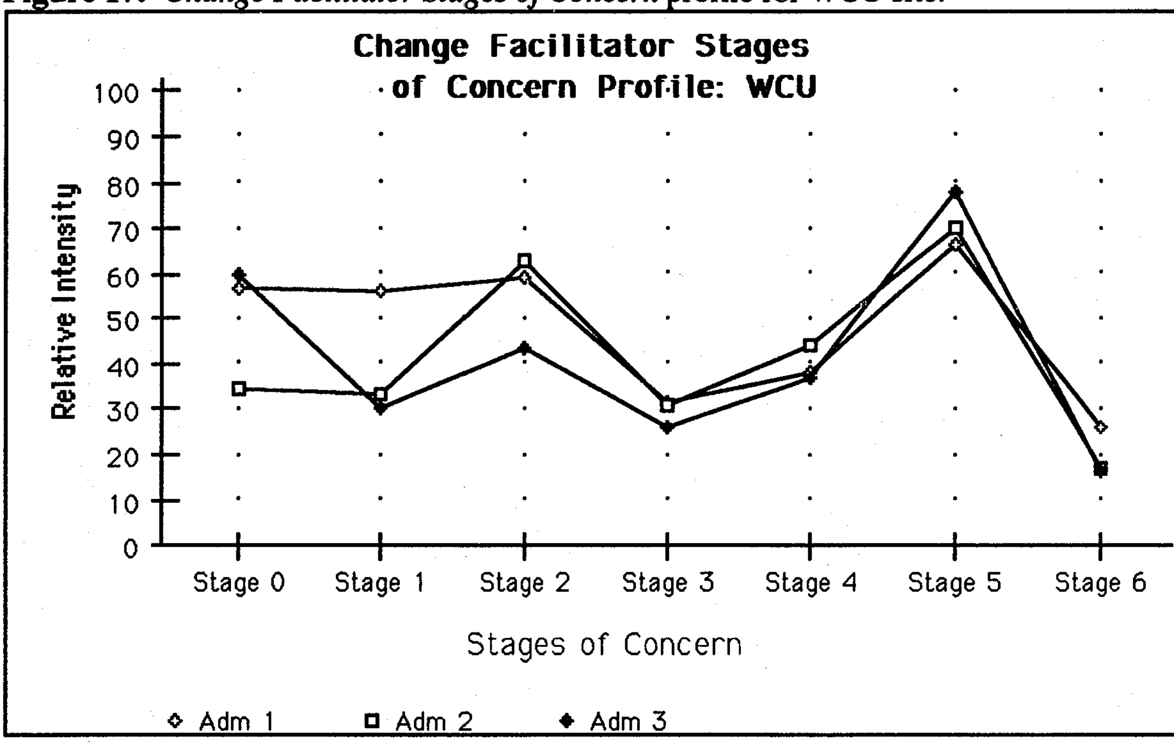


Figure 18. *Change Facilitator Stages of Concern* profile for entire group ($N = 45$).

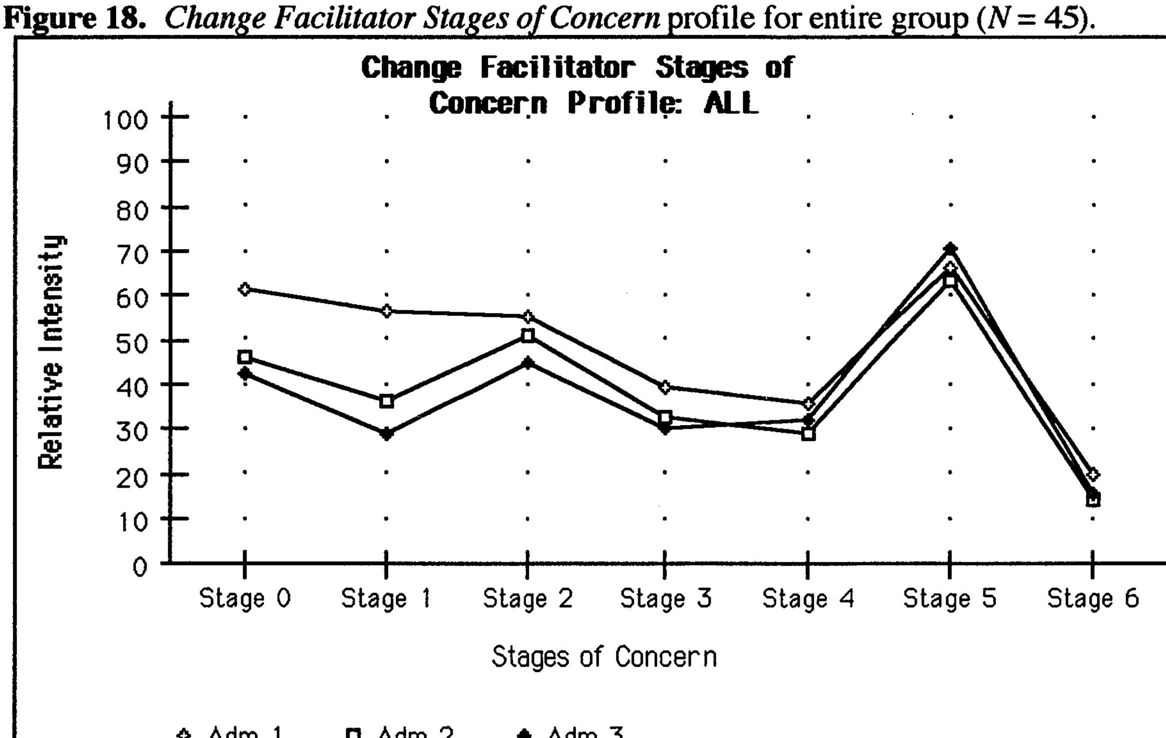


Table 13

Frequencies of Highest Concern Stages for Individuals by Site for All Administrations

	Administration 1							Administration 2							Administration 3						
	Stages of Concern							Stages of Concern							Stages of Concern						
	0	1	2	3	4	5	6	0	1	2	3	4	5	6	0	1	2	3	4	5	6
ASU	3	1	3	0	0	2	0	3	0	3	0	0	3	0	1	0	1	0	0	7	0
UNCC	7	0	0	0	0	3	0	3	0	4	0	0	3	0	5	0	1	0	0	4	0
UNCG	2	1	0	2	0	5	0	3	1	0	1	0	5	0	2	0	2	1	0	5	0
UNCW	3	2	0	0	0	2	0	1	0.5	1.5	0	0	4	0	2	1	1	0	0	3	0
WCU	3	1	1	0	0	4	0	1	0	4	0	0	4	0	0.5	0	0	0	0.5	7	1
Entire Group ($N=45$)	18	5	4	2	0	16	0	11	1.5	12.5	1	0	19	0	10.5	1	5	1	0.5	26	1

Note. When an individual had two concern stages of equally high intensity, both stages were recorded and assigned a frequency of 0.5 participants.

Summary

In this section the results from the analysis of the three survey instruments for the 45 participants in the study were reported. The results were organized around the four research questions.

For research question #1 (teachers' conceptions of effective staff development), no significant differences were found for the items on the *Staff Development Style Inventory* across the three adminstrations. The only exception was one item (of 25) at the UNCC site. Post hoc analysis of the interquartile range for each item was performed to gain a clearer picture of typical responses for each item on the inventory.

Three open-ended items on the *Staff Development Style Inventory* provided additional information about the teachers' conceptions of effective staff development. The characteristic of effective staff development coded most frequently on all three administrations (i.e., the mode) was *classroom relevance and usability*. The characteristic of effective classroom teaching coded most frequently on all three administrations was *activities that involve students (hands-on)*. On administration 1, *variety of instructional approaches/materials used* was coded as frequently as *activities that involve students.*

For research question #2 (teachers' conceptions of teaching adults vs. teaching children) the mode was *little or no difference* between teaching children and teaching adults on administration 1. On administrations 2 and 3 the mode was *adults are harder to discipline, control, and keep on task than children.*

For research question #3 (teachers' pedagogical content knowledge) the teachers expected the workshop participants to primarily use algorithmic procedures to solve problems about average at the beginning of the TEACH-STAT workshop. They expected the participants to primarily use expanded graphing strategies and expanded numerical representations on the last day of the TEACH-STAT workshop.

For research question #4 (teachers' concerns about the workshop content and their roles as change facilitators) most participants held highest concerns at stages 0 (awareness) and 5 (collaboration) on administration 1 of the *Change Facilitator Stages of Concern Questionnaire.* Most participants held highest concerns at stages 0 (awareness), 2 (personal), and 5 (collaboration) on administration 2. Most participants held highest concerns at stages 0 (awareness) and 5 (collaboration) on administration 3.

In the next section are case studies of four Statistics Educators. These case studies provide more in-depth information about the effects of individuals becoming TEACH-STAT workshop leaders.

Case Studies

Case study analysis was applied to four participants in the Statistics Educators Institutes. The four participants were selected from those who completed all interviews. They were selected to allow comparisons between different grade levels (primary grade teachers vs. intermediate grade teachers) and different years of initial participation in the TEACH-STAT project (cohort one vs. cohort two teachers). Data from the recorded interviews along with data from the three survey instruments were used to develop individual profiles for the four participants.

The following conventions are used to indicate the data sources in the case studies. The data sources are indicated by the following abbreviations: (a) "SD Survey" represents the *Staff Development Style Inventory*, (b) "PCK Survey" represents the *Pedagogical Content Knowledge Questionnaire*, and (c) "CFSoCQ" represents the *Change Facilitator Stages of Concern Questionnaire.* The numeral following the abbreviation indicates whether the data were collected on administration 1 (at the beginning of the Statistics Educators Institute), administration 2 (between the Statistics

Educators Institute and the two-week summer TEACH-STAT workshop), or administration 3 (after teaching the TEACH-STAT workshop). For example, the convention "SD Survey 2" indicates that the data source was the second administration of the *Staff Development Style Inventory*. "Interview 3" indicates that the data source was the third interview.

Ellen

Ellen had been teaching for five years and taught fifth grade in 1993-94. She participated in the TEACH-STAT workshop at the UNCG site in the summer of 1993. When she began the Statistics Educators Institute she reported that she had never taught workshops before.

Effective staff development. Several of Ellen's notions about effective staff development remained consistent throughout the project. She consistently viewed effective staff development as a presentation of activities that teachers can take back to use in their classrooms.

> [Effective staff development] is something that can be shown to teachers that they can go back and use in their classroom. (Interview 1)
>
> [Effective staff development] is going to a workshop where they guide you through activities and things that you can really use in the classroom and not just preach something to you. (Interview 2)
>
> I want something I can take back to my classroom and use. (SD Survey 2)
>
> [Effective staff development includes] material that can be adapted to the Standard Course of Study. (SD Survey 3)

It was important to Ellen that workshop content be useful and relevant to her teaching situation.

It was also important to Ellen as a workshop participant to have the opportunity to practice activities with others in the workshop.

> [Effective staff development includes] time to do activities in [the] workshop as practice. (SD Survey 1)

> [They] let you try things out [and] give you an opportunity to practice with each other . . . and discuss in your group of teachers extensions you might be able to use and how you think it'll work in a real situation. (Interview 2)

> I want to practice at the workshop if possible--doing is remembering and understanding. (SD Survey 2)

Using workshop time to practice activities that would later be used in her classroom was viewed by Ellen as a characteristic of effective staff development.

<u>Effective workshop leaders.</u> In Ellen's view, the workshop leader should have tried the activities with students before presenting them to other teachers. In fact, she stated that she had a"pet peeve" (Interview 2) about workshop leaders who suggested classroom ideas that had not been tried with students.

> [Effective workshops are] presented enthusiastically by presenters that have tried the activities with students. (SD Survey 2)

> [Effective workshop leaders] can relate to [the participants] how it worked with kids. It's hard to listen to someone if they haven't tried it out in the classroom. (Interview 2)

> If you haven't done it with kids, you don't have anything to give back to [the workshop participants]. (Interview 3)

She also thought that workshop leaders must be "excited and enthusiastic" (Interviews 1 and 2) about the material they're presenting, "believe in it" (Interview 1), and "sell it" (Interview 2) to the workshop participants.

She repeatedly emphasized the importance of pacing when leading a workshop.

> [One of the most important characteristics of effective staff development is] brisk pace. (SD Survey 1)

> It's real important to be able to present the material effectively and at a good pace so you don't bore the people that are having to listen to you. . . . I think that would probably be one of the hardest skills to acquire is to be able to present your material effectively and at a good pace so that you keep the interest of the people that are listening to you. (Interview 1)

> [Effective staff development includes] good pace by leaders. (SD Survey 3)

It was clear that as a workshop leader Ellen did not want to waste a participant's time. She mentioned the importance of starting on time and trying to dismiss the workshop a few minutes early (Interview 2). Ellen also reported that she and the other TEACH-STAT workshop leaders adjusted the pace after a few days when they were teaching the two-week summer workshop. "We tried to make it seem like we were moving a little bit quicker . . . when we realized there were some frustrations" (Interview 3).

Effective TEACH-STAT workshop leaders. In order to be an effective TEACH-STAT workshop leader, Ellen thought it was important to have a thorough working knowledge of the TEACH-STAT material.

> [In order to be an effective TEACH-STAT workshop leader you need to] have gone through the TEACH-STAT manual and done the activities with your students. (Interview 2)

> [Effective staff development is characterized by] knowledge of material by leaders. (SD Survey 3)

> Know your material so that you're able to answer questions. (Interview 3)

It was only after the experience of teaching the summer TEACH-STAT workshop that Ellen discussed the importance of workshop leaders being aware of their participants' prior knowledge and experiences. She acknowledged that it was acceptable for workshop leaders to admit not knowing something related to the workshop content, and that the participants could contribute equally to the learning situation.

> In order to be most effective it would be wonderful if you could know the experiences and knowledge that your participants have . . . so that you're not wasting time repeating things they already know. . . . We had a wide range of experiences and knowledge in our group and I think there were some frustrations felt by some people at some times because they felt like they weren't getting anything that they didn't already know. . . . It was difficult to try to do things that would meet everyone's needs. (Interview 3)

> Feel comfortable enough to say, "I'm going to have to talk with someone who's more of an expert than me to find that out for you." When I [began teaching the TEACH-STAT workshop] I felt like I really needed to be more aware of statistics than all of the participants were going to be. There were some things that they had done or that they knew that I didn't, and that's o.k. There were times that I felt like everyone was just sharing. It didn't matter which ones were the participants and which ones were the leaders. (Interview 3)

Concerns. Even though she had never taught workshops before, Ellen expressed confidence from the beginning of the project that three things would help her to be successful in her role as workshop leader: (a) knowledge of the workshop content, (b) knowing how the activities had worked with her students, and (c) careful preparation.

> Nervousness comes when you're not very comfortable with what you're presenting. [When I made an earlier presentation to a group of principals] I didn't feel real nervous . . . because I had done all those activities before and it was something I knew very well. Everything I've done with my class I know I'd be very comfortable presenting to other people. (Interview 1)

She expressed a little nervousness about being a workshop leader just before the two-week summer TEACH-STAT workshop began since she "hadn't done it before" (Interview 2). She stated that "after getting these two weeks under my belt, then I'll be ready to teach workshops with one other person" (Interview 2). It was important to Ellen to have at least one other person as a partner when leading TEACH-STAT workshops to serve as a support person and to help with the amount of material that needed to be presented. Ellen's highest stage of concern on all three administrations of the CFSoCQ was stage 5 (collaboration) indicating that she was most concerned about coordinating with the other TEACH-STAT workshop leaders so that they could better facilitate the TEACH-STAT workshop.

After teaching the TEACH-STAT workshop she commented on how helpful it was to "practice your lessons the night before" (Interview 3). She had also learned to write down "the questions I wanted to be sure to hit on in the presentation . . . [to help the participants] think a little deeper" (Interview 3).

Teaching adults vs. teaching children. Ellen expressed that teaching adults was different than teaching children. Some of those differences were that "kids won't argue with you" (Interview 2), they're "not older than you" (Interview 2), and "adults have more life experiences than students do. This can be good (more knowledge) or bad (hard to teach old dogs new tricks)" (SD Survey 2). She viewed adults as less open-minded than children.

> Adults may not be as open to new ideas and strategies. You have to "sell" them on it. I think students accept change more easily. (SD Survey 1)
>
> Adults also have more of an opinion about material before the presentation--students are more open-minded perhaps. (SD Survey 3)

Pedagogical content knowledge. Ellen's predictions as to the percentage of teachers that would be able to correctly answer the question in Item 1 rose from 50% (PCK Surveys 1 and 2) to 70% (PCK Survey 3) after teaching the TEACH-STAT workshop. Her predictions as to the percentage of teachers that would be able to correctly answer the question in Item 2 rose from 30% (PCK Surveys 1 and 2) to 50% (PCK Survey 3).

Ellen expressed concern that most elementary teachers would be unfamiliar with the line plot representation in Item 2. She predicted TEACH-STAT participants would have difficulty solving the problem stated in Item 2 of the *Pedagogical Content Knowledge Questionnaire*.

> I'm not sure most teachers would be able to read the line plot. They might read it: 1 person with 2, 2 people with 3, 3 people with 2, 6 people with 1. (PCK Survey 1)
>
> [The teacher's process for solving the problem would be] probably the same as before if they understand how to read a line plot. (PCK Survey 2)

After teaching the TEACH-STAT workshop, Ellen's earlier prediction that teachers would be unfamiliar with line plots was not mentioned (PCK Survey 3).

Like most of the Statistics Educators, Ellen thought that on the first day of the TEACH-STAT workshop the teachers would use the average algorithm to solve the problems on the *Pedagogical Content Knowledge Questionnaire* (PCK Surveys 1, 2, and 3). She thought that on the last day of the workshop they would use expanded graphing strategies such as stem and leaf plots or box and whisker plots (PCK Surveys 1, 2, and 3). "I think this workshop would show participants how they could look at the entire group of data to make generalizations instead of just having to give a one number average" (PCK Survey 1). Ellen's expectations about the differences in the way participants would solve problems on the first and last day of the workshop could be characterized by the pattern N1 ---> G2.

Jane

Jane also had five years of teaching experience. She taught 5th grade in 1993-94 at the same school as Ellen. She participated in the TEACH-STAT workshop in 1992, and was the only cohort one teacher to participate in the Statistics Educators Institute at the UNCG site. She reported previously conducting 10 workshops of various lengths; the workshop topics were statistics and decimals.

Effective staff development. Jane emphasized that in the most effective workshops participants are actively involved.

> [Effective staff development includes] a lot of hands-on [activities] and demonstrations so that we know what is expected of us. . . . I've gone to a lot [of workshops] where [I've been] read to, and I don't get a lot out of that. I think participating and actually doing things is [better]. (Interview 1)

> [Effective staff development takes place when] participants get to actually participate, they get to grow professionally with information that they learn, . . . they go away with materials and ideas on how to use them, and they're enthusiastic. (Interview 2)

Jane's response in the second interview indicated her view that learning is an important outcome of effective staff development. While these two excerpts provided information about Jane's views of effective staff development in general, her responses more often focused on the characteristics of effective workshop leaders.

Effective workshop leaders. Jane consistently cited three characteristics she considered important for effective workshop leaders. Her past experiences had convinced her that an effective workshop leader (a) develops good rapport with the workshop participants, (b) shares examples of student work, and (c) knows the workshop content well.

> [Effective workshop leaders are characterized by having] rapport with [the] group--not being insulting or controlling, sharing ways the activities went in your classroom and having many examples of student work and student responses, [and] knowing your material and being prepared! (SD Survey 1)

> [Effective workshop leaders need to be able to] deal with all kinds of people, especially when you have people that are at different levels . . . and people that are not as responsive. (Interview 1)

> [Effective workshop leaders are characterized by] knowing the material well, sharing actual student work and experiences, [and relating] well to the participants. (SD Survey 2)

> [Effective workshop leaders should] be prepared, know their material, . . . have student work to show, . . . and make people feel comfortable. (Interview 2)

> Knowing the content you're teaching is very very important. [So is] knowledge of how to deal with people and adults, and that's kind of hard. I think that's either in you or something you really have to work on. Being able to talk to people is very important, [as is having good] eye contact and . . . being warm and friendly and inviting. (Interview 3)

Jane repeatedly placed a great deal of importance on the workshop leader's role in helping participants feel at ease and comfortable in the workshop setting. She wanted to be someone participants would "connect with" and "talk to" (Interview 2).

Effective TEACH-STAT workshop leaders. In addition to knowing content, developing good rapport with participants, and having student work available to share with participants, Jane noted several characteristics that she believed effective TEACH-STAT workshop leaders should possess. Jane did not discuss these specific characteristics until after teaching the summer TEACH-STAT workshop. She thought that effective TEACH-STAT workshop leaders should know how to use the computer (Interview 3). They should also be aware of how to access both material and human resources that may be helpful to teachers (Interview 3).

Jane also thought it was important for TEACH-STAT workshop leaders to have effective questioning skills.

> Questioning . . . is a key. You [should] lead, but you don't want to lead too much. You want to ask questions that take it a step further. Don't just assume just because they got the answer right that they know what they're doing. . . . Ask why and check everything. Now participants get angry when you do this. They don't want to go that step further. . . . It's taken me a while to develop the questioning skills, and I'm still working on it. (Interview 3)

Jane believed that learning how to use effective questioning skills was a slow process.

Concerns. Jane expressed confidence in her abilities to be successful as a TEACH-STAT workshop leader. She had received "a lot of positive feedback" from her past experiences as a workshop leader and indicated she had "good communication with others" (Interview 1). Just before teaching the two-week TEACH-STAT workshop she expressed that she felt "very comfortable" teaching teachers "because I've had a lot of experience" (Interview 2). After the TEACH-STAT workshop she was still "very comfortable, but a little more cautious" and "not as naive" about being a workshop leader. She stated that with "different experiences I know better how to react" (Interview 3). Jane's highest concern stage on all three administrations of the CFSoCQ was stage 5 (collaboration) indicating that she, like Ellen, was most concerned about coordinating with the other TEACH-STAT workshop leaders.

Teaching adults vs. teaching children. Jane said that teaching adults was "not that much different" from teaching children (Interview 3). One difference she specifically noted after teaching the TEACH-STAT workshop was that it was "harder to keep [the adults] on task or get order back when they're talking because you know they're adults" (Interview 3). Other differences were alluded to in her responses on the *Staff Development Style Inventory.*

> Children are more open-minded and do not have opinions formed about some of the material already. When teaching adults, sometimes the way the material is presented needs to be different than when presenting it to students (even though a lot of the time it can be done the same for both groups). (SD Survey 1)
>
> [There are] not really any [differences]. There shouldn't be as many discipline factors. There are still levels of ability to deal with in adults also. (SD Survey 2)
>
> It is extremely difficult to arrive at a level of respect in a short while for a workshop, especially when many teachers don't want to be there or feel they know the material already. Otherwise it is pretty much the same for me--don't talk down to students or adults! (SD Survey 3)

She thought that adults, like children, "want to work through the activities." One difference she especially enjoyed with adults, however, was being able to take an activity to "a whole different level" in which participants, whom she viewed as colleagues with "different experiences," discussed possible classroom extensions and adaptations (Interview 3).

Pedagogical content knowledge. Jane's predictions of the percentage of teachers who would be able to correctly answer the question in Items 1 and 2 of the *Pedagogical Content Knowledge Questionnaire* varied. For Item 1 she predicted 70%, 30%, and 30% on administrations 1, 2, and 3 respectively. For Item 2 she predicted 50%, 70%, and 50% on administrations 1, 2, and 3 respectively. She predicted the teachers would use the average algorithm to solve both problems on the first day of the TEACH-STAT workshop, but noted that many teachers would not understand the graphical representation in Item 1.

> I feel a lot of teachers won't understand the representation. (PCK Survey 2)
>
> I think the representation would throw off many people; however, the ones that got it used the algorithm. (PCK Survey 3)

Jane expected the participants' responses to Item 3 of the *Pedagogical Content Knowledge Questionnaire* to follow the pattern G1 ---> G2. She thought that on the first day of the TEACH-STAT workshop the teachers would use line graphs to solve the problem in Item 3 (PCK Surveys 1, 2, and 3). She predicted the teachers would use back to back stem plots on the last day of the TEACH-STAT workshop (PCK Surveys 1, 2, and 3).

Marilyn

Marilyn taught 2nd grade in 1993-94 at a parochial school. She participated in the 1993 summer TEACH-STAT workshop and the 1994 Statistics Educators Institute at the UNCG site. She had 21 years of teaching experience. Her previous experiences conducting religious workshops for parents included more than 20 workshops each of a length of 10 hours.

Effective staff development. Marilyn thought that one of the major purposes of effective staff development was to help teachers gain knowledge or skills that would be useful in the classroom to improve instruction.

> [Effective staff development is] staff development that helps us to be able to teach our students better and to work with our peers better. (Interview 1)
>
> [Through effective staff development the] individual gains knowledge or skill. (SD Survey 2)
>
> [The] individual can use all or part of [the] new material in real life--their classrooms. (SD Survey 2)
>
> I think that effective staff development is when someone wants to learn more about something, they choose to go and learn about it, and then they actually learn about what it is they're interested in. Then they go back and take bits and pieces that they feel comfortable using and [start] to implement it. (Interview 2)
>
> If you give people the experiences you want . . . their children to have, then they can draw from that. (Interview 2)

Marilyn consistently stated the importance of a connection between staff development content and classroom application, though she also thought that the content must be on an adult level.

> I'm a firm believer that when adults go to workshops, they need to learn adult things. Then they need to learn how to apply it to children things. Many of the things we do [in TEACH-STAT] are adult things. We are teaching adults new adult information. . . . That's what makes you grow professionally and makes you expand your knowledge base. Then after you've got your knowledge expanded, then you've got to learn how to choose and pick and draw [from what you've learned]. (Interview 2)

Marilyn also expressed that effective staff development could have a different purpose. When asked if staff development content must always be immediately applicable at the classroom level, she responded as follows:

> No. Sometimes I think that staff development is just professional development that . . . affirms what you have chosen to do. . . . [The message is sent that] it's good that you're a teacher. Teachers do good things. America needs teachers. . . . [The workshop presentation becomes] an affirmation of an adult choice of life. (Interview 2)

After teaching the TEACH-STAT workshop she summarized her view about the dual purposes of effective staff development. "It's important for it to be meaningful, to be able to go back and use something in my classroom or to affirm myself, . . . to affirm that what I'm doing is right and is good and I'm making a difference" (Interview 3).

Follow-up meetings provided after she participated in the TEACH-STAT workshop had also convinced Marilyn of the importance of continuing support to help teachers implement the ideas learned in workshops.

> This is the first time I've ever been part of a workshop where there were follow-up sessions throughout the year. It's the first time that one of the professors was . . . going to come and observe me. . . . Going back and talking to these teachers once a month or every other month was really wonderful. I really think that follow-up is very important. (Interview 2)

<u>Effective workshop leaders.</u> Marilyn consistently emphasized two characteristics of effective workshop leaders: (a) their knowledge of the workshop content, and (b) their ability to be sensitive to participants' needs and backgrounds. She felt it was important for the workshop leader to have knowledge of the workshop content and its connection to learning outcomes for children.

> You need to know the material that you want the children to know eventually and then you need to be able to help people that you're working with to be able to teach those children that material. (Interview 1)
>
> [The workshop leader] needs to know the material that they are going to present. (Interview 2)
>
> You need to know your material. (Interview 3)

She spoke frequently of the workshop leader's role in meeting the needs of the workshop participants.

> You need to be sensitive and aware of the needs of the people you're working with. (Interview 1)
>
> Know the needs of the participants. Realize that many ideas are new and it might take time to change opinions about new innovations. (SD Survey 1)
>
> Know the backgrounds of the people coming to listen to me. . . . I really find it comfortable if I know where they're coming from. I think that's important for me to know. (Interview 2)
>
> [Effective staff developers meet] the needs of the participants. (SD Survey 3)
>
> You have to know your audience and learn and grow with them. If you don't, then you're going to lose them. (Interview 3)

Marilyn later described these two roles of effective workshop leaders as being "part educator and part caretaker," and she considered the caretaker role as "a social type of thing" (Interview 3).

Effective TEACH-STAT workshop leaders. Marilyn expressed that as a TEACH-STAT workshop participant she had learned a lot listening to the other participants and hearing about what they'd done with TEACH-STAT activities in their classrooms (Interview 1). From these experiences she had found ways to adapt TEACH-STAT activities for her second-graders. As a TEACH-STAT workshop leader, she wanted to be sure that other teachers felt the same freedom she felt to adapt TEACH-STAT activities to their specific classroom situations.

> I think it's important to be able to know that no matter how you approach it, it's o.k. You don't have to have a mindset of what's in our textbooks, or a mindset of what one other person did, but you can use all that information and go back and be creative in your own situation. (Interview 1)

> When you go to a workshop, you have to pick and choose the things that you are comfortable doing when you go back [to your classroom]. (Interview 2)
>
> Our outcome is that you will gain more knowledge as an adult and that you will be able to go back and use parts of this that you're comfortable using and start broadening your classroom experience for your students. You do not have to go back and start teaching TEACH-STAT on the first day of school. (Interview 2)

Marilyn also predicted that she and the other workshop leaders would be successful teaching the TEACH-STAT workshop because they had tried the TEACH-STAT activities with their own students.

> We all attended the [TEACH-STAT] workshop. All of us went to the follow-up meetings throughout the [school] year. We all used the material in our classrooms, so we all gained experience. So whether or not we've ever spoken in front of adults before, we have the background to say, "When I did it with a child, this is what happened." We've got our own personal memory tapes to draw from. (Interview 2)

Concerns. Marilyn consistently expressed comfort and confidence about becoming a TEACH-STAT workshop leader because of her extensive experiences in teaching parents. "Teaching other adults is not a problem for me. . . . I can work through other people's temper tantrums" (Interview 1). Her highest concern stages at the beginning of the Statistics Educators Institute were stages 5 (collaboration) and 4 (consequence) indicating that she was most concerned about coordinating with the other nine workshop leaders to increase their impact on the workshop participants (CFSoCQ 1). Just before and after teaching the TEACH-STAT workshop, her highest concern stage was stage 5 (collaboration) indicating that she was still most concerned about coordination with the other TEACH-STAT workshop leaders (CFSoCQ 2 and 3).

Teaching adults vs. teaching children. Marilyn expressed in several ways that teaching adults was different than teaching children.

> Often we are the first people to teach the new skill/concept with children. Often we have to convince adults that what we are teaching has merit. (SD Survey 1)
>
> The discipline problem isn't a factor [when teaching adults]. (SD Survey 1)
>
> Children have fewer pre-set notions and aren't as set in their ways and opinions. (SD Survey 2)
>
> There are going to be some people [in the workshop] who are going to be whiney and you've got to take care of them. You can't take care of them in the same way that you take care of a child who's whiney. (Interview 2)

Marilyn's comments indicated that she believes working with adults requires somewhat different approaches than working with children, but she wasn't certain that specific approaches could be learned prior to teaching the workshop. "I don't think you can learn this stuff ahead of time; it's part of the process" (Interview 3).

Pedagogical content knowledge. Marilyn consistently predicted that 90% of the teachers who would participate in the TEACH-STAT workshop would be able to correctly answer the questions in Items 1 and 2 of the *Pedagogical Content Knowledge Questionnaire* on the first day of the workshop (PCK Surveys 1, 2, and 3). She predicted they would use the average algorithm to solve the problem.

At the beginning of the Statistics Educators Institute, Marilyn predicted that teachers would use bar graphs on both the first and last days of the TEACH-STAT workshop to solve the problem in Item 3 (PCK Survey 1). This expectation of the teachers who would attend the TEACH-STAT workshop could be characterized by a pattern of no change (G1 ---> G1), but she added that "on the last day they would understand more information about the representation they made and would be able to make better comparisons" (PCK Survey 1).

Just before and after she taught the TEACH-STAT workshop, however, Marilyn predicted that teachers would use line plots or bar graphs on the first day of the workshop and stem and leaf or box plots on the last day of the workshop to solve the problem in

Item 3 (PCK Surveys 2 and 3). "They probably wouldn't know about stem and leaf and/or box plots on day 1" (PCK Survey 2). This expectation can be characterized by a pattern of change (G1 ---> G2) from traditional to expanded graphing strategies.

Barb

Barb was a first-grade teacher in 1993-94 with 14 years of teaching experience. She had participated in the 1992 TEACH-STAT workshop, and thus was a member of cohort one. She participated in the 1994 Statistics Educators Institute at the UNCCH site. She indicated previously conducting workshops of various lengths (1-6 hours) on whole language, the writing process, math manipulatives, and TEACH-STAT.

Effective staff development. One of the most important characteristics of effective staff development for Barb was that workshop content be "meaningful and relevant" to the participants (SD Surveys 1, 2, and 3; Interviews 1, 2, and 3). She also thought workshop content should be adaptable to an individual teacher's style (SD Survey 1) and should "provide a strong base of the 'whys' or theory upon which to build new knowledge" (SD Survey 2).

> [Effective staff development needs to be] meaningful--something that I can really take and apply, something that causes me to think and question what I'm currently doing. . . . Sometimes it can simply verify the effectiveness of what I'm doing also, but that's not quite enough. It needs to move beyond that in some way and help me grow professionally. It doesn't matter how long [the staff development] is and it doesn't matter how many handouts I receive. It doesn't matter how important the person is who is doing the speaking. . . I do believe that some of the most effective workshops and seminars that I have attended have been taught by teachers. (Interview 1)

Barb's experiences with study groups at her school during the 1993-94 school year convinced her that effective staff development could be provided through models other than the workshop model. The study groups had been initiated by her school principal and had been well received at her school. Barb stated that she thought her principal "knew that this was a safer route for people to express how they feel and to listen to each other" (Interview 2).

> It was really neat to see rooms with pockets of teachers all clustered together talking and discussing and laughing and getting to know each other better in a very professional way. (Interview 2)

Barb described a study group that she had facilitated in which teachers "brought in their favorite pieces of children's literature and read them to each other and then talked about why they were our favorites" (Interview 2).

> We learned so much about each other, and these were teachers I probably wouldn't have come into contact with much at all except through this study group idea. . . . To me, that's real staff development. (Interview 2)

To Barb, the effectiveness of the study group model was grounded in the opportunities it provided for teachers to share and discuss ideas with one another.

> Teaching is very isolated. . . . And then you're very very busy. If you're doing what you're supposed to be doing, you're too busy to talk to anyone else during the day. I think that providing opportunities for discourse between teachers is very important. That's vital; it's a real lifeline. (Interview 2)

After teaching the two-week summer TEACH-STAT workshop, Barb noticed the importance of allowing ample time in workshops for participants to develop their thinking.

> [Delivering staff development] after a school day [is] not as effective as a whole day or half day with a fresh beginning. (SD Survey 3)
>
> About the third or fourth day [of the TEACH-STAT workshop] you could really see [the investigation process] start to take hold. That just verified for me how important it is for some staff development programs to give [teachers] time. It shouldn't be a two-and-a-half hour rah rah. It needs to

> be ongoing staff development in some way, be it weekly . . . or daily. You really get the whole picture then. (Interview 3)

Barb also began describing the experiential nature of effective staff development after teaching the TEACH-STAT workshop. She was preparing to teach a writing workshop the following week and was thinking about a new approach.

> I'm taking some of the TEACH-STAT ideas and working them into the writing process because I feel it's so important for the participants to be interactive. It shouldn't be me up at the overhead projector showing them examples of children's writing. It needs to be them doing some writing and experiencing some research. . . . Instead of giving them a lot of make-it/take-it ideas to go back with, I want them to experience writing themselves, and then think about their children. I don't know how that's going to work; it's a different approach, but it's more or less centered on the TEACH-STAT approach. (Interview 3)

Her summary of this approach was that the workshop participants would "experience it as learners themselves" and "learn some new things" (Interview 3). Over the life of the project, Barb's ideas about effective staff development seemed to become more focused on the importance of the participants as learners.

Effective workshop leaders. Barb expressed that the most effective workshop leaders know their material very well and can sense the needs of their participants.

> I need to have a thorough knowledge of what I am teaching. (Interview 1)
>
> First and foremost I really need to know what I'm doing and I need to know my material. Secondly, I need to know how to feel the crowd. . . . [That means] getting a sense of their needs and making sure that all along their needs are being heard and that we don't just . . . stick to the lesson plans like glue. . . . We have to make sure we provide plenty of opportunities for them to speak and to talk and to question and to discuss, and for them to make contacts with other people. (Interview 2)
>
> [Effective workshop leaders are characterized by] knowing what you're doing and thinking always about the people you're doing it for or with because their needs may be different than another group's. . . . I think that it's important to take [people] where they are and move from there, just as in teaching in the classroom. (Interview 3)

The two characteristics of knowing the workshop content and attending to the needs of the participants consistently appeared in Barb's descriptions of effective workshop leaders.

Effective TEACH-STAT workshop leaders. As a member of a team of Statistics Educators conducting the summer TEACH-STAT workshop, Barb repeatedly emphasized her role in supporting the other workshop leaders on her team.

> In the TEACH-STAT program we're teaching with a team approach. We're taking different areas of the TEACH-STAT curriculum and working with [them]. . . . It's also my responsibility to know what my co-facilitators are going to be presenting because I need to be there to support them. (Interview 1)
>
> I have just spent this weekend . . . really going over with a fine-tooth comb what's going to happen in the next two weeks. [I need to know] not only what I have to present but what my fellow facilitators are going to be presenting because I need to be there to support them. (Interview 2)

Barb also wanted the TEACH-STAT participants to enjoy a supportive climate.

> We have 22 people enrolled [in the summer TEACH-STAT workshop], and they're from all over. What a great experience for them because they're going to be able to call each other up, and that's the kind of feeling we want to have them leave with--that they have made some valuable personal and professional friends. They can get support from one another and from us, but mostly from each other. (Interview 2)

After the experience of teaching the summer workshop, Barb reinforced the importance of TEACH-STAT workshop leaders knowing their content well enough to be able to adjust to meet participants' needs.

> You can't lock yourself into your agenda. You need to be flexible and you need to go where they take you. . . . That's why you need to have a very good base of core knowledge, because you can go in many different routes with the same knowledge. . . . Know what you want to teach, and there are a multitude of ways to teach it. (Interview 3)

Concerns. At the beginning of the Statistics Educators Institute Barb expressed that she was comfortable working with teachers, but also wanted to learn how to become more effective in her presentations.

> What I would like to really get much better at is shaking off some of the jitters, especially those first days being in front of 24 people, and wanting to make it very worth their while. I wish I were more at ease with it, but of course, that tends to happen once you're up there for a little while. (Interview 1)

Just before teaching the TEACH-STAT workshop she expressed again that she was comfortable teaching teachers, and she attributed her comfort to the fact that the TEACH-STAT workshop activities had been tested and tried.

> I'm very comfortable [teaching teachers]. When I was [in another school system] I conducted a lot of different workshops. TEACH-STAT has given me a lot of self-confidence, more so than I had before because before I conducted workshops using a lot of my own ideas. Now I'm doing something tried and true and tested and supported by whole groups of people. . . . It's really fun to be part of this innovative process. (Interview 2)

The highest concern stage for Barb on the CFSoCQ at the beginning of the Statistics Educators Institute was stage 0 (awareness), indicating that she was most concerned about issues unrelated to her role as a TEACH-STAT change facilitator. Just before and after teaching the TEACH-STAT workshop her highest concern stage was stage 5 (collaboration) indicating that she was most concerned about coordinating with other TEACH-STAT workshop leaders (CFSoCQ 2 and 3).

Teaching adults vs. teaching children. At the beginning of the Statistics Educators Institute Barb indicated a difference between teaching adults and children. The differences she described were children's need for management structures and adults' need for relevance.

> Adults may not need the formal structures in regard to management (lines, etc.) and they seek out relevancy of material to their lives/profession. (SD Survey 1)

After the experience of teaching the two-week summer TEACH-STAT workshop, however, Barb expressed that there may not be such apparent differences.

> The more I consider this question, the more I think that there are not glaringly apparent differences. Both children and adults bring many life experiences to the classroom which in turn makes them assets to their peers. New knowledge is built upon previously learned [knowledge] in both cases. Content needs to be integrated into [both] their lives. Adults may be more self-directed, but not necessarily so for all! (SD Survey 3)

> I learned a little more than I knew before about presenting to adults--little things like comfort levels and security and even basic things like wait time. (Interview 3)

Pedagogical content knowledge. Barb's predictions about the percentage of teachers she thought would be able to answer the question in Items 1 and 2 of the *Pedagogical Content Knowledge Questionnaire* correctly on the first day of the TEACH-STAT workshop varied. She predicted for both items that the percentage would be 70%, 50%, and 90% on administrations 1, 2, and 3 respectively. The process she expected the teachers to use was the average algorithm (PCK Surveys 1, 2, and 3).

On Item 3 she predicted the teachers would use a bar graph representation on the first day of the workshop and a stem and leaf representation on the last day (PCK Surveys 1 and 2). Commenting on the similarities or differences in her predictions, Barb stated, "[The stem and leaf plot] shows individual data; [the bar graph] groups data and individual scores do not show" (PCK Survey 1). "[The teachers would] more efficiently organize their data [on the last day]" (PCK Survey 2). The pattern of change she expected to observe in the TEACH-STAT participants was one of changing from traditional graphing strategies to expanded graphing strategies (G1 ---> G2).

After the experience of teaching the two-week summer TEACH-STAT workshop, Barb predicted a different pattern of change. She expected the teachers to use the average algorithm on the first day of the workshop to answer Item 3 and to use a stem and leaf representation on the last day (PCK Survey 3). Her description could be characterized by a pattern of change from algorithmic procedure to expanded graphing strategies (N1 ---> G2).

Summary of Case Studies

The individual stories profiled in these four case studies allow a glimpse into the effects of teachers' becoming workshop leaders. Those with prior experience teaching workshops (Jane, Marilyn, and Barb) emphasized that effective staff development should help participants expand their knowledge or skills--in other words, to experience learning. Ellen, who had no previous experience teaching workshops, never mentioned the importance of participants' learning. She viewed effective staff development as a collection of activities that could be used immediately in her classroom. Perhaps this view influenced her thinking about a workshop process she valued as a participant--being able to practice the activities with other teachers. Ellen also preferred workshops that moved along at a brisk pace.

Other workshop processes were valued by the teachers. Actively involving participants in the workshop, providing opportunities for discourse, sharing examples of student work, and providing follow-up and support were considered important. Marilyn and Barb, the two teachers with the most classroom teaching experience (21 and 14 years, respectively) and both teachers of primary grades, also thought that workshop content should be presented in such a way that participants feel free to adapt the ideas to their individual teaching situations. Barb discussed another staff development model (school-based study groups) that she had found to be effective.

All four teachers indicated that effective workshop leaders must possess two important characteristics: (a) They know the workshop content extremely well, and (b) they are sensitive to and value the prior knowledge, different experiences, and various needs of the workshop participants. Marilyn described these two characteristics as "educator" and "caretaker" functions.

Ellen, Jane, and Marilyn (all from the UNCG site) expressed confidence that trying the TEACH-STAT activities with their students would help them be successful as TEACH-STAT workshop leaders. Barb wanted to know the TEACH-STAT content well enough to be able to support the other workshop leaders at her site. Both Ellen and Jane (the two fifth-grade teachers) discussed the importance of developing effective questioning skills as a TEACH-STAT workshop leader. Both felt they needed to learn more about questioning skills. Neither Marilyn or Barb mentioned questioning skills as a characteristic of an effective TEACH-STAT workshop leader.

All four teachers expressed confidence in their comfort level toward teaching teachers. Their highest concern score on the *Change Facilitator Stages of Concerns Questionnaire* was stage 5 (collaboration) indicating they were most concerned about coordinating with the other workshop leaders at their site.

Though Ellen and Marilyn said teaching adults was different from teaching children, and Jane said teaching adults was not much different from teaching children, all three stated that adults are less open-minded than children. Jane was the only person who mentioned that it is sometimes harder to keep adults on task. Barb stated after teaching the TEACH-STAT workshop that the differences between teaching adults and children weren't so apparent. She noted that both adults and children bring valuable life experiences to the learning situation, both build new knowledge on existing knowledge, and both need content that is relevant to their lives.

The teachers' predictions about the percentage of teachers who would be able to correctly answer the question in Items 1 and 2 of the *Pedagogical Content Knowledge Questionnaire* were mixed. Ellen thought the line plot representation in Item 2 would be difficult for the teachers on the first day of the workshop. Jane thought that the representation in Item 1 would be more difficult for the teachers on the first day of the workshop. All four thought that the teachers would use the average algorithm on the first day to solve the problem in Items 1 and 2. Their predictions for how the workshop participants would solve Item 3 on the first and then the last day of the TEACH-STAT workshop could generally be described by one of two change patterns: (a) N1 --> G2, or (b) G1 --> G2. Both patterns indicate that the teachers expected the participants to use expanded graphing representations at the end of the TEACH-STAT workshop.

CHAPTER V

CONCLUSIONS

Overview of Study

Methodology

The purpose of this study was to investigate the effects of classroom teachers becoming TEACH-STAT workshop leaders. The TEACH-STAT project was a professional development program designed to improve mathematics instruction by preparing teachers in North Carolina to teach statistical concepts to children in grades K-6. Four research questions framed the investigation: (a) How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' conceptions of effective staff development? (b) How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' conceptions about teaching adults (as opposed to teaching children)? (c) How does becoming a TEACH-STAT workshop leader affect the pedagogical content knowledge of the Statistics Educators? and (d) How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' concerns about the workshop content/innovation and their roles as change facilitators?

The subjects for the study were 45 elementary classroom teachers who participated in Statistics Educators Institutes (SEIs) at five university sites in North Carolina during the spring and summer of 1994. The goal of the five-day SEIs was to prepare teachers to become TEACH-STAT workshop leaders. The SEI sessions included content on adult learning, the change process, and statistics pedagogical content knowledge. Time was also provided for guided working sessions for these teacher-leaders to plan collaboratively to conduct two-week 1994 TEACH-STAT summer workshops.

Three survey instruments (*Staff Development Style Inventory*, *Pedagogical Content Knowledge Questionnaire*, and *Change Facilitator Stages of Concern Questionnaire*; described in Chapter III) were used to collect data about the teachers' conceptions of effective staff development and teaching adults, the teachers' pedagogical content knowledge, and the teachers' concerns about TEACH-STAT and their roles as change facilitators. Each of the 45 subjects completed all survey instruments at three points in time: (a) at the beginning of the Statistics Educators Institute, (b) at the conclusion of the Statistics Educators Institute, and (c) after teaching the two-week 1994 summer TEACH-STAT workshop. Interviews conducted with some of the participants at the same three points in time provided additional information for four case studies.

Survey Results

On the *Staff Development Style Inventory* no significant differences were found for the items across the three adminstrations. The only exception was one item (of 25) at the UNCC site. Post hoc analysis of the interquartile range for each item was performed to gain a clearer picture of typical responses for each item on the inventory.

Three open-ended items on the *Staff Development Style Inventory* provided additional information about the teachers' conceptions of effective staff development and teaching adults. The category of effective staff development coded most frequently on all three administrations was *classroom relevance and usability*. The category of effective classroom teaching coded most frequently on all three administrations was *activities that involve students (hands-on)*. On administration 1, *variety of instructional approaches/materials used* was coded as frequently as *activities that involve students* as a characteristic of effective classroom teaching. On the third open-ended item, participants described the major differences between teaching children and teaching adults. On administration 1, the category coded most frequently was *not much or no difference* between teaching children and teaching adults. On administrations 2 and 3 the category coded most frequently was *adults are harder to discipline, control, and keep on task than children.*

No significant differences were found across the three administrations for two items on the *Pedagogical Content Knowledge Questionnaire*. Overall, the median prediction for the total group ($N = 45$) was that 70% of the elementary teachers attending a TEACH-STAT workshop on the first day would correctly answer the question in Item 1 and 50% would correctly answer the question in Item 2. When asked to predict the process they expected the teachers to use on the first day of the workshop to solve the problems in Items 1 and 2, the response coded most frequently for all three administrations was average as algorithm. Analysis of Item 3 revealed that the Statistics Educators expected the TEACH-STAT workshop participants primarily to use algorithmic procedures to solve the problem at the beginning of the workshop. They expected the participants primarily to use expanded graphing strategies and expanded numerical representations on the last day of the TEACH-STAT workshop.

Most participants held highest concerns at stages 0 (awareness) and 5 (collaboration) on administration 1 of the *Change Facilitator Stages of Concern Questionnaire*. Most participants held highest concerns at stages 0 (awareness), 2 (personal), and 5 (collaboration) on administration 2. Most participants held highest concerns at stages 0 (awareness) and 5 (collaboration) on administration 3.

Case Study Results

Four case studies allowed a more in-depth look into the effects of individual teachers becoming TEACH-STAT workshop leaders. Ellen was a fifth-grade teacher with five years of teaching experience. Ellen participated in the 1993 TEACH-STAT workshop at UNCG and had no prior experience teaching workshops. Jane was a fifth-grade teacher at the same school as Ellen. She also had five years of teaching experience. She participated in the 1992 TEACH-STAT workshop and had taught several workshops on TEACH-STAT topics. Marilyn was a second-grade teacher at a parochial school. She had 21 years of teaching experience and had taught numerous adult religious classes. Marilyn participated in the 1993 TEACH-STAT workshop at the UNCG site. Barb taught first grade and had 14 years of teaching experience. She had taught several workshops on various topics, including TEACH-STAT. She participated in the 1992 TEACH-STAT workshop at UNCCH.

Those with prior experience teaching workshops (Jane, Marilyn, and Barb) emphasized that effective staff development should help participants expand their knowledge or skills--in other words, to experience learning. Ellen, who had no previous experience teaching workshops, never mentioned the importance of participants' learning. She viewed effective staff development as a collection of activities that could be used immediately in her classroom. Perhaps this view influenced her thinking about a workshop process she valued highly as a participant--being able to practice the activities with other teachers. Ellen also preferred workshops that moved along at a brisk pace.

Other workshop processes were valued by the teachers. Actively involving participants in the workshop, providing opportunities for discourse, sharing examples of student work, and providing follow-up and support were considered important. Marilyn and Barb, the two teachers with the most classroom teaching experience (21 and 14 years, respectively) and both teachers of primary grades, also thought that workshop content should be presented in such a way that participants feel free to adapt the ideas to their individual teaching situations. Barb discussed another staff development model (school-based study groups) that she had found to be effective.

All four teachers indicated that effective workshop leaders must possess two important characteristics: (a) They know the workshop content extremely well, and (b) they are sensitive to and value the prior knowledge, different experiences, and various needs of the workshop participants. Marilyn described these two characteristics as "educator" and "caretaker" functions.

Ellen, Jane, and Marilyn (all from the UNCG site) expressed confidence that trying the TEACH-STAT activities with their students would help them be successful as TEACH-STAT workshop leaders. Barb wanted to know the TEACH-STAT content well enough to be able to support the other workshop leaders at her site. Both Ellen and Jane (the two fifth-grade teachers) discussed the importance of developing effective questioning skills as a TEACH-STAT workshop leader. Both felt they needed to learn more about questioning skills. Neither Marilyn or Barb mentioned questioning skills as a characteristic of an effective TEACH-STAT workshop leader.

All four teachers expressed confidence in their comfort level toward teaching teachers. Their highest concern score on the *Change Facilitator Stages of Concern Questionnaire* was stage 5 (collaboration) indicating they were most concerned about coordinating with the other workshop leaders at their site.

Though Ellen and Marilyn said teaching adults was different from teaching children, and Jane said teaching adults was not much different from teaching children, all three stated that adults are less open-minded than children. Jane was the only person who mentioned that it is sometimes harder to keep adults on task. Barb stated after teaching the TEACH-STAT workshop that the differences between teaching adults and children weren't so apparent. She noted that both adults and children bring valuable life experiences to the learning situation, both build new knowledge on existing knowledge, and both need content that is relevant to their lives.

The teachers' predictions about the percentage of teachers who would be able to correctly answer the question in Items 1 and 2 of the *Pedagogical Content Knowledge Questionnaire* were mixed. Ellen thought the line plot representation in Item 2 would be difficult for the teachers on the first day of the workshop. Jane thought that the representation in Item 1 would be more difficult for the teachers on the first day of the workshop. All four thought that the teachers would use the average algorithm on the first day to solve the problem in Items 1 and 2. Their predictions for how the workshop participants would solve Item 3 on the first and then the last day of the TEACH-STAT workshop could generally be described by one of two change patterns: (a) N1 --> G2, or (b) G1 --> G2. Both patterns indicate that the teachers expected the participants to use expanded graphing representations at the end of the TEACH-STAT workshop.

Limitations

The results of this study and accompanying discussion and conclusions should be viewed in light of several limitations. Only five of the nine Statistics Educators Institute sites were represented in the data analysis. There was no assurance that the Statistics Educators Institutes were conducted in a completely consistent manner across the five sites. Even though curriculum modules were provided for the Statistics Educators Institutes, it is likely that the university faculty at the five sites placed different emphases on various aspects of the curriculum.

The sample size was small ($N = 45$) and all of the subjects were elementary teachers. Virtually all subjects were white females; there was one white male and one black female among the 45 participants. The participants were involved in staff development with a specific focus on statistics. Many of the Statistics Educators (36 of 45) had previously taught workshops, and several (19 of 45) indicated having previously taught statistics or TEACH-STAT topics in workshops.

Instrumentation limitations should also be noted. The *Staff Development Style Inventory* and the *Pedagogical Content Knowledge Questionnaire* were not field-tested with elementary classroom teachers. Analysis of the open-ended responses for the *Staff Development Style Inventory* (Items 26-28) resulted in categories of responses. Analyses by others may have resulted in different categories of responses.

Discussion

Research Question #1

Research question #1 was: How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' conceptions of effective staff development? Overall, there were no significant differences across administrations for any of the 25 items in Parts I and II of the *Staff Development Style Inventory* for the entire group ($N = 45$). These results indicate that the teachers did not change their views of effective staff development as measured by these items while they were involved in the process of becoming a TEACH-STAT workshop leader. One possible explanation for these results may be that their prior experiences as workshop participants or as workshop leaders had influenced their conceptions of effective staff development. Only nine of the participants reported that they had never taught any workshops before, and 19 participants reported having previously taught TEACH-STAT or statistics topics in workshops. A second possible explanation for these results may be that the data collection instrument was not sensitive enough to reflect subtle changes in the teachers' conceptions of effective staff development. A third possibility is that the teachers really do know what effective staff development should be like.

The post hoc analysis of the interquartile range for each item allowed a view of typical responses for each item. The items in Part I (Items 1-17) were Likert-style items with descriptions on each end of a five-point scale. Interquartile ranges clustered at one end (1-2) or the other (4-5) of the five-point scale could be interpreted as indicative that the group believed the description on that end of the scale was characteristic of the most effective mathematics workshops. The interquartile ranges were clustered at one end (1-2) or the other (4-5) for 12 of the 17 items in Part I, providing a description of the participants' conceptions of effective mathematics workshops.

Item 2.	Participants frequently work together on activities.
Item 3.	When learning about a math concept, participants mainly spend time investigating big problems.
Item 4.	Workshop leaders encourage participants to investigate problems in a variety of ways.
Item 6.	When workshop participants have trouble, the workshop leader asks them leading questions.
Item 7.	When teaching a new topic, workshop leaders spend a lot of time helping participants see similarities and differences between new and previously learned ideas.
Item 8.	Workshop leaders regularly change their instructional approach (e.g., lecture, discussion, discovery, etc.).
Item 9.	Almost all questions posed by the workshop leader require the participants to give explanations.
Item 10.	Workshop tasks and assignments allow participants to make individual adaptations.
Item 11.	Workshop content is provided through the context of challenging problems or real-life situations.
Item 14.	Workshop leaders help participants develop theoretical understanding of new strategies or content.
Item 15.	Opportunities are provided to practice new skills in the workshop setting.
Item 17.	The goals of the workshop are clearly communicated.

All of the items in this list except Items 14, 15, and 17 were items that were directly adapted from the *Mathematics Teaching Style Inventory* (Madsen et al., 1991).

Items 14 and 15 represented two components of the training model of staff development (Showers, Joyce, & Bennett, 1987) and Item 17 was supported by Korinek et al.'s (1985) study of best staff development practices.

As a collection, the descriptors are consistent with a conceptual approach (as opposed to a procedural approach) to mathematics instruction such as that called for in the *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989). That is, they reflect a view of mathematics workshop instruction that is characterized by participants frequently working together to investigate "big" problems. The workshop participants are encouraged to solve problems in a variety of ways and to provide explanations for their solutions. The content of the mathematics workshops is provided through problem-solving contexts and workshop leaders explicitly help participants identify the connections between new ideas and prior knowledge. When participants have difficulty understanding a concept, workshop leaders use effective questioning skills rather than telling participants about the concept. Workshop leaders also use a variety of instructional approaches and allow for individual adaptations. These approaches to instruction--emphasizing teaching for understanding and actively engaging learners in solving problems, reasoning, communicating, and connecting ideas--are the same as those advocated by NCTM (1989) for students.

The participants in this study were involved in becoming workshop leaders in TEACH-STAT, where the goals of staff development were to affect teachers' content and pedagogical content knowledge about teaching statistics concepts. It is reasonable to assume that these participants interpreted the goals of mathematics workshops in general to be to affect teachers' content and pedagogical content knowledge about teaching mathematics concepts. The goal of instruction described by NCTM (1989) is learning mathematics content. Hence, the consistency between the instructional approaches advocated by NCTM and those perceived by the teachers in this study to be effective in mathematics workshops may be related to similar instructional goals. However, whether or not these instructional approaches would be perceived by teachers also to be effective when the goal of instruction is in another domain of knowledge (e.g., knowledge of learners) remains open for investigation.

The interquartile range for five items included the center (3) of the five-point scale. This may be interpreted as uncertainty as to which descriptor was characteristic of the most effective mathematics workshops or as an indication that in the most effective mathematics workshops there should be a balance between the two descriptors on the endpoints of the scale.

Item 1.	Almost always many different activities are going on simultaneously during the workshop. Almost always the participants are all engaged in the same activity during the workshop.
Item 5.	Almost all help is initiated by workshop participants asking for it. Almost all help is initiated by the workshop leader seeing the need for it.
Item 12.	New topics are developed through examples and demonstrations. New topics are developed through experiences with problem-solving.
Item 13.	Workshop content is presented in ways that are relevant mainly to participants' classrooms. Workshop content is presented in ways that are relevant mainly to participants' learning.
Item 16.	The workshop leader and the participants cooperatively determine the learning process. Workshop leaders determine the learning process.

Of these five items, Items 1, 5, and 12 were adapted directly from the *Mathematics Teaching Style Inventory* (Madsen et al., 1991). Those three items were designed to elicit teachers' thinking about instructional practices in mathematics classrooms. The descriptors were developed to suggest conceptual/nontraditional vs. procedural/traditional approaches to instruction. When these items were adapted for mathematics workshops, the expected responses were not clear. One interpretation of these results is that for the most effective mathematics workshops: (a) Sometimes there are different activities going on simultaneously and sometimes the participants are all engaged in the same activity (Item 1); (b) sometimes help is initiated by the participants asking for it and sometimes the workshop leader sees the need for it (Item 5); and (c) sometimes new topics are developed through examples and demonstrations and sometimes through problem-solving experiences (Item 12).

Item 13 was constructed to reflect recommendations from the knowledge base on adult learning that adults need to perceive that what is being learned is relevant and useful in their professional settings (Nowak, 1994; Wood & Thompson, 1993). One interpretation of the results is that the teachers thought that in the most effective mathematics workshops the content is presented in ways that are relevant sometimes to the participants' classrooms and sometimes to their learning.

Item 16 reflected involving learners in the planning process and was based on Knowles' (1984a) model of adult learning. The interquartile ranges for this item were 1-3, 1-2, and 1-3 on administrations 1, 2, and 3 respectively. The median was 2 on all three administrations. Even though the interquartile range for this item included the center of the scale, the analysis of this item indicated strong leanings toward one end of the scale (unlike Items 1, 5, 12 and 13). The results suggest that most teachers thought the workshop leader and the participants should cooperatively determine the learning process in the most effective mathematics workshops. Perhaps the Statistics Educators

Institute experience of preparing to be a TEACH-STAT workshop leader, however, influenced some teachers to perceive that it was their role as a workshop leader to determine the workshop processes.

Results from the analysis of the items in Part II of the *Staff Development Style Inventory* (Items 18-25) indicated that the teachers believed that in the most effective mathematics workshops the following strategies are used very frequently or frequently: (a) posing open-ended problems, (b) gathering and organizing participant responses, (c) encouraging analysis and generalization, (d) small group investigations, and (e) using concrete manipulatives. They believed that these strategies are used frequently or sometimes: (a) whole group instruction, (b) whole group discussion, and (c) using technology.

Posing open-ended problems, small group investigations, and using concrete manipulatives are strategies characteristic of constructivist principles like those advocated in the SummerMath for Teachers professional development program (Schifter & Fosnot, 1993). Gathering and organizing participant responses and encouraging analysis and generalization are strategies characteristic of the statistical investigation processes advocated in the TEACH-STAT curriculum. The teachers in this study felt that these strategies should be used at least somewhat more frequently than whole group instruction and discussion or technology in the most effective mathematics workshops. The strategies that the teachers felt should be used most frequently are consistent with the conceptual approach to instruction indicated by the results of Items 1-17.

An open-ended item (Item 26) allowed the participants to list up to three characteristics that they considered most important for effective staff development. The category of responses coded most often on all three administrations was *classroom relevance and usability*. The number (percentage) of participants giving responses coded in this category was 26 (58%), 22 (49%), and 19 (42%) for administrations 1, 2, and 3 respectively.

The appearance of relevance as an important characteristic of effective staff development should not be surprising. It is consistent with adult learning theory which observes that adults are pragmatic learners who need to perceive that what is to be learned is relevant and useful in their professional settings (Nowak, 1994; Wood & Thompson, 1993). It is also consistent with results of prior studies designed to determine teachers' perceptions of effective staff development (Holly, 1982; McBride, Reed, & Dollar, 1994).

The number of participants writing responses in most categories across all three administrations remained relatively stable, with responses in some categories slightly declining, partly due to the fact that on administration 3 three participants (7%) wrote no response. In one category, however, there was a notable increase after the first administration. The number (percentage) of participants who gave responses coded in the category *climate conducive to learning* was 3 (7%), 12 (27%), and 12 (27%) for administrations 1 through 3, respectively. It seems reasonable to conclude that the Statistics Educators Institute had an affect on raising the consciousness of some Statistics Educators about the importance of providing a climate conducive to learning when conducting mathematics workshops for teachers.

Five other categories showed increases in the frequency of coded responses after administration 1, though the number of participants was relatively small. These categories, along with the number (percentage) of participants with coded responses in each category on administrations 1 through 3, respectively, were: (a) *staff developer's subject matter knowledge* (9 [20%], 11 [24%], and 11 [24%]); (b) *meets participants' needs; participant gains knowledge/skill* (6 [13%], 8 [18%], and 10 [22%]); (c) *opportunities for participants to solve problems, discuss, think, process, share ideas,* *work in groups* (5 [11%], 7 [16%], and 8 [18%]); (d) *enthusiasm/confidence of staff developer* (3 [7%], 8 [18%], and 5 [11%]); and (e) *staff developer's presentation skills* (2 [4%], 4 [9%], and 4 [9%]).

Reorganizing the response categories into clusters allows speculation about teachers' conceptions of effective staff development. Three conceptually-linked clusters of categories that could be considered are organized around conceptions of staff development as sharing the wisdom of practice, as managing the workshop environment, and as facilitating learning.

I. Staff Development as Sharing the Wisdom of Practice
   - Category A: Relevance

II. Staff Development as Managing the Workshop Environment
   - Category F: Preparation/organization of staff developer
   - Category J: Pacing/good use of time
   - Category K: Activities that involve participants (hands-on)
   - Category L: Variety of instructional approaches/materials used

III. Staff Development as Facilitating Learning
   - Category E: Meets participants' needs; participant gains knowledge/skill
   - Category H: Staff developer's presentation skills
   - Category I: Staff developer's subject matter knowledge
   - Category M: Opportunities for participants to solve problems, discuss, think, process, share ideas, work in groups
   - Category O: Climate conducive to learning

Conception I could be described as a theoretical view of effective staff development as sharing the wisdom of practice. This view seems to manifest itself in an expressed immediate need for staff development to be relevant and useful. Teachers who share this conception of staff development often expect staff development to provide them with practical activities that they can easily implement in their own classrooms. In this conception of staff development classroom teachers are often seen as the best staff developers because of the pragmatic considerations they bring to the staff development setting. They can share real examples of student work and speak from personal classroom experience. From a workshop leader's perspective, having this conception of staff development may be related to a desire to be viewed as successful by providing for teachers' expressed needs for relevancy. Positive feedback from workshop participants who are pleased that they have received ideas that are usable in their classrooms is one measure of the workshop leader's effectiveness.

Conception II is characterized by a focus on the tasks of effective staff development. That is, the focus is on managing the workshop environment. In this view of effective staff development, workshop leaders are responsible for being well-organized, planning a variety of activities that involve participants, and effectively managing the staff development time. Workshop participants are expected to become engaged in the staff development activities, but not necessarily to build deep understandings.

Conception III is related to learning outcomes for staff development. Effective staff development in this conception is viewed as facilitating learning. The workshop leader's role is to select challenging tasks that allow learners to construct meaning and to provide a supportive climate for learning. Such tasks offer opportunities for participants to solve problems, discuss, think, process, and work in groups. The staff developer's subject matter knowledge and presentation skills are critical attributes needed for orchestrating discourse within the staff development setting. Participants are expected to reflect upon, analyze, and evaluate their own learning. Participants are also invited and encouraged to consider adaptations of the staff development content to fit the specific context of their classroom settings. Staff development in this conception requires adequate time for participants to struggle with ideas and deepen understandings.

These three theoretical conceptions seem to parallel the teacher concerns identified by Fuller (1969). Fuller found that with increasing experience and maturity, teachers' concerns moved through a predictable pattern from concerns about self to concerns about task and finally to concerns about their perceived impact on others. From a workshop leader's perspective, Conception I is related to concerns about what the participants will *like* and whether the participants will view the workshop leader as credible and successful (self). Conception II is related to concerns about planning what the participants will *do* (tasks). Conception III is related to concerns about what the participants will *learn* (impact). These three conceptions are also similar to the stages of development identified by Killion (1988) for those who assume roles as staff development trainers.

Six of the response categories for Item 26 were not included in the conceptual clusters. Categories B (interesting topic), C (clear goals/objectives), D (assessment of goals/objectives), and N (follow-up) are characteristics of all three conceptions. These categories also had a relatively small number of coded responses. Category G (enthusiasm/confidence of staff developer) was ambiguous and seemed to straddle Conceptions II (enthusiasm) and III (confidence). Category P (other) was also not included.

The frequencies of coded responses for all three administrations in the conceptual cluster categories are displayed in Figure 19. There is evidence in these response frequencies that the Statistics Educators were beginning to shift their conceptions of effective staff development toward Conception III. The frequencies of responses in the Conception I and II clusters declined across the three administrations while those in Conception III increased.

Figure 19. Frequencies of responses by category from Item 26 (characteristics of effective staff development) organized by conceptual clusters.

	Adm. 1	Adm. 2	Adm. 3
Conception I: Staff Development as Sharing the Wisdom of Practice			
A. Relevance	26	22	19
Conception II: Staff Development as Managing the Workshop Environment			
F. Preparation/organization of staff developer	10	8	7
J. Pacing/good use of time	7	7	4
K. Activities that involve participants (hands-on)	19	19	15
L. Variety of instructional approaches/materials used	8	4	5
Conception III: Staff Development as Facilitating Learning			
E. Meets participants' needs; participant gains knowledge/skills	6	8	10
H. Staff developer's presentation skills	2	4	4
I. Staff developer's subject matter knowledge	9	11	11
M. Opportunities for participants to solve problems, discuss, think, process, share ideas, work in groups	5	7	8
O. Climate conducive to learning	3	12	12

The case studies provided further insight into the Statistics Educators' shifting conceptions of effective staff development. Ellen, who had no previous experience teaching workshops, gave responses on administrations 1 (categories A, J, K) and 2 (categories A, K) that fell into Conception I and II clusters. She viewed effective staff development as sharing useful activities that could be easily implemented in the classroom, thought it important for the workshop leader to have tried the activities with students, and wanted the workshop to move along at a brisk pace. Only after the experience of teaching the TEACH-STAT workshop did Ellen note the importance of the workshop leader's knowledge as a characteristic of effective staff development. Her responses on the third administration encompassed aspects of all three conceptions (categories A, J, I), suggesting an emerging reconceptualization of effective staff development.

Jane's responses to Item 26 on the first administration fell in all three conceptional clusters (categories A, F, I, O). But on the third administration her responses (categories I, M, O) represented a solid Conception III view of effective staff development. Jane had been involved in cohort one of the TEACH-STAT project and had participated as a faculty member in teaching the 1993 summer TEACH-STAT workshop. She had also taught several workshops on statistics and TEACH-STAT in local school systems prior to the Statistics Educators Institute. Her experiences teaching workshops seemed to influence her conception of effective staff development, and her participation as a Statistics Educator appeared to help her clarify a Conception III view of effective staff development.

Barb was also a cohort one TEACH-STAT member and had multiple experiences teaching workshops prior to participating in the Statistics Educators Institute. Her responses on all three administrations (categories A, E, O; A, M, O; and A, O on administrations 1 through 3, respectively) were indicative of a Conception I and Conception III view of effective staff development. The first interview with Barb, however, suggested that she held a different notion of the meaning of relevance (Conception I) as a characteristic of effective staff development. For Barb, relevant didn't just mean simple to use and easily transferred to her classroom. Barb wanted staff development to be

> meaningful--something that I can really take and apply, something that causes me to think and question what I'm currently doing. . . . Sometimes it can simply verify the effectiveness of what I'm doing also, but that's not quite enough. It needs to move beyond that in some way and help me grow professionally. (Interview 1)

Marilyn had not taught many workshops for teachers prior to the Statistics Educators Institute, but she did have extensive experience teaching adult religious classes. These experiences seemed to have influenced her conceptions of effective staff development. On the first administration, Marilyn held conceptions of effective staff development that were related to Conception II (category L) and Conception III (category E). On the second administration, Marilyn's responses encompassed Conception I (category A) and Conception III (categories E, O). On the third administration, Marilyn's responses were in Conception III (categories E, I). Marilyn's pattern of responses indicated that becoming a Statistics Educator helped her clarify a Conception III view of effective staff development. Throughout the project Marilyn indicated that she wanted the workshop participants to be able to adapt what they learned in the TEACH-STAT workshop to their specific classroom situations. Marilyn also recognized the importance of adequate time for participants to internalize new ideas. "Recognize that many ideas are new and it might take time to change opinions about new innovations" (SD Survey 1).

The case studies illuminate how the Statistics Educators negotiated their roles as workshop leaders and clarified their conceptions of effective staff development. The case study of Sara Nickerson (Kilcher, 1990) in her first year as a school improvement team change facilitator identified similar struggles in role negotiation and clarification. These similarities underscore the importance of providing support for teachers assuming new professional roles.

Open-ended item 27 allowed participants to list up to three characteristics that they considered most important for effective classroom teaching. The item was designed to explore possible differences in teachers' conceptions of effective staff development and effective classroom teaching. The category of responses coded most frequently on all administrations was *activities that involve students (hands-on).* The number (percentage) of participants with responses coded in this category was 17 (38%), 15 (33%), and 16 (36%) for administrations 1 through 3, respectively.

On administration 1 the category *variety of instructional approaches/materials used* was coded as frequently (17 [38%]) as *activities that involve students.* The number (percentage) of participants with responses coded in the category *variety of instructional approaches/materials used,* however, dropped off on administrations 2 and 3 to 10 (22%) and 9 (20%), respectively. Two other categories showed decreases across the three administrations. Like Item 26, however, three participants (7%) wrote no responses for administration 3. The categories, along with the number (percentage) of participants with responses coded in each category on administrations 1 through 3, respectively, were (a) *opportunities for students to solve problems, discuss, think, process, share ideas, work in groups* (14 [31%], 7 [16%], and 10 [22%]); and (b) *meets students' needs or developmental stages; student gains knowledge* (13 [29%], 5 [11%], and 8 [18%]).

In three categories there were increases in the number (percentage) of participants with coded responses after the first administration. These categories were *climate conducive to learning* (6 [13%], 14 [31%], and 11 [24%]), *teacher's subject matter knowledge* (7 [16%], 13 [29%], and 11 [24%]), and *relevance to students/real world* (5 [11%], 13 [29%], and 9 [20%]). The decreases in three categories after administration 1 appear to have been offset by increases in three other categories after administration 1.

Reorganizing the response categories into clusters similar to those identified for Item 26 allows speculation about teachers' conceptions of effective classroom teaching. Most response categories were similar to those identified for Item 26 and therefore are organized in the same conceptual clusters. However, some differences in response categories (e.g., category N for Item 27 was *student discipline/classroom management* instead of *follow-up*; category G for Item 27 was *enthusiastic teacher/motivator* instead of *enthusiasm/confidence of staff developer*) resulted in a slightly different organization. Three conceptually-linked clusters of categories that could be considered are organized around conceptions of classroom teaching as sharing the wisdom of the world, as managing the classroom environment, and as facilitating learning.

I. Classroom Teaching as Sharing the Wisdom of the World

Category A: Relevance to students/real world

II. Classroom Teaching as Managing the Classroom Environment

Category B: Interesting/fun topic

Category F: Preparation/organization of teacher

Category G: Enthusiastic teacher/motivator

Category J: Pacing/good use of time

Category K: Activities that involve students (hands-on)

Category L: Variety of instructional approaches/materials used

Category N: Student discipline/classroom management

III. Classroom Teaching as Facilitating Learning

Category E: Meets students' needs or developmental stages; student gains knowledge

Category H: Teacher's presentation skills

Category I: Teacher's subject matter knowledge

Category M: Opportunities for students to solve problems, discuss, think, process, share ideas, work in groups

Category O: Climate conducive to learning

Conception I could be described as a theoretical view of effective classroom teaching as sharing the wisdom of the world. In this view teachers are considered more expert than students. Their experiences in the world and their notions about what one needs to know to be successful in the world determine the curriculum emphases. Much of the classroom instruction may be in the form of "telling" as the wisdom of the teacher is shared with students.

Conception II is characterized by a focus on the tasks of effective classroom management. In this view of effective classroom teaching, teachers are responsible for being well-organized, selecting topics that will be interesting and motivating to students, planning a variety of activities that will involve students, and effectively managing time and student discipline. Students are expected to engage in classroom activities, but not necessarily to build deep understandings.

Conception III is related to learning outcomes for students. Effective classroom teaching in this conception is viewed as facilitating learning. The classroom teacher's role is to select challenging tasks that build on students' prior knowledge and allow students to construct meaning. Students are provided with opportunities to solve problems, think, discuss, process, and work in groups in a supportive learning environment. The teacher's subject matter knowledge and presentation skills are critical attributes needed for flexibly meeting student needs, connecting concepts, and orchestrating classroom discourse.

The frequencies of responses across all three administrations in these conceptual clusters are displayed in Figure 20. Analysis of the response frequencies in the conceptual clusters does not reveal a distinguishable pattern. The shift towards Conception III that was evident in the teachers' conceptions of effective staff development (Item 26) did not transfer to their conceptions of effective classroom teaching.

Figure 20. Frequencies of responses by category from Item 27 (characteristics of effective classroom teaching) organized by conceptual clusters.

	Adm. 1	Adm. 2	Adm. 3
Conception I: Classroom Teaching as Sharing the Wisdom of the World			
A. Relevance to students/real world	5	13	9
Conception II: Classroom Teaching as Managing the Classroom Environment			
B. Interesting/fun topic	3	4	5
F. Preparation/organization of teacher	7	11	6
G. Enthusiastic teacher/motivator	8	5	8
J. Pacing/good use of time	4	3	3
K. Activities that involve students (hands-on)	17	15	16
L. Variety of instructional approaches/materials used	17	10	9
N. Student discipline/classroom management	3	4	3
Conception III: Classroom Teaching as Facilitating Learning			
E. Meets students' needs; student gains knowledge/skills	13	5	8
H. Teacher's presentation skills	1	3	2
I. Teacher's subject matter knowledge	7	13	11
M. Opportunities for participants to solve problems, discuss, think, process, share ideas, work in groups	14	7	10
O. Climate conducive to learning	6	14	11

Research Question #2

Research question #2 was: How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' conceptions about teaching adults (as opposed to teaching children)? The results of Item 28 from the *Staff Development Style Inventory* indicated that on the first administration the Statistics Educators thought that there was little difference between teaching adults and teaching children and that adults had more abstract thinking capabilities than children. On the second administration the Statistics Educators thought that adults were harder to discipline and control, were more critical and demanding, and were less open-minded and curious than children. On the third administration the Statistics Educators thought that there was not much difference between teaching adults and teaching children, though some still believed that adults were harder to discipline, control, and keep on task than children.

These results can be interpreted to suggest that the Statistics Educators came to the Statistics Educators Institute believing that teaching adults was similar to teaching children except for adult capabilities for more abstract thought. The Statistics Educators Institute influenced them to believe that some adult learners could be "difficult," and the Statistics Educators became more anxious and wary about teaching adults and handling off-task adult behaviors prior to the TEACH-STAT workshop. After teaching the TEACH-STAT workshop the Statistics Educators seemed to reject the notion that teaching adults was difficult and returned to their original conceptions of teaching adults.

Once again, reorganizing the response categories for Item 28 into conceptually-linked clusters allows speculation regarding teachers' conceptions of teaching adults. Three conceptual clusters of response categories that could be considered are organized around conceptions of adult learners as similar to children, as more difficult than children, and as more complex thinkers than children.

I. Adult Learners as Similar to Children

Category I: Not much or no difference

II. Adult Learners as More Difficult than Children

Category D: Adults are more critical/demanding, less tolerant than children

Category E: Adults are less open-minded, curious, willing to experiment

Category G: Adults are harder to discipline/control/keep on task than children

III. Adult Learners as More Complex Thinkers than Children

Category A: Adults need relevance; children need excitement

Category B: Adults' level of thinking is more abstract

Category C: Adults have more prior knowledge/range of life experiences

Conception I characterizes adult learners as similar to children. From a workshop leader's perspective, there is little or no difference between planning and delivering instruction for children and planning and delivering instruction for adults.

Conception II characterizes adult learners as "difficult." That is, they are hard to keep on task, unwilling to experiment, discover, and try new ideas, and less open-minded and curious than children. This conception seems to be theoretically linked to previously discussed conceptions of effective staff development focused on workshop leaders' concerns about what the participants will *like* (Conception I; see Figure 19) and *do* (Conception II; also Figure 19).

Conception III characterizes adult learners as complex thinkers who bring various life experiences and prior knowledge to the learning environment. In this conception, the workshop leader must find ways to help adults build on their prior knowledge, confront their beliefs, and engage in sophisticated thinking about their teaching practices.

Three categories of responses were not included in the conceptual clusters because of the relatively small number of responses in each category. These categories were category F (adults can move at a faster pace than children), H (adults are easier to discipline/control/keep on task than children), and J (other).

The frequencies of responses for the categories organized by conceptual clusters across all three administrations are displayed in Figure 21. Generally, the shape of the responses for Conceptions I and III is U-shaped. That is, a decrease in responses on the second administration was followed by an increase on the third administration. The shape of the responses for Conception II is an inverted U-shape. That is, an increase in

Figure 21. Frequencies of responses by category from Item 28 (differences between teaching children and teaching adults) organized by conceptual clusters.

	Adm. 1	Adm. 2	Adm. 3
Conception I: Adult Learners as Similar to Children			
I. Not much or no difference	14	7	10
Conception II: Adult Learners as More Difficult than Children			
D. Adults are more critical/demanding, less tolerant than children	7	14	5
E. Adults are less open-minded, curious, willing to experiment	8	10	7
G. Adults are harder to discipline/control/keep on task than children	6	16	12
Conception III: Adult Learners as More Complex Thinkers than Children			
A. Adults need relevance; children need excitement	6	1	2
B. Adults' level of thinking is more abstract	11	4	8
C. Adults have more prior knowledge/range of life experiences	5	8	9

responses on the second administration was followed by a decrease on the third administration. These patterns in the data offer further evidence that the Statistics Educators developed a more commonly held view of adult learners as difficult after participating in the Statistics Educators Institute, but then abandoned that common view for more diverse views about adult learners after teaching the TEACH-STAT workshop. That is, the participant responses were clustered in Conception II on the second administration. Responses on administrations 1 and 3 were more evenly spread among all three conceptions of teaching adults.

Several considerations offer possible explanations for these results. One possibility is that the Statistics Educators Institute module on presentation skills (Module 7) affected the Statistics Educators' conceptions of adult learners. This module included a discussion of strategies for responding to workshop participants who were "unhappy campers." Strategies were offered for participants who might be hecklers, withdrawn, or chatterers. It seems plausible that the content of this module magnified the Statistics Educators' concerns about difficult workshop participants. The shape of the responses in the second cluster of responses categories (Conception II) indicates that the Statistics Educators' views of adults as difficult learners grew more pronounced just before teaching the summer workshop, but dissipated somewhat after the experience of teaching the TEACH-STAT workshop.

A possible confounding variable affecting the results might be explained by the teachers' interpretations of Item 28. The survey item asked the Statistics Educators, "What are the major differences between teaching children and teaching adults?" It is possible that the Statistics Educators' responses were framed based on perceived differences in learning structures. That is, they may have interpreted the question to be, "What are the differences between teaching children in classrooms and teaching adults in workshops?" A classroom learning structure is characterized by longer commitments of time (a semester or an academic year) and evaluation of learning (grading) by the teacher. A workshop learning structure is characterized by shorter, more temporary interaction times and no formal evaluation of learning by the workshop leader. Without the formal responsibility and authority for evaluating participants' learning by awarding grades, and without the long-term commitment of time, the Statistics Educators may have felt limited in their ability to control participants' behavior and engagement. For example, Jane indicated after teaching the TEACH-STAT workshop that "it is extremely difficult to arrive at a level of respect in a short while for a workshop, especially when many teachers don't want to be there or feel they know the material already" (SD Survey 3).

Other examples of Statistics Educator responses suggest that they perceived the workshop learning structure to be somewhat different than a classroom environment. One respondent observed on the third administration that "adult learners sometimes want to talk, read the newspaper, etc., during workshops. Dealing with such adult distractions is 'stickier' than dealing with student misbehavior. In both cases, however, a good sense of humor usually helps." Other responses on the third administration of the *Staff Development Style Inventory* provide additional insight into the participants' views about the learning disposition that adults may bring to the staff development process:

> •Adults are sometimes reluctant to "take risks" . . . would rather not answer than be wrong.
>
> •Adults get very upset when they think they are being treated like children. Some adults think the discovery process is not meant for them. Therefore, when we teach them to discover we are teaching down to them.
>
> •Adults are more impatient, I feel (i.e., tell me now how to do [it]). Children are more investigation oriented. Adults are "too busy" to take the time to discover.

A third possible explanation for these results may be that they reflect the Statistics Educators' reactions to the workshop participants' feedback about their expertise as

Statistics Educators. Many 1994 TEACH-STAT workshop participants were recruited from the same schools where the Statistics Educators taught. These participants knew that the workshop leaders had been learning how to become Statistics Educators. The participants may have perceived the Statistics Educators as novices in leading workshops, and consequently expressed less positive feedback about the quality of the TEACH-STAT workshop. The Statistics Educators' conceptions of adult learners as difficult may have resulted from such participant feedback about the workshop delivery.

Research Question #3

Research question #3 was: How does becoming a TEACH-STAT workshop leader affect the pedagogical content knowledge of the Statistics Educator? Overall, no significant differences were found across the three administrations for Items 1(a) and 2(a) of the *Pedagogical Content Knowledge Questionnaire.* The median response for the total group ($N = 45$) on all three administrations indicated a prediction that 70% of the elementary teachers attending a TEACH-STAT workshop on the first day would correctly answer the question in Item 1 and 50% would correctly answer the question in Item 2.

When asked to describe the process they thought the TEACH-STAT workshop participants would use on the first day of the workshop to solve the problems in Items 1 and 2, the most frequently coded response for all three administrations for both items was average as algorithm. The data indicate that most Statistics Educators expected elementary teachers beginning the TEACH-STAT workshop to answer the questions in Items 1 and 2 using the arithmetic algorithm to compute the mean.

The results of the analysis of Items 1 and 2 of the *Pedagogical Content Knowledge Questionnaire* also seem to indicate that as a total group the Statistics Educators viewed the representation in Item 2 as somewhat more difficult for elementary teachers than the representation in Item 1. Some participants clearly indicated their concern that elementary teachers may not be familiar with the line plot representation in Item 2:

•I'm not sure most teachers would be able to read the line plot. They might read it: 1 person with 2, 2 people with 3, 3 people with 2, 6 people with 1.

•Some would add up all the data values (1+1+2+2+2+3+3+6) and divide by 8. Some may get confused if they are unfamiliar with line plots and add up the frequencies (2+3+2+1) instead, thus getting an incorrect answer.

•I still think that without labels it is impossible to know which is which. I think that they might say that child #1 has 2 pets, #2 has 3 pets, etc. Added together there would be 8 pets, divided by 8 students. Each child would then have 1 pet on average.

There were mixed responses, however. For example, the median response on all three administrations at the WCU site indicates that the Statistics Educators there thought that Item 2 (median = 70%) was somewhat more difficult than Item 1 (median = 50%). The case study of Jane revealed that she thought the representation in Item 1 would be difficult for the teachers on the first day of the TEACH-STAT workshop.

On Item 3 of the *Pedagogical Content Knowledge Questionnaire* participants described the representation they predicted elementary teachers would use on the first and then the last day of the TEACH-STAT workshop to compare two data sets. Most participants predicted the teachers would predominantly use an algorithmic procedure on the first day of the workshop and expanded graphical representations (including stem and leaf plots, box and whisker plots, or scatter plots) on the last day of the workshop. A few participants across the three administrations expected the teachers to use expanded numerical representations (average as mean, median, mode, midpoint, and/or balance point; more than one measure of center to determine representativeness) on the last day. Two participants specifically stated the teachers would use *both* expanded numerical and expanded graphical representations on the last day of the workshop.

Selected responses for Item 3(c) are included below to demonstrate more clearly what the participants expected. Their expectations generally remained consistent across all three administrations.

•On the last day, teachers would be looking for a more "sophisticated" method of displaying data graphically.

•On the last day of TEACH-STAT the teachers would use less traditional forms of graphs. They would be more conscious of outliers. They would use median, mode, or mean as they are deciding which group performed better.

•I think by the end of TEACH-STAT teachers will know a variety of ways to represent data and learn that finding the average by adding and dividing does not always answer the question posed.

•The TEACH-STAT program showed me how to go beyond computation to create a visual representation of data that could be a source of a variety of information. The average answered the question, but we see more looking at the graph.

•Those unfamiliar with graphing and statistics tend to place too much stock in just the mean. TEACH-STAT downplays the mean somewhat and puts it in its proper place among equally important concepts.

•On the first day of a workshop for K-6 teachers most teachers are not very experienced with comparing data such as this. After two weeks of intensive activities in which teachers have become comfortable with comparing data sets, I feel that they are more likely to use their new experiences.

Mokros and Russell (1995) suggested that children develop a strong foundation of the idea of representativeness before being introduced to the average algorithm ("add-'em-up-and-divide"). This foundation follows a pedagogical path that allows children to

> construct the idea of representativeness through many encounters with a variety of real data sets. They must collect, represent, describe, and interpret data about meaningful topics (NCTM, 1989) and in this process broaden and deepen their uses of *typical, average, representative, balance,* and *center.* (p. 37)

Evidence in this study suggests that the Statistics Educators believed adults would also demonstrate broadened notions of representativeness after encounters with a variety of data sets in TEACH-STAT.

> •On the first day of a workshop for K-6 teachers most teachers are not very experienced with comparing data such as this. After two weeks of intensive activities in which teachers have become comfortable with comparing data sets, I feel that they are more likely to use their new experiences.
>
> •I think by the end of TEACH-STAT teachers will know a variety of ways to represent data and learn that finding the average by adding and dividing does not always answer the question posed.

The Statistics Educators did not expect the elementary teachers who would attend the TEACH-STAT workshop to use broad ideas of representativeness when they entered the workshop. However, they expected the teachers to use expanded ideas of representativeness at the conclusion of the TEACH-STAT workshop. In particular, they expected the teachers to use "newer" and "more sophisticated" graphical representations.

Whether or not the Statistics Educators were basing their predictions on their own knowledge about statistics before entering the TEACH-STAT workshop is unknown, but this explanation seems plausible. As one respondent stated, "The TEACH-STAT program showed me how to go beyond computation to create a visual representation of data that could be a source of a variety of information." If the Statistics Educators based their expectations on a perception that the teachers' conceptual knowledge of statistics was relatively shallow, then the results are consistent with previously stated concerns about elementary teachers' lack of depth with regard to mathematics content (e.g., Ball, 1988, 1989; NCTM, 1991; Schifter & Fosnot, 1993).

The results also have implications for those who conduct workshops like the Statistics Educators Institute designed to help prepare teachers to become statistics workshop leaders. Those who conduct workshops like the Statistics Educators Institute could help Statistics Educators confront their expectations by creating opportunities for them to discuss their conceptions about the prior knowledge that adults bring with them to the learning situation. Further discussion about how to assess adults' prior knowledge, how to use adults' misconceptions as opportunities for learning, and how to adapt workshop content for those whose conceptions are more (or less) developed could provide insights to help teachers become effective statistics educators of adults.

Research Question #4

Research question #4 was: How does becoming a TEACH-STAT workshop leader affect the Statistics Educators' concerns about the workshop content/innovation and their roles as change facilitators? The *Change Facilitator Stages of Concern Questionnaire* provided a measure of the relative intensity of the Statistics Educators' concerns about TEACH-STAT and their roles as change facilitators. On administration 1, most participants held highest concerns at stages 0 (awareness) and 5 (collaboration). On administration 2, most participants held highest concerns at stages 0 (awareness), 2 (personal), and 5 (collaboration). On administration 3, most participants held highest concerns at stages 0 (awareness) and 5 (collaboration). Consistent with the way that Hall et al. (1991) have interpreted the stages, high stage 0 concerns indicate concerns unrelated to the innovation (in this case, TEACH-STAT) or the change facilitator role. High stage 2 concerns are typical of those with doubts about their ability in the role of change facilitator for the innovation. High stage 5 concerns are typical of those concerned about coordinating with other change facilitators for increased effectiveness.

Thirty-two of the 45 Statistics Educators held highest concerns at stage 5 on at least one of the three administrations of the *Change Facilitators Stages of Concern Questionnaire*. Some of these individuals (n = 14) progressed toward higher ranking stages of concern (see Figure 11) across the three administrations in patterns such as

0-0-5 (n = 3), 0-5-5 (n = 1), 1-5-5 (n = 3), 0-2-5 (n = 4), 2-2-5 (n = 2), or 5-5-6 (n = 1). Other individuals (n = 10) held highest concerns at stage 5 across all three administrations (5-5-5). The remaining individuals in this group (n = 8) showed fluctuating patterns of concerns across the three administrations: 0-5-0 (n = 2), 5-2-5 (n = 3), 2-0-5 (n = 1), 5-5-0 (n = 1), and 5-5-1 (n = 1).

Thirteen of the 45 Statistics Educators did not hold highest concerns at stage 5 (collaboration) on any of the three administrations. These individuals primarily held highest concerns at stages 0 (awareness) or 2 (personal). Patterns of concerns across the three administrations for these 13 individuals were 0-0-0 (n = 4), 1-1-0 (n = 1), 0-2-0 (n = 2), 0-0-2 (n = 1), 0-2-2 (n = 1), 2-0-2 (n = 1), 1-2-2 (n = 1), 3-0-2 (n = 1), and 3-3-3 (n = 1).

Interpretation of these results suggests that the Statistics Educators were mostly concerned about coordinating with others in their roles as TEACH-STAT workshop leaders. The relatively high intensity of the Statistics Educators' concerns about collaboration throughout the project could be explained by the unique nature of this particular staff development project. Rather than an individual "train the trainers" model, this project was designed to prepare a team of workshop leaders to deliver the summer TEACH-STAT workshop at each site. These Statistics Educators had participated in team building activities, had negotiated what TEACH-STAT activities were most important for inclusion in the summer workshop, and had divided workshop instructional responsibilities. While there may have been comfort in knowing that, for example, nine others were going to help teach the TEACH-STAT workshop at a given site, there was also concern about how to coordinate the efforts effectively with so many others.

The results indicated relatively lower concerns about management (stage 3) in the role of TEACH-STAT facilitator. In Modules 2 (Planning for TEACH-STAT Workshops) and 5 (Planning the Details) of the Statistics Educators Institute, responsibilities for workshop teaching assignments and administrative tasks were divided among team members. Shared responsibilities among team members at each site may have helped the team members to be relatively less concerned about management.

The Statistics Educators also had relatively lower concerns about their impact (stage 4) in the role of TEACH-STAT facilitator. A possible explanation for this result is that the Statistics Educators had used the TEACH-STAT activities in their classrooms and observed their impact on students. Perhaps these experiences, along with the frequent acknowledgment of the importance of these experiences during the Statistics Educators Institutes, contributed to the Statistics Educators' low concerns about impact. This result might also be explained, however, by the Statistics Educators' conceptions of effective staff development. A conception of effective staff development as managing the workshop environment (Conception II; see Figure 19) emphasizes actively involving workshop participants (task) more than it emphasizes impacting participants' learning (impact).

Discussion of Case Studies

The four case studies illuminated one additional aspect that was personally important to the participants during the process of becoming a workshop leader. Specifically, the case studies highlighted the teachers' views about the knowledge or skills needed to be an effective workshop leader.

Ellen had never been a workshop leader before. She consistently stated that effective workshop leaders should know the material they are going to present. They should also have tried the workshop activities with students before presenting them to other teachers. Only after teaching the TEACH-STAT workshop did Ellen begin to discuss that participants could also contribute subject matter knowledge and experiences to the learning situation. She observed that the workshop leader did not have to be the only "expert" and that other "experts" could be consulted to find out about questions raised by the workshop participants. In fact, she noted that she had learned from the participants in the TEACH-STAT workshop. This seemed to be an important step for Ellen because it opened up the possibility of her role as a learner at the same time she was assuming the role of workshop leader.

Ellen remained focused throughout the project on the importance of workshop leaders presenting material at a brisk pace. She often mentioned her concern about boring the workshop participants or frustrating them because "they weren't getting anything that they didn't already know." To Ellen, a solution to this dilemma was to "make it seem like we were moving a little bit quicker." This focus on the workshop leader's pacing seems to be consistent with Ellen's view of effective staff development as a collection of activities and new ideas that can be practiced at the workshop and then used in the classroom. At some point, however, Ellen may be faced with resolving the differences between her currently consistent view of effective workshop leaders as managers of pace and her newly emerging view of workshop leaders as participants in the learning process.

Jane, like Ellen, considered knowing the workshop content and sharing examples of student work to be important characteristics of effective workshop leaders. Unlike Ellen, however, she consistently discussed the importance of the workshop leader's rapport with the participants. Throughout the project she listed a variety of attributes that she believed contributed to good rapport and a positive learning climate--"not being insulting or controlling," making "people feel comfortable," "dealing with all kinds of people," "being able to talk to people," having "good eye contact," and "being warm and friendly and inviting." As a workshop leader, she wanted to be someone the participants would "connect with" and "talk to." Jane's view of effective workshop leaders as warm and inviting people who are able to establish a comfortable climate for learning is consistent with adult learning theory. Adults learn best in an informal atmosphere of trust and openness where they are treated as professional adults and the fear of judgment during learning is reduced (Knowles, 1984a; Nowak, 1994; Wood & Thompson, 1993).

Marilyn had many experiences teaching adults. She recognized the importance of workshop leaders being sensitive to the participants' needs and backgrounds. For her it was important as a workshop leader to know "where they're coming from." She stated, "You have to know your audience and learn and grow with them." Like both Ellen and Jane, Marilyn also emphasized that effective workshop leaders should have knowledge of the workshop content and will have "personal memory tapes to draw from" if they have tried the workshop activities with their students. In trying to construct an image that, for her, reflected both of these characteristics (knowing the content and being sensitive to participants' needs and backgrounds), Marilyn described an effective workshop leader as "part educator and part caretaker."

Barb agreed that effective workshop leaders should know their material, but be sensitive enough to the needs of the participants not to "stick to the lesson plans like glue." She was also interested in establishing a supportive climate that allowed "personal and professional" friendships to develop among workshop leaders and participants. Barb wanted the workshop participants to develop a collegial network that could provide support and assistance in the future. It seems that Barb was aware of the importance of collegial support as teachers are implementing new ideas in their classrooms (McLaughlin & Marsh, 1978; Schifter & Fosnot, 1993).

One characteristic of effective workshop leaders that was uniquely mentioned by Marilyn and Barb (both primary grade teachers) was allowing participants to feel comfortable adapting workshop content to their specific classroom situations. Perhaps this view may be related to their roles as teachers of children in grades 1 and 2. However, it seems more likely that this view is related to their conceptions of effective staff development as facilitating learning (Conception III; see Figure 19). This characteristic reflects their common view that workshop leaders should be sensitive to the needs and experiences of the workshop participants.

McLaughlin and Marsh (1978) found that effective classroom implementation of new ideas was a process of mutual adaptation. The mutual adaptation process occurs when teachers modify their classroom practices using what they learned in staff development situations, and at the same time staff development project goals and concepts are adapted to the daily realities of the classroom and school. Further inquiry into the factors that contribute to or impede mutual adaptation would provide additional information about the issues raised from the case studies of Marilyn and Barb.

One characteristic of effective TEACH-STAT workshop leaders that was uniquely shared by Ellen and Jane (both fifth-grade teachers) was the importance of developing effective questioning skills. It is interesting that neither Marilyn nor Barb mentioned this characteristic as that of an effective TEACH-STAT workshop leader. Is it because they already possessed strong questioning skills grounded in classroom experience? Is there a relationship between a teacher's questioning skills and the grade level they teach? Additional inquiry into this characteristic of effective TEACH-STAT workshop leaders is needed.

Conclusions

The results of this study provided a consistent view of the processes teachers perceive should take place in the most effective mathematics workshops. These workshops are characterized by instructional approaches that allow participants to work together to investigate "big" problems. The workshop participants are also encouraged to solve problems in a variety of ways and to provide explanations for their solutions. The content of the mathematics workshops is provided through problem-solving contexts and workshop leaders explicitly help participants identify the connections between new ideas and prior knowledge. When participants have difficulty understanding a concept, workshop leaders use effective questioning skills rather than telling participants about the concept. Workshop leaders use a variety of instructional approaches such as posing open-ended problems, gathering and organizing participant responses, encouraging analysis and generalization, small group investigations, and using concrete manipulatives. Instructional approaches also allow for individual adaptations.

These results suggest an important connection between staff development goals related to specific subject matter (in this case, mathematics) and teachers' perceptions of effective workshop processes. NCTM (1991), in their *Professional Standards for Teaching Mathematics*, advocates that within all professional learning situations teachers should experience good mathematics teaching. The vision of good mathematics teaching described by NCTM (1989, 1991) parallels the workshop processes perceived by teachers in this study to be characteristic of effective mathematics workshops.

The Statistics Educators' responses to an open-ended item about the most important characteristics of effective staff development were interpreted through three theoretical conceptions. The three conceptions of staff development considered were (a) Conception I: Staff development as sharing the wisdom of practice, (b) Conception II: Staff development as managing the workshop environment, and (c) Conception III: Staff development as facilitating learning. Patterns of concerns of workshop leaders holding each conception parallel those of teachers as they gain experience and maturity in their roles (Fuller, 1969). From a workshop leader's perspective, Conception I is related to concerns about self, Conception II is related to concerns about task, and Conception III is related to concerns about impact.

Evidence in this study suggests that the Statistics Educators were beginning to shift their conceptions of effective staff development toward Conception III. These results are important in two ways. First, they appear to confirm Killion's (1988) hypothesis that workshop leaders progress through stages of growth in their conceptions of effective staff development. Second, they suggest that interventions such as the Statistics Educators Institute, designed to prepare teachers to become workshop leaders, can positively influence teachers' conceptions of effective staff development. The Statistics Educators Institute especially seemed to help the workshop leaders recognize the importance of and plan for establishing a workshop climate conducive to learning.

There is evidence that interventions such as the Statistics Educators Institute can provide unexpected negative influences as well. Just prior to teaching the TEACH-STAT workshop the teachers expressed concerns about handling off-task or negative adult behaviors in their roles as workshop leaders. This view of adult learners was not predominant at the beginning of the Statistics Educators Institute but became pronounced just prior to teaching the summer TEACH-STAT workshop. This view of adult learners was later abandoned by many of the workshop leaders for more favorable views of adult learners after teaching the summer TEACH-STAT workshop.

Many of the teachers were concerned about coordinating their efforts with other workshop leaders. This concern about collaboration may have resulted from the use of teams of workshop leaders at each site. Concerns about collaboration did not dissipate after teaching the summer workshop. These results are important for raising the question of whether collaboration concerns among teams of teachers as workshop leaders can affect them in other aspects of their roles as workshop leaders. For example, the energy expended worrying about collaboration may have impacted their effectiveness in planning, orchestrating workshop discourse, or making adaptations to meet workshop participants' needs. In other words, the amount of energy available for other aspects of carrying out the role of workshop leader may have been reduced by the Statistics Educators' concerns about collaboration.

Results of the case studies provided additional information about the teachers' perceptions of effective workshop leaders. All four teachers indicated that effective workshop leaders must possess two important characteristics: (a) They know the workshop content extremely well, and (b) they are sensitive to and value the prior knowledge, different experiences, and various needs of the participants. Three teachers believed it was also important for the workshop leader to have tried the workshop activities with students before presenting them to other teachers.

These results are important in what they suggest for staff development designed around teachers' becoming workshop leaders. In order for these staff development designs to be effective, the teachers must have strong content knowledge. They must also learn to be sensitive to the workshop participants' needs, experiences, and prior knowledge. Finally, their classroom experiences using learning activities like those presented in workshops can be powerful tools in their roles as workshop leaders.

The teachers in this study expected elementary teachers on the first day of the TEACH-STAT workshop to solve problems about the concept of "average" by using predominantly algorithmic procedures (i.e., "add-'em-up-and-divide"). They expected elementary teachers to use expanded graphical representations, such as stem and leaf plots and box plots, along with expanded numerical representations (e.g., mode and median) to compare two data sets on the last day of the TEACH-STAT workshop. This finding raises questions about the Statistics Educators' expectations of adults' prior knowledge and conceptions of statistics. Opportunities to confront expectations about adults' prior knowledge before assuming the role of workshop leader may help teachers develop adult pedagogical skills.

Implications for Mathematics Staff Development

Mathematics Workshop Characteristics

Mathematics staff developers should be aware of the characteristics of effective mathematics workshops identified by the teachers in this study. These characteristics describe workshop processes and strategies that are consistent with the instructional approaches envisioned by NCTM (1989, 1991) for both students and adults learning mathematics. Mathematics workshops for teachers designed around these processes that teachers believe are present in the most effective mathematics workshops should be evaluated for their effects on teachers' knowledge.

Teachers as Workshop Leaders

The results of this study suggest that staff development designs built upon teachers becoming workshop leaders should provide special assistance to help teachers develop in this role over time. Such assistance should provide opportunities for teachers to (a) enhance their content knowledge, (b) try workshop activities in their classrooms and reflect on them, (c) develop their conceptions of effective staff development, and (d) confront their expectations about adult learners. Each aspect will now be considered in more detail.

First, teachers who become workshop leaders need to have strong content knowledge. Strong content knowledge allows the workshop leader to, as Barb stated, "be flexible and . . . go where [the participants] take you." Deep conceptual understandings of mathematics content also allow the workshop leader to help participants explore connections between concepts (Brown & Borko, 1992). Opportunities to develop or demonstrate strong content knowledge in mathematics before becoming a workshop leader should be an important consideration in staff development design.

Second, teachers' classroom experiences are valuable assets as workshop leaders. Classroom experiences using teaching activities like those presented in workshops provide the workshop leader with "personal memory tapes" of the practical, as well as the pedagogical, issues related to the activities. If, as Guskey (1986) posits, teachers' beliefs and attitudes follow evidence that changes in teaching practice are producing positive learning outcomes for their students, then classroom experiences prior to leading a workshop can have an important affect on the workshop leaders' attitudes and beliefs. The results of this study also indicate that teachers value workshop leaders' classroom experiences with activities prior to leading workshops.

Third, teachers who become workshop leaders may need specialized assistance in conceptualizing effective staff development. If workshop leaders progress through stages of growth in their conceptions about effective staff development as this study suggests, then opportunities for workshop leaders to express their conceptions over time become important. Projects designed to prepare teachers to become workshop leaders should assess teachers' conceptions of effective staff development at regular intervals. If teachers' conceptions are not shifting toward a broader conception of staff development as facilitating learning, then project coordinators must reconsider the potential of the teacher as a workshop leader.

Fourth, teachers who become workshop leaders must be provided opportunities to develop their understanding of the nature of adult learners and of creating a climate conducive for adult learning. Care must be taken not to paint a picture of adult learners that is overly negative. High expectations for adults are as important as high expectations for students. However, teachers who become workshop leaders may need help in recognizing the importance of the prior knowledge and life experiences that adults bring to the workshop setting.

Also, there is a need to help mathematics workshop leaders explore pedagogical content knowledge related to teaching adults. The teachers in this study expected adults to use predominantly algorithmic procedures to solve problems about the concept of "average" on the first day of the TEACH-STAT workshop and to use expanded graphical representations to represent data sets on the last day. These expectations suggest that workshop leaders must confront their expectations about adults' prior knowledge and conceptions of mathematics topics. Exploring such expectations may provide helpful pedagogical insights for teachers assuming roles as educators of adults.

One additional aspect must be mentioned. The continuing and growing collaborative concerns of the teachers in this study suggest that professional development teams of 6-10 workshop leaders may not be as effective as smaller teams (2-3) or individual teachers as workshop leaders. Opportunities to develop their knowledge of collegiality (Fullan, 1994b) may have reduced the teachers' concerns about collaboration. Competing demands for developing other domains of teachers' knowledge, however, may reduce the amount of time available for developing collegial knowledge. This aspect of becoming a workshop leader requires further investigation.

Recommendations for Future Research

This study has deepened understandings about teachers' conceptions of effective staff development and their roles as mathematics workshop leaders. Additional lines of inquiry, however, are recommended to expand on this work. Natural extensions of this study are to conduct similar studies grounded in other contexts (e.g., workshop content in other subject matter areas or other mathematics topics). Three additional lines of inquiry suggested by this study seem important to pursue to further our understanding of how to provide support for classroom teachers who are becoming workshop leaders.

First, the characteristics of effective mathematics workshops identified by the teachers in this study are associated with a staff development goal of impacting teachers' content knowledge and pedagogical content knowledge. This correspondence raises questions about other possible connections between staff development goals and effective workshop processes. For example, are these the same workshop characteristics that teachers would identify if the staff development goal was to impact teachers' knowledge of learners? Are these the same workshop processes that teachers would identify if the staff development goal was to impact teachers' content knowledge in other content areas (e.g., science)? Additional studies to determine possible connections between specific staff development goals (related to teachers' knowledge) and effective workshop processes are needed. Collectively, these studies could provide a foundation for new staff development frameworks.

A second line of inquiry suggested by this study is to further investigate the notion of stages of development for workshop leaders in their conceptions of effective staff development. The case study of Ellen raises several questions. Ellen had never been a workshop leader before. Prior to leading the TEACH-STAT workshop, Ellen believed she needed to know more about statistics than the workshop participants. She conceived effective staff development as a collection of activities that she could practice at the workshop and then take back and use in her classroom. After teaching the TEACH-STAT workshop, Ellen acknowledged the contributions that workshop participants could make to the learning situation. Ellen's emerging reconceptualization of the role of a workshop leader suggests that there may be stages in teachers' conceptions of effective staff development. Is Ellen's current view of effective staff development related to her lack of experience as a workshop leader? How will her conceptions of staff development change as she gains more experience as a workshop leader? Longitudinal studies would help describe teachers' conceptions of effective staff development over time and possibly offer insights into the support needed for classroom teachers at different stages in their conceptions.

Finally, additional inquiry is needed to provide deeper understanding of the interventions that are most helpful in assisting teachers who are becoming workshop leaders to overcome concerns about collaboration with other workshop leaders. This study suggested several questions related to collaboration among workshop leaders. For example, would concerns about collaboration have been as high if there were fewer workshop leaders at each site? Did collaboration concerns reduce the workshop leaders' effectiveness in other aspects of their roles as workshop leaders? Were concerns about collaboration related to lack of understanding about each other's strengths and weaknesses? If so, do opportunities for workshop leaders to get to know one another over time need to be considered in designing staff development to help teachers become workshop leaders? What are the most effective ways to help teachers develop collaborative skills? Comparative studies of various collaborative strategies when preparing workshop leaders may provide further insight into effective interventions related to these concerns.

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APPENDIX A.
Table of Contents from TEACH-STAT Professional Development Manual

Permission to Reproduce

March 6, 1995

Diane Frost
1265 Thayer Drive
Asheboro, NC 27203

Dear Diane:

On behalf of The University of North Carolina, I am granting you permission to reproduce the table of contents from the TEACH-STAT professional development manual (summer 1994 draft) as an appendix in your doctoral dissertation at the University of North Carolina at Greensboro under advisor George Bright. The University of North Carolina is the current copyright holder of the TEACH-STAT professional development manual.

Sincerely,

Susan Friel

Susan N. Friel, Director
Math Science Education Network

Contents

APPENDIX B.
Staff Development Style Inventory

STAFF DEVELOPMENT STYLE INVENTORY

BACKGROUND INFORMATION

A. How many years of teaching experience (including 1993-94)?__________

B. Grade level taught in 1993-94:____________________

C. Certification:____

D. Year of initial participation in TEACH-STAT workshop: 1992 or 1993

E. Have you conducted any workshops before? Yes or No

If you answered "Yes" to the above question, then please respond to the following:

F. About how many workshops have you conducted for each workshop length listed below:

_____1-3 hours_____4-6 hours_____7-10 hours_____more than 10 hours

G. What were the topics of the workshops you've taught?

____

H. CODE: Your Mother's Birth Date

Year:_______Month:______Day:________

This inventory is designed to determine your perceptions about effective staff development practices. There are no right or wrong answers. Your views about mathematics workshops based on your own experiences are what is most important.

For each item on the inventory, two endpoints of a five-point scale are described. You are to determine the point along the five-point scale that most accurately describes your perceptions about the *most effective mathematics workshops*.

EXAMPLE:

Workshops should always begin at 6:00 a.m.			Workshops should always begin at 10:00 p.m.	
1	2	3	4	5

(Indicates response on end of scale suggesting this person believes all workshops should begin at 6:00 a.m.)

Workshops should always begin at 6:00 a.m.			Workshops should always begin at 10:00 p.m.	
1	2	3	4	5

(Indicates response toward end of scale suggesting this person believes workshops should begin in the evening.)

STAFF DEVELOPMENT STYLE INVENTORY
(for Mathematics Workshops)

PART I WORKSHOP PROCEDURES

Circle the point along each of the five-point scales which most accurately describes the workshop procedures that take place in the ***most effective mathematics workshops.*** There are no right or wrong answers.

Please answer all questions.

1. Almost always many different activities are going on simultaneously during the workshop. | Almost always the participants are all engaged in the same activity during the workshop.

   1 2 3 4 5

2. Participants frequently work together on activities. | Participants seldom work together on activities.

   1 2 3 4 5

3. When learning about a math concept, participants rarely spend time investigating big problems. | When learning about a math concept, participants mainly spend time investigating big problems.

   1 2 3 4 5

4. Workshop leaders encourage participants to investigate problems the way that was demonstrated. | Workshop leaders encourage participants to investigate problems in a variety of ways.

   1 2 3 4 5

5. Almost all help is initiated by workshop participants asking for it. | Almost all help is initiated by the workshop leader seeing the need for it.

   1 2 3 4 5

6.	When workshop participants have trouble, the workshop leader explains how to do it.			When workshop participants have trouble, the workshop leader asks them leading questions.		
	1	2	3	4	5	
7.	When teaching a new topic, workshop leaders spend a lot of time helping participants see similarities and differences between new and previously learned ideas.			When teaching a new topic, workshop leaders spend very little time helping participants see similarities and differences between new and previously learned ideas.		
	1	2	3	4	5	
8.	Workshop leaders seldom change their instructional approach (e.g., lecture, discussion, discovery, etc.).			Workshop leaders regularly change their instructional approach. (e.g., lecture, discussion, discovery, etc.).		
	1	2	3	4	5	
9.	Almost all questions posed by the workshop leader require the participants to give explanations.			Almost all questions posed by the workshop leader can be answered with yes, no, or a number.		
	1	2	3	4	5	
10.	Workshop tasks and assignments allow participants to make individual adaptations.			Workshop tasks and assignments are the same for all participants.		
	1	2	3	4	5	
11.	Workshop content is provided through the context of challenging problems or real-life situations.			Workshop content is not provided through the context of challenging problems or real-life situations.		
	1	2	3	4	5	

12.	New topics are developed through examples and demonstrations.			New topics are developed through experiences with problem-solving.	
	1	2	3	4	5
13.	Workshop content is presented in ways that are relevant mainly to participants' classrooms.			Workshop content is presented in ways that are relevant mainly to participants' learning.	
	1	2	3	4	5
14.	Workshop leaders do not elaborate on theoretical understanding of new strategies or content.			Workshop leaders help participants develop theoretical understanding of new strategies or content.	
	1	2	3	4	5
15.	Opportunities are provided to practice new skills in the workshop setting.			Opportunities are not provided to practice new skills in the workshop setting.	
	1	2	3	4	5
16.	The workshop leader and the participants cooperatively determine the learning process.			Workshop leaders determine the learning process.	
	1	2	3	4	5
17.	The goals of the workshop are clearly communicated.			The goals of the workshop are not clearly communicated.	
	1	2	3	4	5

PART II WORKSHOP STRATEGIES

As a workshop leader, how frequently would you use each strategy in your workshops?

	Very Frequently	Frequently	Sometimes	Seldom	Never
18. Whole group instruction	___	___	___	___	___
19. Whole group discussion	___	___	___	___	___
20. Posing open-ended problems	___	___	___	___	___
21. Gathering and organizing participant responses	___	___	___	___	___
22. Encouraging analysis and generalization	___	___	___	___	___
23. Small group investigations	___	___	___	___	___
24. Using technology	___	___	___	___	___
25. Using concrete manipulatives	___	___	___	___	___

PART III OPEN-ENDED RESPONSES

26. In your opinion, what are the most important characteristics of effective staff development? Please list no more than three.

27. In your opinion, what are the most important characteristics of effective classroom teaching? Please list no more than three.

28. What are the major differences between teaching children and teaching adults?

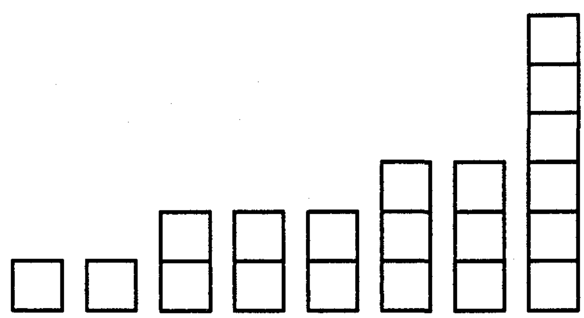
APPENDIX C.

Pedagogical Content Knowledge Questionnaire

PEDAGOGICAL CONTENT KNOWLEDGE QUESTIONNAIRE

1. Suppose you asked a group of elementary teachers on the first day of a TEACH-STAT workshop to solve this problem:

   Eight students counted the number of pets in their homes. The students made towers of Unifix cubes to represent the numbers of pets in their homes. Their towers are shown below:



   What is the average number of pets in their homes?

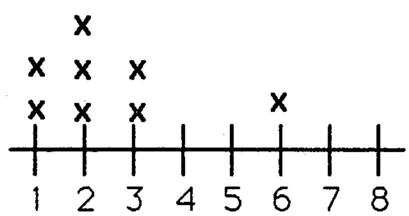
   a. About what percentage of the teachers do you think would be able to answer the question correctly (circle one)?

   10%   30%   50%   70%   90%

   b. Describe the process for solving the problem that you think would be most commonly used by those teachers.

2. Suppose you asked a group of elementary teachers on the first day of a TEACH-STAT workshop to solve this problem:

Eight students counted the number of pets in their homes. Their data are shown below:



What is the average number of pets in their homes?

a. About what percentage of the teachers do you think would be able to answer the question correctly (circle one)?

10% 30% 50% 70% 90%

b. Describe the process for solving the problem that you think would be most commonly used by those teachers.

3. Suppose you asked a group of elementary teachers on the first day and again on the last day of a TEACH-STAT workshop to solve this problem:

> Two groups of students were tested to determine how much they knew about mathematics problem solving. Their scores are shown below:
>
> Group A: 65, 77, 82, 85, 87, 66, 95, 71, 88, 92,
> 82, 84, 68, 77, 75, 95, 83, 75, 41, 59, 81
>
> Group B: 75, 78, 55, 63, 99, 78, 85, 87, 39, 81, 80,
> 85, 86, 77, 83, 69, 86, 89, 81, 75, 67, 70, 83
>
> How would you represent this information to determine whether one group performed better than the other group?

a. What representation do you think would be most commonly used by those teachers on the first day of the workshop?

b. What representation do you think would be most commonly used by those teachers on the last day of the workshop?

c. Comment on the similarities or differences in your predictions in parts a and b above.

APPENDIX D.
Change Facilitator Stages of Concern Questionnaire
(also known as *Concerns Questionnaire for Change Facilitators)*

Reference:

Hall, G. E., Newlove, B. W., George, A. A., Rutherford, W. L., & Hord, S. M. (1991). Measuring change facilitator stages of concern--A manual for the use of the CFSoC questionnaire. Greeley, CO: Center for Research on Teaching and Learning, University of Northern Colorado.

UNIVERSITY OF NORTHERN COLORADO

COLLEGE OF EDUCATION
EDUCATIONAL LEADERSHIP AND POLICY STUDIES
GREELEY, COLORADO 80639
(303) 351-2861

March 12, 1995

Diane Frost
1265 Thayer Dr.
Asheboro, NC 27203

Dear Dr. Frost:

Congratulations upon having successfully completed your dissertation study. I am looking forward to learning more about your findings.

You have my permission to include a copy of the Stages of Concern Questionnaire in your dissertation report. Please include appropriate references, such as the technical manual.

Thank you for including a part of our CBAM work in your study, and I wish you continued academic success.

Sincerely yours,

Gene E. Hall

Gene E. Hall, Professor

CONCERNS QUESTIONNAIRE for CHANGE FACILITATORS

CODE: **Your Mother's Birth Date**

Year:_____Month:_______Date:_______

The purpose of this questionnaire is to determine what you are thinking about regarding your responsibilities as a change facilitator for an innovation. It is not necessarily assumed that you have change facilitator responsibilities. This questionnaire is designed for persons who do not serve as change facilitators as well as for those who have major responsibility for facilitating change. Because the questionnaire attempts to include statements that are appropriate for widely diverse roles, there will be items that appear to be of little relevance or irrelevant to you at this time. For the completely irrelevant items, please circle "0" on the scale. Other items will represent those concerns you do have, in varying degrees of intensity, and should be marked higher on the scale.

For example:

This statement is very true of me at this time.	0	1	2	3	4	5	6	7
This statement is somewhat true of me now.	0	1	2	3	4	5	6	7
This statement is not at all true of me at this time.	0	1	2	3	4	5	6	7
This statement seems irrelevant to me.	0	1	2	3	4	5	6	7

Please respond to the items in terms of your present concerns, or how you feel about your involvement with facilitating **TEACH-STAT.** We do not hold to any one definition of this program, so please think of it in terms of your own perceptions of what it involves. Remember to respond to each item in terms of your present concerns about your involvement or potential involvement as a facilitator of the above-named innovation.

Thank you for taking time to complete this task. Please feel free to write any comments, reactions, or questions you may have about the items on the questionnaire. Also, use the last page to express any additional concerns you have about the innovation or this questionnaire.

0	1	2	3	4	5	6	7
Irrelevant	Not true of me now		Somewhat true of me now			Very true of me now	

1. I would like more information about the purpose of this innovation. 0 1 2 3 4 5 6 7

2. I am more concerned about facilitating use of another innovation. 0 1 2 3 4 5 6 7

3. I would like to develop working relationships with administrators and other change facilitators to facilitate the use of this innovation. 0 1 2 3 4 5 6 7

4. I am concerned because responding to the demands of staff relative to this innovation takes so much time. 0 1 2 3 4 5 6 7

5. I am not concerned about this innovation at this time. 0 1 2 3 4 5 6 7

6. I am concerned about how my facilitation affects the attitudes of those directly involved in the use of this innovation. 0 1 2 3 4 5 6 7

7. I would like to know more about this innovation. 0 1 2 3 4 5 6 7

8. I am concerned about criticism of my work with this innovation. 0 1 2 3 4 5 6 7

9. Working with administrators and other change facilitators in facilitating use of this innovation is important to me. 0 1 2 3 4 5 6 7

10. I am preoccupied with things other than this innovation. 0 1 2 3 4 5 6 7

11. I wonder whether use of this innovation will help or hurt my relations with my colleagues. 0 1 2 3 4 5 6 7

12. I need more information about and understanding of this innovation. 0 1 2 3 4 5 6 7

13. I am thinking that this innovation could be modified or replaced with a more effective program. 0 1 2 3 4 5 6 7

14. I am concerned about facilitating use of this innovation in view of limited resources. 0 1 2 3 4 5 6 7

15. I would like to coordinate my efforts with other change facilitators. 0 1 2 3 4 5 6 7

16. I would like to know what resources are necessary to adopt this innovation. 0 1 2 3 4 5 6 7

0	1	2	3	4	5	6	7
Irrelevant	Not true of me now		Somewhat true of me now			Very true of me now	

17.	I want to know what priority my superiors want me to give this innovation.	0 1 2 3 4 5 6 7
18.	I would like to excite those directly involved in the use of this innovation about their part in it.	0 1 2 3 4 5 6 7
19.	I am considering use of another innovation that would be better than the one that is currently being used.	0 1 2 3 4 5 6 7
20.	I would like to help others in facilitating the use of this innovation.	0 1 2 3 4 5 6 7
21.	I would like to determine how to enhance my facilitation skills.	0 1 2 3 4 5 6 7
22.	I spend little time thinking about this instruction.	0 1 2 3 4 5 6 7
23.	I see a potential conflict between facilitating this innovation and overloading staff.	0 1 2 3 4 5 6 7
24.	I am concerned about being held responsible for facilitating use of this innovation.	0 1 2 3 4 5 6 7
25.	Currently, other priorities prevent me from focusing my attentio on this innovation.	0 1 2 3 4 5 6 7
26.	I know of another innovation that I would like to see used in place of this innovation.	0 1 2 3 4 5 6 7
27.	I am concerned about how my facilitating the use of this innovation affects those directly involved in the use of it.	0 1 2 3 4 5 6 7
28.	Communication and problem-solving relative to this innovation take too much time.	0 1 2 3 4 5 6 7
29.	I wonder who will get the credit for implementing this innovation.	0 1 2 3 4 5 6 7
30.	I would like to know where I can learn more about this innovation.	0 1 2 3 4 5 6 7
31.	I would like to modify my mode of facilitating the use of this innovation based on the experiences of those directly involved in its use.	0 1 2 3 4 5 6 7

0	1	2	3	4	5	6	7
Irrelevant	Not true of me now		Somewhat true of me now			Very true of me now	

32. I have alternate innovations in mind that I think would better serve the needs of our situation. 0 1 2 3 4 5 6 7

33. I would like to familiarize other departments or persons with the progress and process of facilitating the use of this innovation. 0 1 2 3 4 5 6 7

34. I am concerned about finding and allocating time needed for this innovation. 0 1 2 3 4 5 6 7

35. I have information about another innovation that I think would produce better results than the one we are presently using. 0 1 2 3 4 5 6 7

PLEASE COMPLETE THE FOLLOWING:

36. Male _______ Female _______

37. Age _____ 20-29 _____ 30-39 _____ 40-49 _____ 50-59 _____ 60 or over

38. What, specifically, is your current position (e.g., Dean, Regional Service Center Evaluator, Secondary School Principal)?______________________________

39. How many years have you been in your current position?______________________

40. In total, how many years have you been in a position similar to the one you have now? ________________

41. How long have you been involved with the implementation of the innovation you focused on for this questionnaire? Years ______ Months _______

42. Are you currently involved in implementing any other innovation? Yes ____ No ____

43. Use this space (and back of this page) to express any concerns you have not been able to indicate in the questionnaire.

44. What do you hope to learn from this workshop?

APPENDIX E.
Interview Questions

INTERVIEW QUESTIONS

1. What is effective staff development?

2. What knowledge do you need to have to be an effective workshop leader?

3. What would you like to know in order to be an effective TEACH-STAT workshop leader?

4. How comfortable are you in teaching teachers? (Why?)

5. Do you see yourself as a change facilitator?

APPENDIX F.
Participant Data
Self-Reported on First Administration of
Staff Development Style Inventory
and
Change Facilitator Stages of Concern Questionnaire

SITE	CODE	SEX	YRS EXP	GRADE TAUGHT 1993-94	YEAR ENTERED TEACH-STAT	TAUGHT WORK-SHOPS BEFORE?
ASU	29-4-20	F	4	5	93	yes
ASU	15-6-12	F	12	2	92	yes
ASU	42-10-23	F	5	6-8	92	no
ASU	21-2-16	F	18	K	92	yes
ASU	20-3-29	F	13	6	93	yes
ASU	34-7-29	F	16	5	92	yes
ASU	20-6-20	M	20	3	92	no
ASU	32-3-20	F	20	3	92	yes
ASU	28-10-13	F	15	6	93	yes
UNCC	59-10-18	F	5	3	92	yes
UNCC	6-6-6	F	23	3	93	no
UNCC	15-10-1	F	15	5	93	no
UNCC	28-1-2	F	19	1	93	yes
UNCC	10-6-28	F	18	5	92	yes
UNCC	30-8-30	F	21	6	93	yes
UNCC	26-6-22	F	4	5	93	yes
UNCC	20-6-15	F	10	5-6	92	yes
UNCC	26-7-27	F	11	4	93	yes
UNCC	32-9-21	F	17	3	92	yes
UNCG	37-6-10	F	5	5	93	no
UNCG	43-12-10	F	5	5	92	yes
UNCG	33-2-18	F	3	2	93	yes
UNCG	19-9-18	F	21	2	93	yes
UNCG	34-2-21	F	9	2-3	93	yes
UNCG	19-10-21	F	21	6	93	no
UNCG	13-1-26	F	25	4	93	yes
UNCG	30-12-14	F	16	K	93	no
UNCG	29-9-19	F	19	K	93	yes
UNCG	19-8-26	F	4	3	93	yes

SITE	CODE	SEX	YRS EXP	GRADE TAUGHT 1993-94	YEAR ENTERED TEACH-STAT	TAUGHT WORK-SHOPS BEFORE?
UNCW	42-8-22	F	5	2	92	yes
UNCW	38-11-14	F	13	2	93	yes
UNCW	30-8-30	F	20	5	93	yes
UNCW	42-12-22	F	3	2	93	yes
UNCW	21-10-11	F	12	1-3	92	yes
UNCW	23-1-19	F	8	4	93	yes
UNCW	25-3-21	F	6	1	93	yes
WCU	24-1-4	F	14	6	92	yes
WCU	23-12-16	F	23	K-5	92	yes
WCU	26-10-26	F	21	6-7	92	yes
WCU	13-9-18	F	16	K-5	93	yes
WCU	26-6-30	F	25	4	93	yes
WCU	25-1-23	F	4	6	93	no
WCU	26-3-31	F	18	7	93	yes
WCU	26-1-3	F	14	K-5	92	yes
WCU	23-5-12	F	19	K	93	no

APPENDIX G.
Frequencies of Responses by Site for *Staff Development Style Inventory* (Items 1-25)

	ADMINISTRATION #1							ADMINISTRATION #2							ADMINISTRATION #3						
	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng
ITEM #1																					
ASU			1	7	1	**4**	2	1	1	2	2	3	**4**	4			3	4	2	**4**	2
UNCC		1	1	4	4	**4**	3			6	3	1	**3**	2		2	6	2		**3**	2
UNCG			2	6	2	**4**	2			3	6	1	**4**	2		1	3	6		**4**	2
UNCW			4	1	2	**3**	2			3	3	1	**4**	2			2	4	1	**4**	2
WCU		1	4	2	2	**3**	3		1	6	1	1	**3**	3		2	4	3		**3**	2
Total		2	12	20	11	**4**	3	1	2	20	15	7	**3**	4		5	18	19	3	**3**	3
ITEM #2																					
ASU	5	3		1		**1**	3	6	3				**1**	1	6	3				**1**	1
UNCC	5	3	1		1	**1.5**	4	9				1	**1**	4	8	2				**1**	1
UNCG	7	1	1	1		**1**	3	6	4				**1**	1	5	3	1		1	**1.5**	4
UNCW	5	1		1		**1**	3	6	1				**1**	1	6	1				**1**	1
WCU	7	2				**1**	1	7	2				**1**	1	5	4				**1**	1
Total	29	10	2	3	1	**1**	4	34	10			1	**1**	4	30	13	1		1	**1**	4
ITEM #3																					
ASU			2	7		**4**	1			1	4	4	**4**	2				5	4	**4**	1
UNCC	1	2	4	3		**3**	3		1	1	2	6	**5**	3			3	4	3	**4**	2
UNCG			8	2		**3**	1			6	3	1	**3**	2		1	4	4	1	**3.5**	3
UNCW			1	4	2	**4**	2			2	4	1	**4**	2				5	2	**4**	1
WCU		1	4	2	2	**3**	3			3	4	2	**4**	2	1		2	5	1	**4**	4
Total	1	3	19	18	4	**3**	4		1	13	17	14	**4**	3	1	1	9	23	11	**4**	4

	ADMINISTRATION #1							ADMINISTRATION #2							ADMINISTRATION #3						
	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng
ITEM #4																					
ASU	1		1	5	2	**4**	4			1	4	4	**4**	2	1	1	2	1	4	**4**	4
UNCC			1	3	6	**5**	2				2	8	**5**	1				4	6	**5**	1
UNCG				3	7	**5**	1			3	5	2	**4**	2			1	7	2	**4**	2
UNCW			1	4	2	**4**	2				4	3	**4**	1		1		5	1	**4**	3
WCU			1	3	5	**5**	2				5	4	**4**	1				4	5	**5**	1
Total	1		4	18	22	**4**	4			4	20	21	**4**	2	1	2	3	21	18	**4**	4
ITEM #5																					
ASU		1	6	2		**3**	2	2	1	4	2		**3**	3	1	1	4	3		**3**	3
UNCC		1	4	3	2	**3.5**	3		3	2	4	1	**3.5**	3			4	4	2	**4**	2
UNCG			7	1	2	**3**	2		1	6	3		**4**	2		1	6	2	1	**3**	3
UNCW		1	2	2	2	**4**	3	2		1	3	1	**4**	4			3	2	2	**4**	2
WCU		2	4	2	1	**3**	3	1	2	3	2	1	**3**	4		5	3	1		**2**	2
Total		5	23	10	7	**3**	3	5	7	16	14	3	**3**	4	1	7	20	12	5	**3**	4
ITEM #6																					
ASU		1	3	4	1	**4**	3				7	2	**4**	1				2	7	**5**	1
UNCC		1	2	2	5	**4.5**	3			1	2	7	**5**	2	1		2	2	5	**4.5**	4
UNCG				4	6	**5**	1				5	5	**4.5**	1				4	6	**5**	1
UNCW			2	1	4	**5**	2			1	3	3	**4**	2	1			4	2	**4**	4
WCU			2	4	3	**4**	2				4	5	**5**	1			1	3	5	**5**	2
Total		2	9	15	19	**4**	3			2	21	22	**4**	2	2		3	15	25	**5**	4

	ADMINISTRATION #1							ADMINISTRATION #2							ADMINISTRATION #3						
	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng
ITEM #7																					
ASU	5	3	1			1	2	5	3	1			1	2	7	1		1		1	3
UNCC	6	2	2			1	2	7	2		1		1	3	7	2	1			1	2
UNCG	2	5	3			2	2	4	4	2			2	2	2	3	5			2.5	2
UNCW	6			1		1	3	6	1				1	1	7					1	0
WCU	2	4	3			2	2	4	4	1			2	2	5	1	1	2		1	3
Total	21	14	9	1		2	3	26	14	4	1		1	3	28	7	7	3		1	3
ITEM #8																					
ASU			2	3	4	4	2				4	5	5	1				2	7	5	1
UNCC		1	1	2	6	5	3				2	8	5	1				2	8	5	1
UNCG				4	6	5	1				1	9	5	1				2	8	5	1
UNCW				3	4	5	1	1			1	5	5	4				2	5	5	1
WCU				4	5	5	1				4	5	5	1			1	2	6	5	2
Total		1	3	16	25	5	3	1			12	32	5	4			1	10	34	5	2
ITEM #9																					
ASU	5	4				1	1	8	1				1	1	9					1	0
UNCC	6	2	2			1	2	7	2	1			1	2	8	2				1	1
UNCG	4	5	1			2	2	5	5				1.5	1	6	3	1			1	2
UNCW	5	2				1	1	6	1				1	1	6	1				1	1
WCU	5	3		1		1	3	7	2				1	1	7	1	1			1	2
Total	25	16	3	1		1	3	33	11	1			1	2	36	7	2			1	2

	ADMINISTRATION #1							ADMINISTRATION #2							ADMINISTRATION #3						
	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng
ITEM #10																					
ASU	3	4	2			2	2	7	1	1			1	2	6	2		1		1	3
UNCC	4	4	1		1	2	4	8		2			1	2	4	5		1		2	3
UNCG	7	3				1	1	3	5	1	1		2	3	4	5	1			2	2
UNCW	2	4		1		2	3	3	3		1		2	3	6	1				1	1
WCU	5	4				1	1	4	4	1			2	2	7	1	1			1	2
Total	21	19	3	1	1	2	4	25	13	5	2		1	3	27	14	2	2		1	3
ITEM #11																					
ASU	6	2	1			1	2	8	1				1	1	9					1	0
UNCC	6	1	3			1	2	7	2		1		1	3	5	4		1		1.5	3
UNCG	8	1	1			1	2	6	3	1			1	2	4	5	1			2	2
UNCW	5	1	1			1	2	5	1	1			1	2	6	1				1	1
WCU	7	2				1	1	4	5				2	1	8		1			1	2
Total	32	7	6			1	2	30	12	2	1		1	3	32	10	2	1		1	3
ITEM #12																					
ASU		1	4	4		3	2	1		1	6	1	4	4			3	2	4	4	2
UNCC		1	3	2	4	4	3	2		1	4	3	4	4			4	5	1	4	2
UNCG			4	4	2	4	2			6	2	2	3	2			3	6	1	4	2
UNCW			5	1	1	3	2	1		1	4	1	4	4	1		4	1	1	3	4
WCU			2	5	2	4	2	1	1	1	4	2	4	4	2		1	5	1	4	4
Total		2	18	16	9	4	3	5	1	10	20	9	4	4	3		15	19	8	4	4

	ADMINISTRATION #1							ADMINISTRATION #2							ADMINISTRATION #3						
	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng
ITEM #13																					
ASU		2	6	1		3	2		2	5	2		3	2		1	4	2	2	3	3
UNCC	3	2	3		2	2.5	4		4	5		1	3	3		2	6	1	1	3	3
UNCG	1	3	4	2		3	3		2	6	2		3	2		1	8	1		3	2
UNCW	2		3	2		3	3	1	1	4		1	3	4	1		5		1	3	4
WCU	1	2	6			3	2			8	1		3	1		3	2	3	1	3	3
Total	7	9	22	5	2	3	4	1	9	28	5	2	3	4	1	7	25	7	5	3	4
ITEM #14																					
ASU			3	5	1	4	2			3	6		4	1			1	4	4	4	2
UNCC		2	3	1	4	3.5	3			4	4	2	4	2			3	4	3	4	2
UNCG			3	3	4	4	2			3	4	3	4	2		1	2	6	1	4	3
UNCW		1	3	1	2	3	3			1	5	1	4	2			2	2	3	4	2
WCU			1	6	2	4	2		1	1	4	3	4	3			1	4	4	4	2
Total		3	13	16	13	4	3		1	12	23	9	4	3		1	9	20	15	4	3
ITEM #15																					
ASU	4	4	1			2	2	8	1				1	1	9					1	0
UNCC	6	3		1		1	3	10					1	0	8	2				1	1
UNCG	9	1				1	1	6	3	1			1	2	6	4				1	1
UNCW	3	3	1			2	2	7					1	0	7					1	0
WCU	8	1				1	1	6	3				1	1	7	1		1		1	3
Total	30	12	2	1		1	3	37	7	1			1	2	37	7		1		1	3

	ADMINISTRATION #1							ADMINISTRATION #2							ADMINISTRATION #3						
	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng
ITEM #16																					
ASU	1	3	3	2		3	3	4	3	1	1		2	3	4	2	2	1		2	3
UNCC	5	3	1	1		1.5	3	7	1	2			1	2	5	2	3			1.5	2
UNCG	3	6	1			2	2	3	6		1		2	3	2	5	2	1		2	3
UNCW	3	2	1	1		2	3	2	3	1	1		2	3	3	3	1			2	2
WCU	4	3	2			2	2	3	3	2	1		2	3	4	2	2	1		2	3
Total	16	17	8	4		2	3	19	16	6	4		2	3	18	14	10	3		2	3
ITEM #17																					
ASU	8		1			1	2	8	1				1	1	9					1	0
UNCC	7	2	1			1	2	10					1	0	10					1	0
UNCG	10					1	0	7	3				1	1	8	1	1			1	2
UNCW	6		1			1	2	7					1	0	6	1				1	1
WCU	9					1	0	7	2				1	1	7	1		1		1	3
Total	40	2	3			1	2	39	6				1	1	40	3	1	1		1	3
ITEM #18																					
ASU	2	3	4			2	2	1	2	6			3	2	1	1	7			3	2
UNCC	1	6	3			2	2		3	6	1		3	2		3	7			3	1
UNCG	1	5	4			2	2	1	2	7			3	2	1	5	4			2	2
UNCW	1	3	3			2	2		3	4			3	1	1	2	4			3	2
WCU	1	2	6			3	2	1	3	5			3	2	1	3	5			3	2
Total	6	19	20			2	2	3	13	28	1		3	3	4	14	27			3	2

	ADMINISTRATION #1					Med	Rng	ADMINISTRATION #2					Med	Rng	ADMINISTRATION #3					Med	Rng
	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng
ITEM #19																					
ASU	2	5	2			2	2	2	4	3			2	2	1	4	4			2	2
UNCC	1	6	3			2	2	1	6	3			2	2		6	4			2	1
UNCG	2	7	1			2	2	1	5	4			2	2	1	6	3			2	2
UNCW	2	2	3			2	2	1	3	3			2	2	1	3	3			2	2
WCU	2	4	3			2	2	2	5	2			2	2	2	4	3			2	2
Total	9	24	12			2	2	7	23	15			2	2	5	23	17			2	2
ITEM #20																					
ASU	1	8				2	1	3	6				2	1	3	6				2	1
UNCC	5	2	3			1.5	2	5	4	1			1.5	2	3	7				2	1
UNCG	5	3	2			1.5	2	5	3	2			1.5	2	3	7				2	1
UNCW	3	2	2			2	2	3	3	1			2	2	1	5	1			2	2
WCU	7	1	1			1	2	6	2	1			1	2	7	2				1	1
Total	21	16	8			2	2	22	18	5			2	2	17	27	1			2	2
ITEM #21																					
ASU		6	3			2	1	1	8				2	1		8	1			2	1
UNCC	5	2	2	1		1.5	3	4	4	2			2	2	3	6	1			2	2
UNCG	3	5	2			2	2	2	5	3			2	2	3	5	2			2	2
UNCW	2	3	2			2	2	2	2	2	1		2	3	2	3	2			2	2
WCU	2	5	1	1		2	3	4	5				2	1	6	3				1	1
Total	12	21	10	2		2	3	13	24	7	1		2	3	14	25	6			2	2

	ADMINISTRATION #1							ADMINISTRATION #2							ADMINISTRATION #3						
	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng
ITEM #22																					
ASU	1	7	1			**2**	2	3	6				**2**	1	4	5				**2**	1
UNCC	6	3	1			**1**	2	5	5				**1.5**	1	4	5	1			**2**	2
UNCG	4	4	2			**2**	2	3	6	1			**2**	2	3	6	1			**2**	2
UNCW	3	3	1			**2**	2	4	2	1			**1**	2	4	2	1			**1**	2
WCU	5	4				**1**	1	6	3				**1**	1	7	2				**1**	1
Total	19	21	5			**2**	2	21	22	2			**2**	2	22	20	3			**2**	2
ITEM #23																					
ASU	1	6	2			**2**	2	3	6				**2**	1	2	6	1			**2**	2
UNCC	2	4	4			**2**	2	8	2				**1**	1	2	7	1			**2**	2
UNCG	6	2	2			**1**	2	3	4	3			**2**	2	1	9				**2**	1
UNCW	3	3	1			**2**	2	3	3	1			**2**	1	2	4	1			**2**	2
WCU	7	2				**1**	1	5	4				**1**	1	7	2				**1**	1
Total	19	17	9			**2**	2	22	19	4			**2**	2	14	28	3			**2**	2
ITEM #24																					
ASU	1	4	4			**2**	2		5	4			**2**	1		6	3			**2**	1
UNCC	3	5	1	1		**2**	3	2	1	6	1		**3**	3	1	4	3	2		**2.5**	3
UNCG		5	5			**2.5**	1	1	4	5			**2.5**	2		6	4			**2**	1
UNCW	1	5	1			**2**	2		4	3			**2**	1	1	5	1			**2**	2
WCU	3	6				**2**	1	3	3	3			**2**	2	2	6	1			**2**	2
Total	8	25	11	1		**2**	3	6	17	21	1		**2**	3	4	27	12	2		**2**	3

	ADMINISTRATION #1							ADMINISTRATION #2							ADMINISTRATION #3						
	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng	1	2	3	4	5	Med	Rng
ITEM #25																					
ASU	6	3				**1**	1	4	5				**2**	1	7	2				**1**	1
UNCC	7	3				**1**	1	6	4				**1**	1	5	5				**1.5**	1
UNCG	5	4	1			**1.5**	2	4	5	1			**2**	2	2	8				**2**	1
UNCW	4	2	1			**1**	2	2	4	1			**2**	2	3	3	1			**2**	2
WCU	5	4				**1**	1	6	2	1			**1**	2	7	2				**1**	1
Total	27	16	2			**1**	2	22	20	3			**2**	2	24	20	1			**1**	2

APPENDIX H.
Participant Responses for Item #26 of *Staff Development Style Inventory*

SITE	CODE	ITEM #26 ADMIN 1	ITEM #26 ADMIN 2	ITEM #26 ADMIN 3
ASU	29-4-20	•Relevance to real-life, day to day experience in the classroom •Appropriate level of instruction •Follow-up	•Relevance •High activity/participation level •Realistic approaches	•Relevance to classroom •High interest level held in a variety of ways •Ease of use in actual classroom
ASU	15-6-12	•Participant involvement •Leader well prepared •Manipulative use	•Participant involvement •Leader well prepared •Materials ready	•Involve participants •Show how can use in classroom •Correlate to curriculum
ASU	42-10-23	•Relevant materials that will easily be used in the classroom •Objectives from subject areas clearly covered, with minimum time & planning •Money is given to buy necessary materials or materials are provided	•Group bonding •Useful materials •Change in attitude (excited about it)	•Usable materials to take back to classroom •Sharing ideas with other teachers •Keeping up with new topics
ASU	21-2-16	•Knowledge of subject area •Sensitivity to participants needs •Workshop relative to needs of participants	•Confidence with presentation •Knowledge of material •Effective presentation skills	•Knowledge of material to be presented •Knowledge of participants abilities & backgrounds •Effective presentation skills
ASU	20-3-29	•Organized approach--leader knows "where she's going" •Fast-paced...not a lot of "lull" time •Access to relevant strategies/materials to be used in the classroom	•Relevance (Is this worth my time?) •Pacing (Participants have little "lull" time) •Hands-on experience (Participants will understand and remember)	•Relevance to participants..."Can I use this in my classroom?" •Fast paced, organized presentation
ASU	34-7-29	•It relates to classroom needs and Standard Course of Study •It gives practical hands-on experiences so participants can use what they learn with students •It gives participants opportunities to share ideas	•Relates to the curriculum or participants needs or to the agenda •Presentation •Participation	•That the information being taught is relevant to the participants (i.e., curriculum aligned) •Presentation (i.e., several techniques used) •Experience (participants actually have concrete/hands-on experience using material or knowledge & follow-up
ASU	20-6-20	•Fulfilling the need of the participant by actively involving everyone •Clear objectives •Variety of examples offered and explored	•Relative examples •Attainable objectives	•Meeting the needs of the participants •Using relative examples •Sense of humor

ASU	32-3-20	•Setting clear goals about what is to be accomplished •Communicating effectively with workshop participants •Checking to see that goals are being met	•To communicate goals of workshop clearly •To help participants meet goals •To assess what has been accomplished through workshop after workshop ends	•That goals are clearly communicated •That leaders help participants gain understanding of objectives by allowing participants to get involved actively •That leaders take into consideration the wide range of participants' base of knowledge about the topic of staff development
ASU	28-10-13	•Material is relevant •Activity oriented •Presented at time of day that is conducive to learning, [not] at 4:00 p.m.	•Relevant material •Appropriate timing (when it is done) •Setting	•Appropriateness •Hands on •Timed when participants are ready and eager rather than at the end of day

SITE	CODE	ITEM #26 ADMIN 1	ITEM #26 ADMIN 2	ITEM #26 ADMIN 3
UNCC	59-10-18	•Knowledge and relevance to the Standard Course of Study •Prepared facilitators •Active involvement from participants	•All participants are engaged in problem solving and instructor used as a facilitator •Pedagogical content knowledge •Making content relevant to the learner	[NO RESPONSE]
UNCC	6-6-6	•A good instructor •The students have a clear understanding of the workshop •Interest	•Know your subject matter •Be well prepared •Need people skills	•Time of day •Communication •Demonstration
UNCC	15-10-1	•Interest •Involved staff •Effective instruction	•Presenter knows the material •Presenter is well prepared •Presenter must have people skills--making participants feel welcomed and wanting to participate	•Information that can be put to use in the classroom •Staff interested in subject matter •Instructors know subject
UNCC	28-1-2	•Defined purpose •Involvement of participants •Lively format	•Activities that provide hands-on experience for participants •Posing open-ended questions; not an instructor who appears to know it all •Brisk pace and eye contact with participants	•Participant involvement •Clearly defined goals •Well prepared instructors
UNCC	10-6-28	•Pace •Variety •Relating information to the classroom	•Topic relevant •Use of time	•Variety of materials used in instruction •Time to process and share •Easygoing pace
UNCC	30-8-30	•Make it relevant to classroom use •Keep participants involved •Keep it interesting and paced effectively	•Facilities are comfortable •Relevant to participants needs--not a requirement for participant •Well planned and organized	•Participants see relevancy of topics •Active involvement of participants •Comfortable surroundings
UNCC	26-6-22	•Enthusiastic presenter •Presenter who knows his/her material •Variety of activities	•Enthusiasm •Knowledge •Brisk pace, but not so brisk you lose people along the way	•Enthusiastic presenter •Knowledgeable presenter •Relevant content
UNCC	20-6-15	•Relevance to participants class situations •Thorough preparedness by facilitator •Time well managed	•Relevant •Good use of time •Well qualified and prepared facilitator	[NO RESPONSE]

UNCC	26-7-27	•Hitting all realms of learning styles •Posing questions which enable participants to engage in critical thinking •Enthusiastic leaders with participants who want to be there	•Presenter has a good understanding of content being presented and comes across with enthusiasm •Participants are not passive during workshop but involved throughout via discussion, hands-on, thinking activities, etc. •Materials needed are available and all time is used wisely	•Know content being taught •Enthusiasm for teaching •Active participation by workshop participants
UNCC	32-9-21	•Relevance to curriculum •Participants actively involved •Prepared facilitator	•Active participation by workshop participants •Making content relevant to learner/participant •Participants engage in problem solving, open discussion, able to share	•Content is relevant •Teacher can easily take back to classroom as use without much preparation

SITE	CODE	ITEM #26 ADMIN 1	ITEM #26 ADMIN 2	ITEM #26 ADMIN 3
UNCG	37-6-10	•Brisk pace •Activities shared that can easily be implemented •Time to do activities in workshop as practice	•The workshop needs to have relevant information to me presented enthusiastically by presenters that have tried the activities with students. •I want something I can take back to my classroom and use. •I want to practice at the workshop if possible--doing is remembering and understanding.	•Material that can be adapted to Standard Course of Study. •Good pace by leaders. •Knowledge of material by leaders.
UNCG	43-12-10	•Rapport with group--not being insulting or controlling •Sharing of ways the activities went in your classroom and having many examples of student work and student responses •Knowing your material and being prepared!	•Knowing the material well •Sharing actual student work and experiences •A motivating, enthusiastic speaker that relates well to the participants.	•Rapport with the group of participants and the other leaders, if others than yourself •Knowledge of material •Sharing student work and examples.
UNCG	33-2-18	•The staff development person should have a clear understanding of their content area in which they are teaching. •They should have used/taught that skill to their own students to give input to their trainees. •They should be a motivational person that lets the trainees become involved and feel good about their performance.	•Very familiar with curriculum •Environment is very working--overhead, etc. •Good listener and speaker	•Being very familiar and competent with your content area •Presentation of material in precise manner with proper grammar and articulation •Treating everyone with respect
UNCG	19-9-18	•Know the needs of the participants •Realize that many ideas are new and it might take time to change opinions about new innovations •Vary the activities.	•Individual gains knowledge or skill •Individual can use all or part of new material in reall life--their classrooms •Individual is affirmed	•Meeting the needs of participants •Knowing content •Keeping interest level high
UNCG	34-2-21	•Teachers being involved, not being lectured to •Follow-up workshops or a coach to come to the school to help you implement workshop in the classroom •Materials given to participants so they can implement workshop right away	•Follow-up activity or a person or persons that you can call upon for ideas and solutions to problems. •Very familiar with curriculum that teachers are using in their classroom that goes with the staff development. •Participants do not feel uncomfortable with the presenter.	•Follow-up in some way after the workshop. •Participants discovering answers, not being told this is the wrong way or right way. •Participants being involved in workshop.

UNCG	19-10-21	•Relevant material •Easily adaptable to my classroom situation	•Relevant •Interesting •Informative	•Relevant to my teaching assignment •Informative •Interesting
UNCG	13-1-26	•Staying within or less than time allotment (attitude) •Applicable information •Provision of facilitation when attendance walks out	•Relevance •Professionalism (enthusiasm, expectations, ...) •Preparation	•Comfortable environment •Competent presenters •Good attitude
UNCG	30-12-14	•Subject presented in an interesting, enthusiastic method •Facilitator must have knowledge of subject •Facilitator must be prepared	•Knowledge of material •Being fully prepared •Enthusiasm, self-confidence	•Knowledge of material •Enthusiasm of facilitator •Interesting format
UNCG	29-9-19	•Relevant to classroom--"user friendly" •Taught by someone who knows through experience what they are teaching •Challenging yet realistic to implement	•Experienced knowledgeable leaders •Meaningful content •Active participation	•Relevant (or applicable) to classroom •Well organized with active participation
UNCG	19-8-26	•Relative to area of need •Ease of implementation in the classroom •Motivating, stimulating, "let me do it" format	•Can readily be put into practice in the classroom •Active participation required of those attending •Increases participant's knowledge base	•Enrich the participant's knowledge base •Be easily implemented in the classroom

SITE	CODE	ITEM #26 ADMIN 1	ITEM #26 ADMIN 2	ITEM #26 ADMIN 3
UNCW	42-8-22	•A leader who knows the subject well •Participants who actually do the activities, not just hear about them •Good organization--agenda, materials and supplies ready, start on time	•Innovative techniques--backed by research •Active participation--participants do the activities •Clear objectives with a well-organized presenter	•Relevant, accurate, and innovative information •Well-organized activities (good use of time)
UNCW	38-11-14	•Not a lot of lecture •Hands on activities •Ideas that can be used in classroom	•Useful to participant •Involves everyone in workshop •Use different techniques/styles of learning	•Interesting topic •Well planned/organized •Hands on activities
UNCW	30-8-30	•Participation by all who are affected by the decisions made (site based decision/manage). •Not requiring attendance but recommending it •Open discussion allowed (small group then large (whole) group)	•Team unity and sharing •Time to do the work/activity •Address needs of all participants	•Time to get to know one another and strengths of each other. •Give chance to communicate ideas with each other. •Leader is a facilitator, not just instructor.
UNCW	42-12-22	•Hands on experience •Clear goals and outcomes stated •Organized agenda	•Involve the learner •State goals and objectives	•State goals, expected outcomes •Hands on experience
UNCW	21-10-11	•Participants choose to be there •Knowledge of leader(s) •Adequate materials	•Leader(s) and participants work cooperatively to determine direction when problems arise	•Well organized •Well prepared instructors •Participant involvement
UNCW	23-1-19	•Real applicability •Lots of concrete materials •Enough time (not rushed!)	•Positive and comfortable setting •Opportunities to participate •Applicable content	•Affective setting •Clear terminal objectives and related objectives •Open discourse between facilitator and participants
UNCW	25-3-21	•Relevant to participants •Hands on	•Varied activities •Hands on •Clear presenter	•Being aware of what participants already know •Varied activities

SITE	CODE	ITEM #26 ADMIN 1	ITEM #26 ADMIN 2	ITEM #26 ADMIN 3
WCU	24-1-4	•Relevance to teaching/learning situations •Innovative approaches with practice time and positive reinforcement and encouragement •Discussion/processing time	•Positive environment •Relevance to participants' learning/teaching situation •Involvement of participants in activities	•Positive comfortable environment •Opportunities for participants to work in small groups to explore topics •Knowledgeable, effective facilitators (not lecturers) who relate well to participants
WCU	23-12-16	•The goals of the workshop reflect a felt need of the participants. •Workshop instructors are well organized and well versed in the topics they present. •Workshop is presented at a time and under conditions that are conducive to learning.	•Workshop fulfills a real and felt need of participants •Workshop is strong in knowledge base and techniques are up to date •Workshop environment is comfortable (as to time of day and physical surroundings) and non-threatening to participants, thus supportive of teachers.	•Topic meets a felt need of teachers •Supportive, non-threatening climate •Knowledgeable instructors
WCU	26-10-26	•Providing topics and information that the participants request rather than selected topics-Interesting leaders •Allowing participants to work on concepts/materials relevant to their classrooms •Having participants have time to do "make and take" activities with them.	•Topics should be chosen by participants not administrators •Hands on activities •Good leaders	•Topics relevant to participants •Use new materials
WCU	13-9-18	•Group activities •Open-ended activities •Group discussions	•Eagerness to learn (share) about topic •Cooperation with others •Interest	•Expectations clearly stated •Cooperative learning activities •Expectations
WCU	26-6-30	•That each participant will have some good information and materials to take back with them to share with their students and other teachers. I would want the workshop to be very meaningful and a learning experience with new and fresh ideas.	•Using hands on manipulatives and encouraging participation by all.	•Letting the participants be involved, using open-ended problems, manipulatives, and giving them something--ideas, materials, etc.--to take with them to use in the classroom.

WCU	25-1-23	•Staff development should be designed to meet the needs of the classroom teacher, i.e., workshops focusing on areas where teacher needs new innovative methods of presenting material. •Designed to keep teacher up to date on everchanging topics. •Designed to provide teacher with different teaching methods thus getting away from traditional lecture.	•Meeting the needs of those in attendance •Providing hands-on activities relevant to topic presented •Making it interesting and fun!	•Meeting the needs of participants •Modeling concepts they can use in the classroom •Providing staff development that presents up-to-date topics
WCU	26-3-31	•Make it interesting •Make it easy to use along with the assigned curriculum •Make it something the teachers really want to use and share	•Relevant •Not boring •Something I get excited about and want to use NOW	[NO RESPONSE]
WCU	26-1-3	•Finding out their needs, wishes •Developing strategies to meet these needs •Frequent evaluation of progress	•Good planning ahead of time •A variety of experiences •Flexibility on part of leaders	•Good planning beforehand, being prepared •Flexibility, resourcefulness •Choosing topics relevant to participants' needs
WCU	23-5-12	•Giving information and materials relevant to school classroom activities •Time to develop materials and strategies in class •Hands on experience	•Setting goals at the beginning of each new lesson •Work together in small groups to solve problems •The leader clearly states conclusions (never leave participant to guess correct answer)--if not by leader, a general consensus.	•Organization •Directions

APPENDIX I.
Participant Responses for Item #27 of *Staff Development Style Inventory*

SITE	CODE	ITEM #27 ADMIN 1	ITEM #27 ADMIN 2	ITEM #27 ADMIN 3
ASU	29-4-20	•Feeling of student ownership in learning process •Organization /clarity of thought and process--direction •Appropriate level of instruction	•Student ownership in their learning situations •Variety of style so that all children's individualities are tapped •Clarity of how things are how to be handled	•Enthusiasm for learning and presentation •Genuine concern and care for students •Ability to organize lots of "things" and see the "big picture"
ASU	15-6-12	•Student involvement •Hands-on activities •Teacher as leader and motivator	•Teacher prepared •Use of hands-on •Student involvement	•Provide concrete hands-on experiences •Relate to student experiences
ASU	42-10-23	•All students receive instruction and knowledge through teaching •Students learn to think for themselves and become problem solvers •Variety of materials and technology used	•Comprehension of concept •Higher-level thinking skills •Application to real world	•All students receive some sort of learning from the topic •Children should see learning relevant to life •High level thinking skills
ASU	21-2-16	•Students actively involved in learning process •Knowledge of subject matter •Instruction relative to needs of students	•Knowledge of material •Knowledge of developmental stages of children •Effective presentation skills	•Knowledge of material to be presented •Knowledge of students developmental abilities •Effective presentation skills
ASU	20-3-29	•Enthusiasm •Variety in teaching methods •Lots of concrete, hands-on experiences	•Enthusiasm •Preparedness •Hands-on experiences	•Organized approach...know "where you're going" •Enthusiasm...get excited and act excited about the topic
ASU	34-7-29	•Instruction that is relevant to N.C. Standards and at the same time relevant to student interests •Hands on approach and discovery by investigation •Ways to incorporate different student's learning styles	•Relative to instruction of curriculum •Presentation •Active participation from students	•They would be the same for the classroom as for the adults--except adults like less uncertainty
ASU	20-6-20	•Classroom management •Knowledge of subject matter •Communicating well with all types of students	•Being able to effectively communicate with all levels of children •Adapting different techniques for different learning styles	Same as above (reference to item #26) [•Meeting the needs of the participants] [•Using relative examples] [•Sense of humor]

ASU	32-3-20	•Understanding the academic needs of ones' students and knowing how to meet those needs •Setting clear goals of what is to be learned for students with student input •Checking to see if students are meeting academic goals set	•To understand individual needs of students •To plan with students on meeting those needs •Assessing to see if needs have been met	•Teachers modify lessons for different style of learners •Teachers communicate with students about goals to be achieved •Assessing students' understanding of concepts taught is done frequently
ASU	28-10-13	•Activity oriented •Curriculum based	•Flexibility of teacher •Environment that allows exploration & discussion •Hands-on	•Hands-on •Real life examples •Discussion within small/whole group

SITE	CODE	ITEM #27 ADMIN 1	ITEM #27 ADMIN 2	ITEM #27 ADMIN 3
UNCC	59-10-18	•Proper planning and implementation •Active classroom participation •Following a guide of curriculum	•Making content relevant •Engaging children in hands-on approach •Problem solving activities	[NO RESPONSE]
UNCC	6-6-6	[NO RESPONSE]	•Same as above [reference to #26] [•Know your subject matter] [•Be well prepared] [•Needs people skills]	•Communication •Patience •Tender love and care
UNCC	15-10-1	[NO RESPONSE]	•Same as above [reference to #26] [•Presenter knows the material] [•Presenter is well prepared] [•Presenter must have people skills--making participants feel welcomed and wanting to participate] •Teacher must also maintain discipline	•Atmosphere where all children can learn •Teacher knows the material to be taught •Students investigate and discover
UNCC	28-1-2	•Interaction with students (all involved) •Humor •Fitting your teaching to the students, not making your students fit your teaching	•Knowledge of subject •Good relationship with children •Ability to look at things from different viewpoints	•Student involvement •Knowledgeable about subject •Clearly defined goals
UNCC	10-6-28	•Active involvement •Hands on	•Use of time •Meeting needs of individual students as well as covering material specified in BEP [Basic Education Plan]	•Variety of materials used in instruction •Time to process and share •Easygoing pace
UNCC	30-8-30	•Use of cooperative learning •Keep children involved •Receptive to different learning styles	•Well planned & organized •Flexible to different learning styles •Active participation	•Active involvement •Providing experiences for all learning styles •Opportunities to apply learning to real-life situations
UNCC	26-6-22	•Enthusiastic teacher •Good questioning strategies to install HOTS [higher order thinking skills] •Teacher who adjusts teaching styles for presentation based on children's needs	•Enthusiasm •Knowledge •Love for children	•Enthusiastic teacher •Knowledgeable teacher •One who can motivate children

UNCC	20-6-15	•Same as #26 [•Relevance to participants class situations] [•Thorough preparedness by facilitator] [•Time well managed]	•Teaching topics and style relevant to the students experience and needs •Pace of instruction based on student need •Atmosphere of mutual respect	[NO RESPONSE]
UNCC	26-7-27	•Same as above 3 [reference to #26] [•Hitting all realms of learning styles] [•Posing questions which enable participants to engage in critical thinking] [•Enthusiastic leaders with participants who want to be there]	•Same as above; on somewhat of a different level [reference to #26] [•Presenter has a good understanding of content being presented and comes across with enthusiasm] [•Participants are not passive during workshop but involved throughout via discussion, hands-on, thinking activities, etc.] [•Materials needed are available and all time is used wisely]	•Same [reference to #26] [•Know content being taught] [•Enthusiasm for teaching] [•Active participation by workshop participants]
UNCC	32-9-21	•Connecting curriculum to real-life situations •Students actively involved •Teacher is facilitator of learning	•Pedagogical content knowledge •Children are actively involved, using hands-on problem-solving, open discussion •Content is relevant	•Children are problem solvers •Learning is initiated through student's interests •Lots of interaction

SITE	CODE	ITEM #27 ADMIN 1	ITEM #27 ADMIN 2	ITEM #27 ADMIN 3
UNCG	37-6-10	•Using manipulatives to aid in instruction--use a variety of methods. •Working at a good pace for all so students don't become bored or lost. •Integration in order to teach skills as they would be used in real life situations.	•Know my curriculum. •Present in variety of ways for the variety of learners and with enthusiasm. •Be human--let students know it's okay to make mistakes and to not know all the answers all the time.	•Good pace •Knowledge of curriculum •Variety of teaching styles
UNCG	43-12-10	•Rapport with students--not being degrading but being supportive. •Having a positive learning environment that causes students to think and not being afraid to answer or experiment to find answers. •Knowing your material and being prepared for class with your lessons and materials.	•A motivating, enthusiastic teacher that relates well to students. •Knowing lessons well; being prepared.	•Rapport with students and other staff members •Knowledge of material and being a good facilitator of knowledge
UNCG	33-2-18	•The teacher should have the attention and motivation of every student in their class. •The teacher should have equal representation of every student in their class, and enhance learning from all students. •The teacher should have a clear understanding of their content area.	•Very familiar with curriculum •Good listener and speaker	•Content area •Treating child with respect •Enthusiasm
UNCG	19-9-18	•Know the needs of the class •Enjoy your work •Vary activities	•Child learns skills •Child can use this material in real life •Child is affirmed as an individual and a learner	•Meeting needs of children •Keeping control of classroom •Keeping interest level high
UNCG	34-2-21	•Teachers and students learning together; the teacher not being the only one to "teach." •Students actively involved in whatever the task being done. •Discipline in the way that students know their limits and they know what happens once they go beyond the limits.	•Teacher is a facilitator in the classroom. •Good discipline •Organized	•Children being actively involved in the learning process. •The teacher assessing students at all times, therefore knowing her students very well.

UNCG	19-10-21	•Varied methods of presenting •Knowledge of subject matter •Adjustment of lesson to meet needs of students	•Interesting •Relevant •Informative	•Interesting •Hands-on experiences •Meaningful--able to see why we are doing this
UNCG	13-1-26	•Enthusiasm •Kindness, safety •Organization	•Environment safety (students feel safe from criticism and other students, classroom standard of professionalism) •Preparation •Relevance	•Comfortable environment •Competent teachers •Good attitude
UNCG	30-12-14	•Being prepared •Knowing subject matter •Presenting interesting, exciting activities	•Same as above [reference to #26] [•Knowledge of material] [•Being fully prepared] [•Enthusiasm--self confidence]	•Same [reference to #26] [•Knowledge of material] [•Enthusiasm of facilitator] [•Interesting format]
UNCG	29-9-19	•Stimulates thinking •Is active (requires participation)	•Meaningful content •Opportunities to think and explore •Active participation	•Meaningful--not busy work; clear purpose •Hands on •Numerous opportunities to discuss, explain, relate
UNCG	19-8-26	•Students experience some degree of success. •All learning modalities are addressed. •Students become as dependent on themselves and their peers as sources of learning as they are upon their instructor.	•All learning modalities are addressed within the lesson. •Teacher and students are prepared--materials ready, supplies available, little "down time." •Some evaluation or assessment of objective taught is present (whether observation of time on task, checklist, portfolio, quiz, etc.)	•Address all learning styles •Involve students as active participants •Allow students opportunities to work in pairs or groups as well as independently

SITE	CODE	ITEM #27 ADMIN 1	ITEM #27 ADMIN 2	ITEM #27 ADMIN 3
UNCW	42-8-22	•High time on task •Hands on activities--a wide variety of activities •Good organization and clear objectives	•Hands on/manipulative work •Objectives with well-planned outcomes •A risk-taking/conducive climate for learning	•Excellent planning that facilitates high time on task during instruction •Teacher has objectives/outcomes planned before activities
UNCW	38-11-14	•Use variety of learning styles •Set goals, objectives, and have an action plan •Make learning fun for students	•State goals and objectives •Have a plan •Involve all students	•Well-planned •Grade appropriate •Geared toward different learning styles
UNCW	30-8-30	•High time on task by all students •Learn by doing •Assessment techniques	•Knowing the content •Knowing different techniques to use	•Know the students' abilities and interests •Get children involved--learn by doing not listening •Allow for teachable moments
UNCW	42-12-22	•Clear goals and outcomes •Organized agenda •Hands on learning experiences	•Involve the learner •State goals and objectives	•State goals and expected outcomes •Hands on experiences
UNCW	21-10-11	•Love of learning •Desire to help students achieve	•Content is taught through real-life situations	•Same as above [reference to #26] [•Well organized] [•Well prepared instructors] [•Participant involvement]
UNCW	23-1-19	•"Affective" environment •Clear rules & regulations •Current materials that are ample in supply (not out-of-date)	•Clear expectations •Opportunities to learn and self-assess •Real life content	•Same as above [reference to #26] [•Affective setting] [•Clear terminal objectives and related objectives] [•Open discourse between facilitator and participants]
UNCW	25-3-21	•Being aware of ability levels of all students •Varying presentation methods	•Involve learner •Varied activities •Make learning meaningful	•Same as above [reference to #26] [•Being aware of what participants already know] [•Varied activities]

SITE	CODE	ITEM #27 ADMIN 1	ITEM #27 ADMIN 2	ITEM #27 ADMIN 3
WCU	24-1-4	•Warm, encouraging setting •A lot of activity-based teaching •Cooperative learning with effective management techniques	•Positive environment •Security •Effective instruction that takes into account all learning styles	•Positive warm environment •Varied approaches to learning to adapt to different learning styles •Knowledgeable, flexible teacher who encourages students to think about what they're learning.
WCU	23-12-16	•The teacher must understand the developmental needs of students. •The teacher must provide experiences that motivate students to learn. •The teacher must be skilled in techniques and possess a strong knowledge base.	•Supportive environment for students •Effective discipline techniques •Strong knowledge base of teacher	•Knowledge of child development and needs •Strong knowledge base •Good classroom discipline/management
WCU	26-10-26	•A teacher should know the different levels of students and be prepared to work with all levels. •Work with manipulatives--along with paper, pencil, calculators. Provide a variety of learning experiences. •Be willing to listen to the students and allow them to explain how they got their answers.	•Enthusiastic knowledgeable teacher •Hands-on learning •Working cooperatively	•Using hands-on activities •Cooperative learning •Explaining concepts by students
WCU	13-9-18	•Same as above [reference to #26] [•Group activities] [•Open-ended activities] [•Group discussions]	•Interest in topic •Cooperative groups	•Clear directions to students •Organization of classroom •Expectations clearly stated
WCU	26-6-30	•Being able to motivate children in a safe environment that is conducive to learning •Use as many hands-on materials as possible getting the students involved participating, problem solving, etc.	•Same as above [reference to #26] [•Using hands-on manipulatives and encouraging participation by all]	•The same as above...Getting children involved in their learning •Also letting them do hands-on, higher level thinking, and input into what they are learning or doing

WCU	25-1-23	•Effective classroom teaching involves teaching children how to think, not what to think. •Effective teaching involves providing the opportunity for all children to learn regardless of their learning style (hands-on, visuals, audio). •Effective classroom teaching involves focus on ways of answering questions realizing there may be more than one correct answer and more than one method to obtain the answer.	•Meeting the needs of each child--learning styles •Making the class interesting and fun •Providing a variety of activities to enhance the learning of each child	•Providing a variety of instructional methods which will meet the needs of all learners •Making learning fun! •Using manipulatives to provide much hands-on experience.
WCU	26-3-31	•Make it interesting •Use a variety of teaching styles •Show relevance to students	•Relevant •Not boring •Something they get excited about	[NO RESPONSE]
WCU	26-1-3	•Finding out where students are, what they need •Developing strategies to meet these needs •Frequent evaluation of progress	•Same as above [reference to #26] [•Good planning ahead of time] [•A variety of experiences] [•Flexibility on part of leaders]	•Same as above [reference to #26] [•Good planning beforehand, being prepared] [•Flexibility, resourcefulness] [•Choosing topics relevant to participants' needs]
WCU	23-5-12	•Using both large group activities and small group discussions •Materials are familiar to student (not intimidating) and challenging (new) •Teaching organization and following directions	•Reaching every child at their level--everyone participates •Setting a fair standard for all	•Clear directions •Fairness to everyone

APPENDIX J.
Participant Responses for Item #28 of *Staff Development Style Inventory*

SITE	CODE	ITEM #28 ADMIN 1	ITEM #28 ADMIN 2	ITEM #28 ADMIN 3
ASU	29-4-20	•Children may need to be "caught" in a more noticeable way in order for instruction to be effective. Adults may tend to be cognitively more aware of the need for the instruction than are children. After that initial hurdle is crossed, the teaching is much the same.	•Children are probably more tolerant of ambiguity, less than clear direction, less than clear purpose	•Adults are much less tolerant of lack of clarity--ambiguity. It is more difficult to gauge time constraints with adults--harder to predict how easily or with how much difficulty adults will "get it."
ASU	15-6-12	•Ages •Discipline (children require more to stay on task) •I feel more confident with students	•Ages •Level of subject matter	[NO RESPONSE]
ASU	42-10-23	•Adults have a set learning style and are less likely to change •Explaining the necessity for learning would be harder for adults since they have their futures determined •Children are generally more curious •Children are less critical •Children will face more technology in their future	•Adults are harder to discipline •Adults have lower tolerance •Adults are over-worked or may be more negative	•You can't enforce a discipline plan with adults •Adults will not just accept facts and ideas without questioning the relevance •Adults don't need as much hands on
ASU	21-2-16	•Adults require less instruction because of knowledge base	•Adults are more critical in assessment of teacher	•Only the levels of instruction
ASU	20-3-29	•Adults tend to be more critical of their teacher •Adults are harder to get enthused about a topic...harder to "sell" them •Adults can be overly preoccupied with life!	•Adults have a lower tolerance for ambiguity and are more critical in general.	•Adults want to understand thoroughly before moving on. •Adults are sometimes reluctant to "take risks"...would rather not answer than be wrong •Adults won't always quit talking when asked!
ASU	34-7-29	•You can teach the theory behind the lesson to adults but the actual teaching should be the same because we all have different learning styles and we learn like children.	•More explanation as to why it works a certain way. •You can hold children's attention easier--less conversation going on.	•Children need more manipulation and concrete examples than adults and probably need more practice with the skill.

ASU	20-6-20	•Presentation of subject matter •Time limits	•Level of knowledge of content	•Very little differences except for degree of background knowledge
ASU	32-3-20	•Adults are much easier to control	•Adults will not deal with frustration as easily as children •Teaching adults leads the preparer to be more anxious because of working with peers	•Adults operate at a higher frustration level. They deal with stress less effectively than children.
ASU	28-10-13	•Don't insult adults but discreetly teach as if children •Adults talk more and get off topic	•Discipline (inappropriate behaviors) have to be handled more tactfully with adults	•Discipline techniques

SITE	CODE	ITEM #28 ADMIN 1	ITEM #28 ADMIN 2	ITEM #28 ADMIN 3
UNCC	59-10-18	•No major differences. All learn by being actively involved.	•Teachers are less tolerant if they don't understand content •Children don't make large issues about investigation questions	[NO RESPONSE]
UNCC	6-6-6	[NO RESPONSE]	•Children are better listeners than adults.	•Most students who want to learn are good listeners. Adults are very talkative.
UNCC	15-10-1	[NO RESPONSE]	•Teaching children is often easier. Students are often more open minded and willing to "experiment." They do not have pre-conceived ideas.	•Children are easier to control. They are more enthusiastic about learning.
UNCC	28-1-2	•Adults are harder to get quiet than children are. •Children actually listen better than adults.	•Children respond to discipline techniques better than adults. •Adults get hung up on insignificant points.	•Keeping their attention--adults tend to talk more and are more difficult to discipline!
UNCC	10-6-28	•The level of the presentation •Pace	•Not teaching/talking down to adults •Being very responsive to adult concerns/needs	•Pace •How adults are treated when off task
UNCC	30-8-30	•Adults are sometimes harder to keep on task. They are also more ready to give negative criticism.	•Adults are sometimes harder to "control" than children. •Knowing the level of knowledge of participants •Adults are more likely to be outspoken if something isn't pleasing them.	•Children can be excited about learning, but adults need to see the relevancy.
UNCC	26-6-22	•Not many!	•The way you handle whole group discussion is different. •You cannot use the same control methods (for the most part) with adults as you can with children. •Adults tend to be rude, especially if they're forced to be there.	•The major differences between children and teaching adults are: (1) Knowledge you are relaying is going to be more pedagogical for adults than children.
UNCC	20-6-15	•The speed at which you are able to proceed	•Pace is quicker for adults •Adult behaviors are harder to control •Adults are less predictable	[NO RESPONSE]
UNCC	26-7-27	•None--except for level being taught.	•Adults can sometimes feel they should be in the "driver's seat" where children look to the teacher as the one with the knowledge.	•Age •Expectations

UNCC	32-9-21	•Not much; both need to be actively involved.	•Teachers may be less tolerant if they do not quickly grasp material. Children may not make a big issue of a particular investigation that an adult may.	•Adults may be less tolerant.

SITE	CODE	ITEM #28 ADMIN 1	ITEM #28 ADMIN 2	ITEM #28 ADMIN 3
UNCG	37-6-10	•Adults may not be as open to new ideas and strategies. You have to "sell" them on it. I think students accept change more easily.	•Adults have more life experiences--this can be good (more knowledge) or bad (hard to teach old dogs new tricks).	•Adults have more experiences to reflect on (more knowledge). •Adults also have more of an opinion about material before the presentation--students are more open-minded perhaps. •Must deal with discipline with students, although teachers are bad to talk during a presentation (exactly what they hate their students to do!)
UNCG	43-12-10	•Children are more open-minded and do not have opinions formed about some of the material already. •When teaching adults, sometimes the way the material is presented needs to be different than when presenting it to students (even though a lot of the time it can be done the same for both groups)	•Not really any! There shouldn't be as many discipline factors. There are still levels of ability to deal with in adults also.	•Authority--it is extremely difficult to arrive at a level of respect in a short while for a workshop, especially when many teachers don't want to be there or feel they know the material already. •Otherwise it is pretty much the same for me--don't talk down to students or adults!
UNCG	33-2-18	•When teaching adults, the adult usually has some understanding of the content areas; so you must teach them in a way that makes them feel like they are inputting a lot of the information. With teaching students, it is the same; however, some students have to be "probed" more to understand the new information.	•Adults have very hard time with being wrong and must be treated with respect and admiration when they do mess up or you will create a frustrated environment.	•When teaching adults you must consider that they already have experience in the content area and that you may not be teaching them anything new; so you must gear your lesson to whomever you are working with.
UNCG	19-9-18	•Often we are the first people to teach the new skill/concept with children. Often, we have to convince adults that what we are teaching has merit. •Also, the discipline problem isn't a factor.	•Children have fewer pre-set notions and aren't as set in their ways and opinions.	•Handling those who talk too much or show off

UNCG	34-2-21	•Adults come into a workshop with set ideas. Sometimes adults do not want to see the different method where most children are open to new ideas. It is also important to treat adults like adults and not to speak as if they are children.	•One of the major differences in teaching adults and children is that children are much more open to new ideas. •Another difference is that adults want to be treated as adults.	•Children are much more willing to learn new ideas. Adults think there should be a cut and dried way to do everything. •Adults get very upset when they think they are being treated like children. Some adults think the discovery process is not meant for them. Therefore, when we teach them to discover we are teaching down to them. •Adults will challenge your knowledge whereas most children will not.
UNCG	19-10-21	•If we teach each class starting where the students are, making adjustments for learning styles of individuals in the group, teaching adults no different than teaching children	•Adults are more difficult--must unlearn traditional methods, more resistant to change, have seen too many ideas come and go--skeptical of new	•Very little
UNCG	13-1-26	•Adults are there (usually) by choice; children are there on someone else's agenda. •Adults are quicker to pick up and process information •Children are sometimes not developmentally or emotionally-psychologically ready to do either.	•Adults are usually there with a similar agenda and discipline. •Students are a captive audience with their own agendas and bag of needs personal and unresolved with regard to acting on them.	•Not much--reception stagnates when a child's agenda is focused on his own problems and needs...when the child needs psychological support more than skill.
UNCG	30-12-14	•Adults may challenge you; whereas children, generally, see you as "all-knowing." •Adults will be more critical.	•Children are eager to learn--adults can be difficult. •Adults have more knowledge.	•Children are generally more eager to learn. •Adults can be challenging and think they "know it all."
UNCG	29-9-19	•Adults are not always as open as children to new things.	•Adults are less tolerant. •Adults may question ideas more.	•It is easier to deal with misbehaving children than adults. •Generally adults need a broader scope/view than children.

UNCG	19-8-26	•Adults place a higher value upon their time so instruction needs to be right on target. You need to assess where they are so review-type information is minimal. •Adults are more concerned with the "why" aspect of the information. How will it help? Why is it better than what I'm doing? •They are generally more difficult to keep on target--particularly teachers.	•Adults generally have a broader base of knowledge and experience. •It is more difficult to hold the attention of adults.	•When teaching adults you need to be certain they understand the concepts behind the activities. Children are building concepts through their activities. •Vocabulary levels are important also. Adults don't like to be "talked down" to--

SITE	CODE	ITEM #28 ADMIN 1	ITEM #28 ADMIN 2	ITEM #28 ADMIN 3
UNCW	42-8-22	•Adults are more verbally demanding; they will tell you if they don't understand, you are going too fast, etc. Oftentimes students won't tell you these things; you have to notice their needs more.	•Teachers are more vocally demanding; they will tell you if they don't understand.	•Adults will usually tell you when they don't understand--with kids you have to notice. •Adults are more verbally demanding and critical than children. •Adults are often more reluctant to try new things.
UNCW	38-11-14	•Not much difference	•No differences except how you talk to them	•None
UNCW	30-8-30	•Not much difference. Vocabulary may be changed but techniques.	•Not much but must think of teachers as putting themselves in place of students.	•Not much. Adult learners are more impatient, I feel. (i.e., Tell me now how to do.). Children are more investigation oriented. Adults are "too busy" to take the time to discover.
UNCW	42-12-22	•There is not a great deal of difference between teaching students and adults. All audiences need to know what is expected of them, the objective, and what the outcome will be. They need to be challenged and motivated so that they enjoy learning.	•There are no major differences except the complexity of the information.	•There are no major differences between teaching children and teaching adults.
UNCW	21-10-11	•Adults are more difficult to direct/control (talking, etc.)	•Children are sometimes more open to learning new concepts than adults.	•It is harder to create enthusiasm in adults.
UNCW	23-1-19	•None!	•None	•None
UNCW	25-3-21	•Adults have a broader experience base.	•None	•Adults have more prior knowledge than children.

SITE	CODE	ITEM #28 ADMIN 1	ITEM #28 ADMIN 2	ITEM #28 ADMIN 3
WCU	24-1-4	•Adults are not as accustomed to cooperative learning. They need to be made to feel comfortable when sharing ideas and working together. (Some students, especially if they have not experienced a lot of cooperative learning, have the same problem. Children are more adaptable to change, however.)	•Adults are not as flexible as children sometimes in learning new ways to do things. They also are more difficult to manage behaviorally sometimes.	•Approaches to teaching children and adults are very similar. Adult learners sometimes want to talk, read the newspaper etc. during workshops. Dealing with such adult distractions is "stickier" than dealing with student misbehavior. In both cases, however, a good sense of humor usually helps.
WCU	23-12-16	•There are more similarities than differences in teaching adults and children. •Differences would lie in the nature of subject and length of attention span. Otherwise, all learners are due the honor of having their needs met, being instructed by skilled teachers, and an environment that is conducive to learning.	•Adults have lower tolerance for ambiguity. •Adults do not respond to same techniques of control (i.e., talking, heckling) •Adults generally have a longer attention span.	•Attention span.
WCU	26-10-26	•Discipline •Children appear to be more eager to learn •Children are more likely to experiment and try new ideas. Adults don't like to experience failure; don't usually try. •Adults are more critical of their instructors than students. •Children to me appear to be more willing to try to handle manipulatives.	•Discipline •More preparation for teaching adults •Adults are more questioning about why one does an activity rather than doing activity. •Knowing the content.	•Discipline •Explaining concepts •Adults are more skeptical.
WCU	13-9-18	•Ability level	•Ability level •Attention span	•Age •Ability level
WCU	26-6-30	•I don't feel there are many differences. Adults need to use hands-on materials in a motivating way. They want movement and to enjoy learning. Hopefully they will pick up the information quicker.	•Teaching [is] similar. You still want to use manipulatives and hands-on and use open-ended questions with them participating as much as possible without lectures.	•I feel they are very much alike. They like hands-on, being involved, not sitting all the time, having input, and contributing ideas. They are more knowledgeable than students and can pick up the information and use it quicker.

WCU	25-1-23	•Children are still at the concrete level of thinking whereas adults are able to reason abstractly. Many adults don't need to "see" the answer but are willing to take it at face value. Adults sometimes think they already know everything.	•Children are at a different level of thinking. •Children are not as knowledgeable on the subject. •Children sometimes pay closer attention and are also easier to keep on task.	•Adults are worse behavior problems than children. •Adults sometimes tend to think they "know it all" already.
WCU	26-3-31	•I know that I will worry more that other teachers will be more critical of me than my children would be.	•I am less self conscious around kids. I am afraid of looking like a fool in front of peers. I think adults will be more critical.	[NO RESPONSE]
WCU	26-1-3	•Not too much in procedures •Adults may be more aware of what they need and want, or more verbal about it. May see more ways of using new knowledge. •Young students may be more at concrete stage of learning and abstractions a little more difficult yet.	•Depth of content of subject area.	•Process quite similar. •Complexity of problem should be geared to ability of student--but they all can be challenged by more complex questions.
WCU	23-5-12	•Children need step by step instruction. •Children need reinforcement of instruction. •Children learn by doing and seeing. •Children have short attention spans. •Children need movement. •Children are concrete thinkers; it is hard for children to transfer. •Adults have experience to build on; can understand and perform difficult tasks.	•Can control children better than adults. •Adults are more independent.	•Age

APPENDIX K.

Participant Responses for Item #1 of *Pedagogical Content Knowledge Questionnaire*

SITE	CODE	ITEM #1A/1B ADMIN 1	ITEM #1A/1B ADMIN 2	ITEM #1A/1B ADMIN 3
ASU	29-4-20	50% Add & divide	50% Find the frequency that appears most often (2)	50% They'll look at the 3 stacks of 2 cubes and say 2.
ASU	15-6-12	50% Count number of pets and divide by number of homes.	70% Add the number of pets, divide by number of students.	90% Add pets and divide by number of families.
ASU	42-10-23	50% Algorithm--Add up the numbers and divide by 8	50% Algorithm--20/8	70% Adding 1+1+2+2+2+3+3+6 and dividing by 8
ASU	21-2-16	90% Count the number of pets and divide by 8.	90% Counting and dividing to find average.	70% Count and divide.
ASU	20-3-29	30% They would add up the total # of cubes & divide by that # of cubes.	70% Mathematical algorithm for finding mean.	50% Add up all blocks, divide by # of students. (Arithmetic mean)
ASU	34-7-29	30% Most teachers know how to compute average--They would probably count 1 unifix cube as a pet. OR They would say there's not enough info.	90% Algorithm	50% Finding the average
ASU	20-6-20	50% Looking and guessing.	70% Add up and divide.	90% Add up and divide, the algorithm.
ASU	32-3-20	90% They would use the algorithm of finding the average.	70% The algorithm for finding the mean.	70% The algorithm for finding the mean.
ASU	28-10-13	50% Looking at the middle	30% Add up cubes & divide by 8	70% Add all cubes and divide by 8.

SITE	CODE	ITEM #1A/1B ADMIN 1	ITEM #1A/1B ADMIN 2	ITEM #1A/1B ADMIN 3
UNCC	59-10-18	50% Add, then divide	70% Algorithm of average	50% Compute the average
UNCC	6-6-6	90% The students would count out Unix cubes and divide by eight.	70% Graph and cubes	70% That one Unifix cube represents the number of pets in each student's home.
UNCC	15-10-1	90% Count number of Unifix cubes; divide by 8	70% Paper and pencil calculations; Add-Divide	70% 1. Add to find total number 2. Divide by 8
UNCC	28-1-2	70% Add & divide	50% Add & divide	70% Add & divide
UNCC	10-6-28	70% Add & divide	90% Add/divide	90% Add, Divide
UNCC	30-8-30	90% Add and then divide	70% Would use the arithmetic algorithm	70% Add numbers and divide
UNCC	26-6-22	70% Add up & divide algorithm	50% Traditional algorithm	50% Traditional algorithm
UNCC	20-6-15	90% Add up & divide	90% Add up & divide	90% Add up & divide
UNCC	26-7-27	70% Add/Divide calculation	90% Add up--divide by # of items.	70% Arithmetic formula
UNCC	32-9-21	50% Add then divide	50% Add then divide	50% Add then divide

SITE	CODE	ITEM #1A/1B ADMIN 1	ITEM #1A/1B ADMIN 2	ITEM #1A/1B ADMIN 3
UNCG	37-6-10	50% Add up number of pets and divide by number of students. 20/8	50% Count blocks (20). Divide by # of students.	70% Add cubes & divide by count.
UNCG	43-12-10	70% Adding 1+1+2+2+2+3+3+6 and dividing by 8. *I do not think the balance method would even be known by most or that they would even understand the concept well!	30% Adding up & dividing. I think the percentage would be much higher; however, I feel a lot of teachers won't understand the representation!	30% I think the representation would throw off many people; however, the ones that got it used the algorithm!
UNCG	33-2-18	30% Taking the total number and divide by the groups.	30% They would use the textbook method of dividing the total by the # of pets.	70% They would take the total # in each group & calculate the average w/ the formula.
UNCG	19-9-18	90% They would add all the totals & divide by the # of students.	90% They would add all the cubes & divide by 8.	90% Add the pets 1+1+2+2 etc. & divide by 8.
UNCG	34-2-21	70% They would take the number total and divide it by eight.	30% Most teachers would add up all the pets and divide by 8.	70% They would use the algorithm.
UNCG	19-10-21	70% sum/count. Add 1+1+2+2+2+3+3+6 = 20. Count -- eight different students asked. 20/8=2.5	50% sum/count = average.	50% Add numbers represented by each tower. Divide that sum by number of towers to find mean.
UNCG	13-1-26	90% 20/8	90% They would add the # of cubes, then divide by the # of columns.	90% Add all the squares together and divide by the number of columns.
UNCG	30-12-14	50% They would choose 2 because it happened more often.	50% Count the towers represented most often.	50% Count all pets and divide by number of pets.
UNCG	29-9-19	50% Count the # of cubes (pets)--20. Divide by 8 = 2.5	90% Count, divide by 8	90% Count # of pets. Divide by 8.
UNCG	19-8-26	70% Teachers would add them all and divide by the number of towers.	50% Most teachers would total the number of pets and divide by the number of homes. It would be a mathematics procedural calculation.	50% Teachers would count the total number of blocks and divide by the 8 students.

SITE	CODE	ITEM #1A/1B ADMIN 1	ITEM #1A/1B ADMIN 2	ITEM #1A/1B ADMIN 3
UNCW	42-8-22	90% They would add up the # of cubes and divide by 8. They would get the correct answer without having to understand what average really means.	70% They would add up all the values (1+1+2+2+2+3+3+6) and divide by 8.	70% They would add up all the columns and divide by 8. (1+1+2+2+2+3+3+6)/8.
UNCW	38-11-14	90% Add total # of pets and divide by the total number people surveyed.	70% Take the total # of pets and divide by the total # of students.	70% Total # of pets divided by the total # of students.
UNCW	30-8-30	70% Count, add & divide.	90% Several ways--algorithm-add then divide--or balancing out.	90% Add # of pets, divide by 8 students.
UNCW	42-12-22	90% Add all pets then divide by the number of pet owners.	90% Add total pets/ by # of students.	90% Add all values, divide by number of people.
UNCW	21-10-11	70% Count the total # of pets and divide by 8. Because there are no labels, I think some teachers will be confused.	70% Count all pets and divide by 8.	70% Count the # of pets and divide by # of students (8).
UNCW	23-1-19	50% Division the total by # of students.	10% They would assume this is a bar chart instead of a bar graph.	70% Each stack represents 1 student. Each cube represents 1 pet. 20 total pets divided by 8 students surveyed = average.
UNCW	25-3-21	50% Count the number of pets in last column.	70% Add all the squares and divide by number of students.	50% Add number pets and divide by total number.

SITE	CODE	ITEM #1A/1B ADMIN 1	ITEM #1A/1B ADMIN 2	ITEM #1A/1B ADMIN 3
WCU	24-1-4	70% Add up the numbers represented by the Unifix cubes and divide by the total number added.	70% Teachers would let Unifix cubes represent number of pets. According to the model above, 1 student owned 1 pet, 1 student owned 2 pets, 2 students owned 3 pets, 2 students owned 4 pets, etc. 8 students owned 6 pets.	70% Teachers would use one-to-one correspondence to teach this concept. Each imaginary child would hold the number of Unifix cubes that represented the number of pets owned. To find the average, participants could use the "balance for mean" approach. They would take away one cube at a time on the left and right sides of the arrangement until only one cube (representing the mean or average) remained.
WCU	23-12-16	90% Counting all the pets and dividing by 8.	50% Add all numbers and divide by #'s in the set.	30% Traditional algorithm. Add and then divide by 8.
WCU	26-10-26	30% They would add the Unifix cubes and divide.	50% Doing the rule of adding and dividing.	50% They would add & divide.
WCU	13-9-18	30% Look at the number represented in each tower and the number of towers.	30% Look to see where most columns were the same.	50% Add & divide.
WCU	26-6-30	70% Count how many Unifix cubes and divide by 8.	70% They would probably add up boxes then divide by the total amount to get average.	70% Add up number of boxes or pets and divide by number of students.
WCU	25-1-23	50% They would probably add all of the Unifix cubes and divide by 8 since each stack represents a student thus, giving average...	50% They would add up the cubes and divide by 8.	70% They would add up the Unifix cubes and divide by 8 to get the average.
WCU	26-3-31	50% I think that most teachers would count the number of cubes and divide by 8 because there are 8 sets of cubes.	30% I think that they would assign values to the cubes and that they would add and get 20 cubes. Then the 20 would be divided by 8 because there are 8 categories. This is difficult without labels.	30% As this question is posed, I don't know that there is a correct answer. I think that the teachers would assign labels to each axis. Then they would add up the number of animals and divide by the number of categories.
WCU	26-1-3	70% Add them all up and divide by total number of units.	70% Adding up numbers and dividing by total number of students responding.	70% Add up the # and divide by the number of respondents (children).
WCU	23-5-12	50% Add total of pets and divide by number of students.	70% Count all pets and divide by 8.	50% Add and divide.

APPENDIX L.

Participant Responses for Item #2 of *Pedagogical Content Knowledge Questionnaire*

SITE	CODE	ITEM #2A/2B ADMIN 1	ITEM #2A/2B ADMIN 2	ITEM #2A/2B ADMIN 3
ASU	29-4-20	30% Look for the # with the most X's.	50% Find the frequency with the most X's.	30% Look at the tallest column.
ASU	15-6-12	30% Count number of pets and divide by number of homes.	50% X's are students. Numbers represent pets. Count pets, divide by number of students.	70% Find the number of pets that most students have.
ASU	42-10-23	50% Add 1+1+2+2+2+3+3+6 and divide by 8.	50% Adding the number of pets and dividing by the number of students.	70% Adding 1+1+2+2+2+3+3+6 then dividing by 8.
ASU	21-2-16	70% Reading the graph and determine there are more pets on the number 2.	70% Look at graph and determine more pets at 2.	70% Look at line plot with most X's.
ASU	20-3-29	30% Change X's to actual numbers, add & divide.	70% Add up all the pets, divide by # of participants (8).	30% Arithmetic mean--Algorithm would be attempted.
ASU	34-7-29	90% Algorithm usually used.	70% Still by using the algorithm.	70% Using the arithmetic method of finding mean.
ASU	20-6-20	50% Guessing or counting and dividing.	90% Add up and divide.	70% Add up and divide.
ASU	32-3-20	90% They would use the average algorithm.	70% They would use the algorithm for finding the mean.	70% The algorithm for finding the mean.
ASU	28-10-13	50% 2 appears most.	30% Two has more X's.	50% [No response]

SITE	CODE	ITEM #2A/2B ADMIN 1	ITEM #2A/2B ADMIN 2	ITEM #2A/2B ADMIN 3
UNCC	59-10-18	30% Guess	50% Algorithm of average	50% Compute the average.
UNCC	6-6-6	10% Would not answer the question.	30% By collecting data.	90% Two students have one cat, three students have two cats, two students have three cats and one student has six cats.
UNCC	15-10-1	10% Would not answer question	30% If not familiar with line plot, they could not do this.	10% Add to find total and then divide by 8.
UNCC	28-1-2	30% Guess	50% Add & divide	50% Add & divide
UNCC	10-6-28	50% Add, Divide	70% Add/Divide--If they recognized what the line plot showed.	70% Add, Divide
UNCC	30-8-30	90% Add and then divide.	70% Arithmetic algorithm	50% Add numbers and divide.
UNCC	26-6-22	30% Traditional algorithm	30% Traditional algorithm	50% Traditional algorithm
UNCC	20-6-15	90% Add up and divide	90% Add up and divide	90% Add up & divide
UNCC	26-7-27	30% Add/Divide--Av. or by counting	70% Algorithm: Add/Divide by # items.	90% Arithmetic formula
UNCC	32-9-21	30% Guess	50% Add then divide	50% Add then divide

SITE	CODE	ITEM #2A/2B ADMIN 1	ITEM #2A/2B ADMIN 2	ITEM #2A/2B ADMIN 3
UNCG	37-6-10	30% I'm not sure most teachers would be able to read the line plot. They might read it: 1 person w/2, 2 people 2/3, 3 people w/2, 6 people w/1.	30% Probably the same as before if they understand how to read a line plot. Total # of pets divided by # of students.	50% Multiply # of x's by number beneath on number line--Add all together and divide by 8.
UNCG	43-12-10	50% Same approach as before; however I do not feel that some teachers would be familiar with a line plot and be able to transfer this information to 1+1+2+2+2+3+3+6 as easily as before.	70% I think most will understand this representation better and be able to add up and divide now. I don't think 1 person would balance to find the mean.	50% Process--algorithm (add 'em up and divide by 8)
UNCG	33-2-18	70% The teacher would choose the mode (2).	30% Textbook method of determining the average.	90% They would compute the answer w/ the formula and add up the total pets and then divide by the groups.
UNCG	19-9-18	90% They would multiply; add and divide.	90% They would add 1+1+2+2+2+3+3+6 and divide by 8.	90% Add 1+1+2+2+2 etc. and divide by 8.
UNCG	34-2-21	70% Most teachers would find the total and divide by 8.	50% They would use the procedural method.	[NO RESPONSE]
UNCG	19-10-21	50% Provided they know what line plots are-- 2x1 = 2 3x2 = 6 2x3 = 6 1x6 = <u>6</u> 20 20/8 = 2.5	30% Sum/count = average	50% Add numbers represented by X's on line plot. Divide by number of students to get mean.
UNCG	13-1-26	30% They might guess at 20/8. I'm not sure what I would've done with this last year. I might've come up w/ 20/8.	70% They would add the X's and divide by 8.	90% Add the X's and divide by eight.
UNCG	30-12-14	30% They would choose 2 because it appeared more often.	50% 2 occurred most often.	50% They would choose 2 because it occurs most frequently.
UNCG	29-9-19	30% Guessing	70% Balancing spaces	50% Add up total # of pets, divide by 8. Would probably have greater difficulty with this representation than previous one because data is more easily counted on Unifix towers.

UNCG	19-8-26	50% I believe most would say two students have one each, three students have two each, and so forth. Then they would total and divide by number of X's.	50% I believe they would add 1+1+2+2+2+3+3+6 and divide by 8. Some might divide by 4 since responses are only in 4 columns.	50% I don't think most teachers are familiar with line plots. I think they would select "2" because it has the most X's.

SITE	CODE	ITEM #2A/2B ADMIN 1	ITEM #2A/2B ADMIN 2	ITEM #2A/2B ADMIN 3
UNCW	42-8-22	50% They would add the numbers and divide by 8. Some would get confused with the line plot format if they weren't familiar with it.	50% Some would add up all the data values (1+1+2+2+2+3+3+6) and divide by 8. Some may get confused if they are unfamiliar with line plots and add up the frequencies (2+3+2+1) instead, thus getting an incorrect answer.	50% They would add up all the values of frequencies and divide by 8 (same as #1). Some people may be confused by this line plot display and add the frequencies themselves (2+3+2+1/4)
UNCW	38-11-14	50% They will have to realize that each X has a different number value. Add each X to get a total. Then divide by the # of pet owners.	50% Multiply the total # of X by the number below it: 1 x (2 X's) = 2 2 x (3 X's) = 6 3 x (2 X's) = 6 6 x (1 X) = 6 20 / by number of students.	50% Give each X a # that would total 20. Then divide by the number of students.
UNCW	30-8-30	70% Count, Add, then divide	70% Several ways--balancing and 2+6+6+6 = 20/4 = 5	70% Add total # of pets; 2 had 1, 3 had 2, 2 had 3, 1 had 6 = 20. Divide by 8.
UNCW	42-12-22	70% They would not read carefully. If they did-- 1 - 2 = 2 2 - 3 = 6 3 - 2 = 6 6 - 1 = 6 20 / 8 = 2.5	50% 1(2) = 2 2(3) = 6 3(2) = 6 6(1) = 6 20 / 8 = 2.5	10% 1x2=2 2x3=6 3x2=6 6x1=6 20 / 8 = 2.5
UNCW	21-10-11	90% Count # of pets and divide by 8.	50% Add # of pets--divide by 8	70% Add # of pets and divide by # students.
UNCW	23-1-19	50% Dividing total by # of students	30% Add up values of X's, and divide by # of X's.	50% Each x = 1 student 20 total pets / 8 = average
UNCW	25-3-21	50% Looking at the information they would decide that because there are more X's at 2.	50% Add all the X's and divide by # of students.	50% Add number of X's and divide by total number.

SITE	CODE	ITEM #2A/2B ADMIN 1	ITEM #2A/2B ADMIN 2	ITEM #2A/2B ADMIN 3
WCU	24-1-4	70% Add up the total number of pets represented (1,1,2,2,2,3,3,6) and divide by 8.	70% Teachers would instruct their students that the X's represented pet owners. According to the line plot, 2 students owned 1 pet, 3 students owned 2 pets, 2 students owned 3 pets, and 1 student owned 6 pets.	50% Teachers would recognize the fact that the numbers along the horizontal line represents the eight students, and that each "X" above the line represents the number of pets owned by each child. Most teachers would probably add the number of pets and divide by 8.
WCU	23-12-16	50% Count the X's and divide by 8. Some teachers wouldn't be able to interpret the line plot.	10% Guessing the meaning of the X's	10% Guessing--They would not be familiar with line plots.
WCU	26-10-26	30% Some may use the add/divide answers; others may look at the greatest number of X's and give the answers.	30% Adding and dividing	50% Some would use the add and divide method. Others would use the balance method.
WCU	13-9-18	50% Look at the numbers across the bottom of data and then number of X's	30% Looked at which number has most X's	70% Add and divide.
WCU	26-6-30	70% I think they would count total of 20 pets and divide by 8. They might pick 2 or 3 depending on whether they count the remainder 4/8 as another one.	70% Add up the total amount of X's then divide by how many.	70% They would add up the X's and get 20; then divide.
WCU	25-1-23	50% I think some would say 2 because 2 occurs most and some would again add 1+1+2+2+2+3+3+6 and divide by 8.	70% They would add 1+1+2+2+2+3+3+6 and divide by 8. Seeing the numbers would be easier.	70% They would add 1+1+2+2+2+3+3+6 and divide by 8.
WCU	26-3-31	70% Because this arrangement has numerical values assigned, I think that most teachers would add the values 1+1+2+2+2+3+3+6 = 20 and divide by 8. This would give the mean number of pets as 2.5.	70% Again, I think that they would add 1+1+2+2+2+3+3+6 and get 20. Since there are 8 students, they would divide 20 by 8 to get the average.	30% I still think that without labels it is impossible to know which is which. I think that they might say that child #1 has 2 pets, #2 has 3 pets, etc. Added together there would be 8 pets, divided by 8 students. Each child would then have 1 pet on average.

WCU	26-1-3	70% Add up totals (e.g. 2x1, plus 3x2, and so on--); divide by no. of students. Some would be likely to use just # of students, perhaps.	70% Adding up total # of pets and dividing by # of respondents.	70% Same as #1 (Add and divide)
WCU	23-5-12	70% Looking at the total X's over each number.	70% Adding number of pets; dividing their number by number of students.	70% Add and divide.

APPENDIX M.

Participant Responses for Item #3 of *Pedagogical Content Knowledge Questionnaire*

SITE	CODE	ITEM #3A/3B/3C ADMIN 1	ITEM #3A/3B/3C ADMIN 2	ITEM #3A/3B/3C ADMIN 3
ASU	29-4-20	A. Line plot B. Stem & leaf C. The teachers should use a more sophisticated method that will show a better shape of each group of data so that it can be better compared	A. Bar graph B. Back to back stem & leaf C. [NO RESPONSE]	A. Probably, they'd find the mean using the algorithm B. Back to back stem & leaf or simple line plot C. The participants will show <u>understanding</u> of what they're doing and the "numbers" they find instead of simply arriving at an irrelevant #.
ASU	15-6-12	A. Graph B. Stem and leaf C. Most who have participated in TEACH-STAT would have learned how to do stem & leaf and how it better shows this info.	A. Line plot B. Box plot C. [NO RESPONSE]	A. Line graph B. Back to back stem & leaf C. Most teachers would not know about stem and leaf as a way to order this data, especially using the back to back to compare the 2 groups.
ASU	42-10-23	A. Grouping or average B. Line plot, stem & leaf; more discussion C. Similarities--Each time, would try to answer the question, which group performed the best. Average would be involved. Differences--Other measures would be looked at when trying to answer the question. Other graphs would be used instead of bars and grouping.	A. Bar graph of Group A vs. bar graph of Group B B. Back to back stem & leaf plot or two box plots C. Teachers may not be aware of the new representations for data.	A. A table or begin by ordering the scores. Use only average. B. A stem & leaf plot with the three centers of measure C. On the last day of TEACH-STAT the teachers would use less traditional forms of graphs. They would be more conscious of outliers. They would use median, mode, or mean as they are deciding which group performed better.
ASU	21-2-16	A. I think they would find the mean of each group. B. Some groups would learn to find the typical grades and do the different graphs learned in TEACH-STAT. C. I think TEACH-STAT gives teachers a broader base of knowledge and understanding of working with statistics.	A. Individual bar graph B. Line plot or stem & leaf C. Hopefully, teachers will become more comfortable with other types of graphs	A. Bar graph or line plot B. Stem & leaf for quick organization; histograms or maybe box plot or line plot C. I think group would be anxious to try out newly learned skills. The graph used may reflect their understanding of what they have learned.

ASU	20-3-29	A. Charts with grades and X's used B. Bar graphs or line plots C. After the workshop, I think we would see much more variety in the representations.	A. Table, chart B. Back-to-back stem & leaf C. On the last day, teachers would be looking for a more "sophisticated" method of displaying data graphically	A. Numbers would be ordered and just "eyeballed." B. Stem and leaf plots C. A much more "sophisticated" approach would show up after the workshop
ASU	34-7-29	A. They would find the mean. B. I think several would now think about typical and use the median instead. C. Because they will have more knowledge base.	A. Some type of bar graph or line plot B. Line plot, stem & leaf, box plot C. They will learn new ways to represent their data	A. First they would order the info. then find the mean, median, and mode. Maybe using a line plot or bar graph. B. You would see more forms represented--box plots, scatter plots, stem & leaf C. [NO RESPONSE]
ASU	20-6-20	A. They would add up and divide. B. Add up and divide. C. I think they would still not be sure of themselves.	A. Again, I think they would just add up and divide and compare averages. B. Box plot or stem and leaf. C. At the end of the workshop, teachers would be able to do more detailed representations.	A. They would add up and divide to find the average of each group and then compare. B. They may use a line plot or stem and leaf to order their data then compare by using a box plot. C. In part (A) they were only showing the algorithm and in part (B) they were using different graphic representations to compare data.
ASU	32-3-20	A. Adding up scores then average B. They hopefully would use the balance model of determining mean. C. Similarities--get the same answer Difference--in (B) you have a better understanding of the concept of mean	A. They would use the algorithm for the mean and show their computation B. They would use the balance model for finding the mean representing it with unifix cubes or post-it notes. C. The example in part (B) represents more understanding of the concept of mean because they realize the scores have to balance on either side of the mean.	A. Using the algorithm for finding the mean. B. They would use the balance model for finding the mean. C. The balance model shows they have a clearer understanding of the concept. The algorithm demonstrates they know how to add it up and divide by n, but it doesn't demonstrate that the data points have to be equal distance from the mean to the right or to the left or have to be all stacked on the mean.
ASU	28-10-13	A. Bar graph B. Line plot/ Stem & leaf C. [NO RESPONSE]	A. Bar graph B. Box plots, side by side stem & leaf C. Most are only familiar with bar graphs. Hopefully a new awareness will be developed.	A. Bar chart B. Box plots; Line plots C. [NO RESPONSE]

SITE	CODE	ITEM #3A/3B/3C ADMIN 1	ITEM #3A/3B/3C ADMIN 2	ITEM #3A/3B/3C ADMIN 3
UNCC	59-10-18	A. Add, divide B. Order the numbers, find the mean C. [NO RESPONSE]	A. Algorithm of average B. Algorithm of average, depends if they are finding median, mean, or mode C. Algorithms are still the quickest way of finding average without manipulatives.	A. Mean or average B. Mean or average C. [NO RESPONSE]
UNCC	6-6-6	A. Grouping B. Stem and leaf plot C. [NO RESPONSE]	A. By finding the average and comparing them B. By using a box plot C. As the workshop progresses, the teachers will learn different methods to use.	A. A line plot B. A stem and leaf plot C. The teachers would have learned by the end of the workshop that when you have a wide range of numbers it's easier to read a stem and leaf plot.
UNCC	15-10-1	A. Grouping B. Stem and leaf C. [NO RESPONSE]	A. Find the averages and compare B. Box plot C. Part (A)--not exposed to many different types of graphing. Not feel comfortable--not sure they are correct. Part (B)--Feeling more knowledgeable about graphing and comparisons.	A. Double bar graph B. Stem and leaf C. Both would show comparison
UNCC	28-1-2	A. Add and divide to get an average B. They would lay out a line plot C. [NO RESPONSE]	A. An average of each group B. A line plot to represent the data C. Participants would be more inclined to answer according to previous and most recent experiences	A. Add each group and divide to get an average score B. A graphic representation such as a stem & leaf to show the shape of the data C. Before TEACH-STAT most teachers would rely on the algorithm rather than the graphic representation
UNCC	10-6-28	A. Add/divide to get average B. Line plot, bar graph C. [NO RESPONSE]	A. Add/divide each group B. Same as (A)--although with more awareness to alternatives C. [NO RESPONSE]	A. Add, divide B. Add, divide C. At the end participants might make a line plot to visualize
UNCC	30-8-30	A. Doing an average by adding and dividing B. Will probably do an average, but would also look for median and mode C. Teachers will learn more about median and mode, but will still go back to the "old way" of doing it.	A. Finding the average by arithmetic algorithm B. Would hopefully arrange data to determine median and mode as well as mean. But probably still rely on the "old way" to find average C. Teachers will be excited to learn new ways to present to students, but will still use the old practiced ways for themselves.	A. Add numbers and divide B. Either a stem and leaf plot, line plot, or box plot C. I think by the end of TEACH-STAT teachers will know a variety of ways to present data and learn that finding the average by adding and dividing does not always answer the question posed.

UNCC	26-6-22	A. Rank lowest to highest B. Stem & leaf plot C. N/A	A. Chart or frequency table B. Stem & leaf plot C. Stem & leaf plots were not a part of most teachers' educational process, and hence once learned, it can be used effectively. For grades, using a stem & leaf is very effective.	A. Bar graph B. Stem & leaf plot C. [NO RESPONSE]
UNCC	20-6-15	A. Comparing averages--add, divide B. Line plot C. After the workshop, they would have more tools to work with and have learned a more thorough understanding of average.	A. They would average both sets of numbers and compare them. B. They would order the data and determine the mean, median, mode, and choose a representative measure to compare. C. Second representation reflects the acquired knowledge that the mean is not necessarily the most representative measure of a set of data.	A. They would add each set up and divide by the number of grades; compare the averages. B. Stem & leaf plots (back to back) C. On the first day, most teachers would not have any tools to represent the data beyond the usual averaging algorithm. At the end, they would have learned about stem & leaf as a good representation for this sort of data.
UNCC	26-7-27	A. Bar graph B. Stem-leaf plot C. [NO RESPONSE]	A. Bar graph B. Stem/leaf plot C. Bar graph seems to be the catch-all graph. Stem & leaf seems to be a more advanced approach, esp. w/large #'s of data.	A. Bar graph B. Line plot or stem-leaf plot C. Expansion of knowledge
UNCC	32-9-21	A. Order from lowest to highest, get the mean B. Scatter plot C. [NO RESPONSE]	A. Algorithm B. Order from least to greatest; determine whether to use mean or median C. Participants will hopefully be more aware of various methods.	A. Order from smallest to largest to get median B. Use stem plot to find median C. Teachers would know at the end of workshop various ways to display data quickly to find median or mean

SITE	CODE	ITEM #3A/3B/3C ADMIN 1	ITEM #3A/3B/3C ADMIN 2	ITEM #3A/3B/3C ADMIN 3
UNCG	37-6-10	A. Average grades and compare the two averages. B. Possibly a stem & leaf plot. C. I think this workshop would show participants how they could look at the entire group of data to make generalizations instead of just having to give a one number average.	A. Average the test scores to get their comparison of A to B. B. Make a stem & leaf graph; possibly transfer to a box plot. C. They would both show which group as a whole scored higher, but the second (B) one would keep individual data points along with showing median, mode, etc.	A. Add up scores of A and divide by count. Then same with B. B. Back to back stem & leaf plot or box and whiskers. C. [NO RESPONSE]
UNCG	43-12-10	A. Line graph with two different colors for group A & B. B. Stem plot (back to back) C. I think most teachers are familiar with a line graph and would use it until stem plots were learned. There are still MANY teachers that don't even know what a stem plot is!	A. Either a double bar graph or a line graph. B. Back to back stem plot. C. Most everyone's already familiar with the graphs in (A) but use the line plot incorrectly. Hopefully after the workshop no one would use a line plot there!	A. A line graph B. Back to back stem plot for most--A few of higher grade teachers would probably use the box plot. C. A line graph is well known and commonly used by most adults, even though it is not all that effective. Stem plots keep the individual data points and still would show comparisons b/w group A & B. I think only the higher grade level teachers would use a box plot because they feel it more relevant to them. K-3 teachers really didn't hold a lot of stock in this one.
UNCG	33-2-18	A. Sorting and counting the 2 groups to get a representation of the information. B. Stem & leaf, Line plot C. Differences--The teacher would learn better ways to demonstrate their information that shows the true comparison between the 2 groups. Similarities--Sorting would be done with both ideas.	A. Average of the groups B. Mode, range, median, stem & leaf, lots of graphs C. On the last day the teachers would use the info. to produce visuals about the #'s and use the concepts; where in the beginning they only used procedure to average.	A. They would compute the average and compare the two. B. Stem & leaf (double), box plots C. On the last day the teachers are able to use several different types of analysis to show the differences between the two.

UNCG	19-9-18	A. Bar graphs B. Bar graphs C. On the last day they would understand more information about the representation they made and would be able to make better comparisons.	A. Line plots or bar graphs B. Stem & leaf or box plots C. They probably wouldn't know about stem & leaf and/or box plots on day 1; If they used the bar graph again they would be able to label it more clearly. The box plot would show the comparison of both groups of data right next to each other.	A. 2 line plots B. Double stem & leaf or 2 box plots C. The line plots would show single data items and the stem & leaf and box plots would show grouped data--which is what they need to know.
UNCG	34-2-21	A. Most likely they would just make categories for the two groups, and then they would see which group had more in the higher category. B. They would make a back to back stem & leaf graph. C. They would have learned how to sort and organize their data much better. They also would have knowledge of different graphs.	A. They would use the procedural method. B. Mode, median, mean, stem plot, lots of different graphs. C. They will understand the concept therefore they will use other methods than the procedural.	A. They would find the average. B. Back to back stem and leaf C. They are different because the teachers would understand the different graphs. Also, they would understand that one number does not show a good representation.
UNCG	19-10-21	A. Double bar graph or double line graph B. Double stem and leaf C. Bar and line graph representations are traditional graphs--most teachers are not familiar with other ways to represent data.	A. Line or bar graph B. Double stem and leaf C. Most teachers at beginning probably wouldn't know only about traditional graphs (bar and line). Hopefully workshop will encourage them to use a variety of graphs.	A. Double line or bar graph B. Double stem and leaf or graph generated by computer program C. Limited knowledge of ways to represent data at beginning of workshop. Workshop should expose them to other ways to represent data.
UNCG	13-1-26	A. Add and divide to find the averages B. Stem and leaf plot! C. With a calculator, (A) would be quicker; w/out, (B) would be quicker and give a lot more visual information such as where the majority fell (reteaching needs), mean & mode--	A. Average B. Mode C. Teachers are used to averages and mean in grading. Their perception of the greater reliability of mode or median will be more clear and they will perceive that either would be more accurate given the weight of the "outliers" and its effect on mean.	A. Averages B. Stem & leaf C. Teachers will be more aware that averages, by including outliers, unbalance the true picture of class learning, and stem & leaf gives a representation within tens of where the majority of the class members demonstrated skill.
UNCG	30-12-14	A. They would add all the scores and divide to get an average--then compare averages. B. Perhaps they would graph with stem and leaf--then find average C. Students, after TEACH-STAT, have learned to do clearer, more reasonable representations.	A. Add and divide B. Grouping in order, then some sort of graph (stem & leaf?) C. TEACH-STAT taught easier, more effective methods to solve.	A. Add all scores and divide by total number of scores. Then compare group A and B. B. Stem and leaf; scatter plot C. By the end of the workshop participants will have learned more effective and easier representations

UNCG	29-9-19	A. Line plot B. Double stem & leaf, box and whiskers C. Probably did not know about above 2 representations until end of TEACH-STAT	A. Double bar graph B. Box plot C. Bar graph would not provide as much info.; would be harder to compare groups	A. Bar graph B. Stem & leaf, box plot C. Many teachers have some experiences with bar graphs but stem & leaf and box plots are relatively new methods.
UNCG	19-8-26	A. Teachers would likely add scores and compute the average, then compare averages. B. Teachers would likely graph the information, perhaps in more than one form. C. The TEACH-STAT program showed me how to go beyond computation to create a visual representation of data that could be a source of a variety of information. The average answered the question, but we see more looking at the graph.	A. Teachers would order the information, add each column and compare by calculating the average score. B. Teachers now would likely use a box and whiskers or stem & leaf to visually see better performance. C. Both times the information would be ordered. Part (B) would be more conceptually versus procedurally oriented.	A. I think teachers would make a chart ordering the numbers from highest to lowest. Then they would calculate the average. B. I believe they would use a double bar graph or histogram. C. At the close of the workshop teachers would have a greater variety of graphs from which to choose. The bar graph would give a better visual representation.

SITE	CODE	ITEM #3A/3B/3C ADMIN 1	ITEM #3A/3B/3C ADMIN 2	ITEM #3A/3B/3C ADMIN 3
UNCW	42-8-22	A. They would probably average the scores and compare the two averages. B. They would make some type of graphic representation of the scores and draw conclusions based upon the graphs. C. By the end of the workshop, participants would be much more likely to analyze data deeper than before.	A. They would probably use a calculator and find the average score for Groups A & B and compare the two averages. B. Hopefully they would make some type of graphs to represent the data and look beyond just the mean. C. Those unfamiliar with graphing and statistics tend to place too much stock in just the mean. TEACH-STAT downplays the mean somewhat and puts it in its proper place among equally important concepts.	A. They would use the algorithm to determine an average for Group A and Group B and compare the 2 averages. B. Hopefully they would display the data in some type of graph--maybe even more than one (i.e., stem plot and box plot) from which to draw conclusions. They would consider the median, not just the mean. C. After the workshop they would use more sophisticated ways to compare data sets. They would be wary of relying only on the mean.
UNCW	38-11-14	A. I believe they would make bar graphs B. Line plot/or back to back stem & leaf C. After attending the workshop the participant's knowledge would be broadened and they would be able to utilize different ways to show information.	A. Bar graph B. Box plots C. Most teachers are very familiar w/bar graphs and see/use them frequently. Box plots are a more in-depth form of graphing which during the TEACH-STAT workshop they will become familiar.	A. Bar graph B. Stem & leaf or scatter plot C. At the end of the workshop the participants know more about different kinds of graphs.
UNCW	30-8-30	A. Line graph using different colors for Group A and Group B B. Back to back stem leaf C. [NO RESPONSE]	A. Line graph B. Stem leaf, box plot C. New ideas will be used mainly to "show off" new skills. Can't use stem leaf or box plot for (A) if don't know about them so have to wait until end of workshop.	A. Line graphs, color coded on one chart B. Stem leaf/ back to back or box & whiskers C. Many did not know how to make stem/leaf until workshops like TEACH-STAT. This isn't in textbooks. Line graphs, bar graphs, etc. are in textbooks. Textbooks need to be updated.
UNCW	42-12-22	A. Make two bar graphs & compare. B. Line graphs C. The teachers have the knowledge to make both kinds of graphs but at the end of the program they would be aware of which graph was more appropriate to display the information that had been collected.	A. Bar graph B. Box plot C. At the beginning of the workshop they would not be familiar with a more complex type of graphing. At the end of the workshop they would know how to effectively display data in order to compare and interpret the results.	A. Bar graph B. Box plot C. Hopefully, the participants will be more aware of techniques for displaying data--and that there are better ways to display data depending upon what information is needed.

UNCW	21-10-11	A. Mean B. Both mean & median C. Teachers would be more aware of types of representation.	A. Average B. Mean, median C. On the last day, teachers will have had more experience & understanding w/these concepts.	A. Average B. Stem & leaf, Box plot (Mean, median, mode, quartiles) C. Teachers on the last day of workshop will be much more informed and comfortable with analyzing and displaying this info.
UNCW	23-1-19	A. They would look for an average score for each group. B. Stem & leaf plot C. (A)--Look for a concrete piece of data to compare; (B)--Look at the pictures of each group of data to compare.	A. Line graph B. Stem & leaf plot C. A stem & leaf plot will give a quick picture to analyze.	A. Bar chart or line graph B. Stem & leaf C. They give pictorial representations but are difficult to get detailed info. from. (The stem & leaf is a) better picture to show range, mode, median, and mean.
UNCW	25-3-21	A. Average the grades B. Stem & leaf C. Last is more accurate way	A. Use the mean B. Box plot or stem plot C. (B) will give more information	A. Bar graph B. Stem and leaf C. Most participants are not aware of stem & leaf

SITE	CODE	ITEM #3A/3B/3C ADMIN 1	ITEM #3A/3B/3C ADMIN 2	ITEM #3A/3B/3C ADMIN 3
WCU	24-1-4	A. A bar graph B. A stem & leaf plot C. Many teachers are not familiar with the stem and leaf plot because it was not part of the curriculum when they were in school. They are very familiar however, with a bar graph. Once they see how quick and easy a stem and leaf plot is, I think they'll prefer to use it.	A. A list ordered from smallest to largest numbers B. A stem & leaf plot C. On the first day, teachers would probably write what they are most comfortable with. They would use what they are accustomed to using. On the last day, they would use new, efficient knowledge.	A. A table with numbers ordered from smallest to largest. B. A stem-and-leaf plot or a box plot C. On the first day of a workshop for K-6 teachers most teachers are not very experienced with comparing data such as this. After 2 weeks of intensive activities in which teachers have become comfortable with comparing data sets, I feel that they are more likely to use their new experiences.
WCU	23-12-16	A. Double bar graph B. Double stem and leaf C. After having participated in TEACH-STAT the participants would have an awareness of other statistical representations that would more quickly and easily display the data than the traditional bar graph.	A. Bar graph B. Stem & leaf C. Teachers would have a greater number of statistical representations at their disposal to choose from.	A. Bar graph B. 2 box & whisker plots C. TEACH-STAT gives teachers new ways to represent data--
WCU	26-10-26	A. They would use a graph B. They would use a more detailed graph C. On the first day--the teachers may be concerned with the actual numbers rather than designing a graph and visually displaying the material.	A. Line plot, Bar graph B. Histogram, stem plot, box plot C. Some teachers would do "simple" graphs both times--others would do more sophisticated graphs at the end.	A. Line plot, histogram B. Pie graphs, stem & leaf, histograms C. The participants would use more sophisticated, detailed representations at the end; they would use x & y axes
WCU	13-9-18	A. Put scores in numerical order from least to greatest B. [NO RESPONSE] C. This depends on the experiences of teachers before class--	A. Look for mean B. Use a line plot or box plot to compare scores C. [NO RESPONSE]	A. Put in numerical order from lowest to highest, bar graph B. Box plot C. The box plot shows you know a better way to compare data.
WCU	26-6-30	A. Graphing--line or other B. Stem and leaf graph C. Stem and leave I feel would be quicker and show the same information	A. They would probably want to add up numbers and divide by how many to get an average. B. Stem & leaf C. Stem and leaf would be easy to see overall data and where the median, mean, and mode fall.	A. They might add up their numbers for each group using a calculator--then divide to find their average score and compare. B. Stem and leaf graph, box plot C. I feel the information would be easier to see and evaluate mean, median, and mode by using stem & leaf, box plot, or other graph.

WCU	25-1-23	A. A line graph or bar graph B. A histogram or a stem-and-leaf plot C. Usually the first day, they're probably going to use what is already familiar to them, bar or line graph. After the workshop, they'll have a better variety of choices to choose the most effective representation.	A. They would probably draw a double-bar graph. B. A box and whisker graph for each one above the other C. Bar graphs are well-known and easy to use as representations. After learning new, more sophisticated graphs, tendency to use them more.	A. They would probably make a double bar graph or two bar graphs and compare the two. B. Some would make two box and whisker plots to compare and some may make a stem-and-leaf to compare. C. Bar graphs are common and most teachers would probably feel comfortable using this fairly easy representation. After the workshop, teachers want to put into practice what they've learned so they tend to use the more advanced representations.
WCU	26-3-31	A. I think that most teachers would get the average scores for Groups A & B and try to compare those. B. I don't think that there is enough information here to determine problem solving knowledge. C. I think that it is common for us to assume that these scores, if given to us, somehow compare. I don't know anything about the groups, tests--anything!	A. I think that the teachers will find the 2 means and compare them. B. Hopefully, they'll use box plots to compare the scores of the 2 groups. C. [NO RESPONSE]	A. Probably a bar chart. B. Hopefully, box and whiskers. C. The box and whiskers would be a much more sophisticated representation of the data. Using 2 of them, the 2 groups can be compared and contrasted easily.
WCU	26-1-3	A. Use of numbers B. Graphs, pictures, unifix cubes, etc. C. Second one (B) much more visual, concrete.	A. Paper & pencil, numbers B. Graphs, charts C. Movement from paper & pencil to more graphic representations	A. Numerical, using percentages (av. scores) B. Perhaps graphing, other visuals. Maybe stem & leaf to start. C. Hopefully, they would use several different ways to show it--incl. some visuals!
WCU	23-5-12	A. Obtaining a grade average for each group. B. Graphs C. Most teachers have been taught math by traditional computation (add, sub, divide, multiply) and stop at the answer. Graphing may use computation but go one step further and provide more information.	A. Line plot B. Box, leaf and stem C. Knowledge	A. Bar graph B. Box plot C. Box plots show better way to compare data.

APPENDIX N.
Participant Scores on
Change Facilitator Stages of Concern Questionnaire

SITE	CODE	ADMINISTRATION #1 CFSoCQ: Percentile Scores ----------Stages of Concern----------							ADMINISTRATION #2 CFSoCQ: Percentile Scores ----------Stages of Concern----------							ADMINISTRATION #3 CFSoCQ: Percentile Scores ----------Stages of Concern----------						
		0	*1*	*2*	*3*	*4*	*5*	*6*	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*0*	*1*	*2*	*3*	*4*	*5*	*6*
ASU	29-4-20	55	59	43	26	27	40	3	48	37	43	44	68	85	13	4	21	12	35	74	97	13
ASU	15-6-12	75	43	84	66	27	32	13	61	30	43	22	16	43	5	40	21	62	19	33	43	1
ASU	42-10-23	14	34	24	11	16	97	8	7	13	18	2	3	97	0	0	3	12	1	9	97	0
ASU	21-2-16	81	66	79	19	13	72	13	69	30	77	30	20	54	13	0	8	49	15	20	91	13
ASU	20-3-29	69	40	95	66	74	77	13	69	79	97	89	74	82	13	14	1	62	40	68	82	13
ASU	34-7-29	81	56	12	44	62	48	3	61	49	34	30	27	72	31	91	18	1	1	16	85	0
ASU	20-6-20	75	26	77	40	54	60	13	61	5	39	19	3	36	13	22	13	43	50	33	77	13
ASU	32-3-20	87	26	43	55	20	36	8	69	13	49	35	46	67	3	48	8	18	26	20	77	1
ASU	28-10-13	31	49	43	35	33	97	13	22	13	43	15	20	40	8	0	13	68	30	7	77	0
UNCC	59-10-18	48	37	43	15	6	12	18	40	13	56	35	2	54	13	22	13	43	35	6	48	13
UNCC	6-6-6	97	66	81	60	3	18	89	99	61	93	86	39	43	55	99	66	95	89	16	54	98
UNCC	15-10-1	97	34	62	66	11	43	13	48	30	39	44	11	54	13	75	30	24	50	7	54	23
UNCC	28-1-2	91	61	43	26	27	67	18	55	40	62	55	16	54	13	40	13	43	40	27	40	13
UNCC	10-6-28	94	30	18	50	4	28	5	61	21	39	35	39	28	1	55	1	2	11	2	24	3
UNCC	30-8-30	61	59	43	40	33	67	13	61	30	79	19	46	77	13	14	21	24	22	7	60	13
UNCC	26-6-22	14	53	39	30	54	85	31	40	43	39	5	68	82	13	48	43	34	8	33	72	13
UNCC	20-6-15	94	34	73	26	6	18	13	22	13	12	11	11	18	13	14	13	24	5	87	91	13
UNCC	26-7-27	81	37	79	40	2	48	8	69	26	81	35	20	54	1	96	13	43	40	2	28	8
UNCC	32-9-21	61	64	68	86	33	97	18	48	34	81	50	27	85	13	94	37	77	30	54	85	13
UNCG	37-6-10	40	53	39	5	27	91	8	7	18	18	11	11	97	8	40	37	43	5	27	85	13
UNCG	43-12-10	75	46	18	5	46	97	13	40	13	12	5	4	67	8	7	5	12	22	4	97	13
UNCG	33-2-18	61	81	79	89	46	82	75	97	69	68	78	33	24	23	81	76	97	50	87	82	13
UNCG	19-9-18	22	46	34	8	82	85	13	31	13	4	5	6	60	13	48	49	56	5	54	77	13
UNCG	34-2-21	31	66	34	22	11	85	13	22	26	30	8	13	54	13	22	26	39	11	9	54	13
UNCG	19-10-21	48	99	43	26	97	97	0	0	81	30	44	68	67	0	48	30	43	40	16	43	39
UNCG	13-1-26	61	56	73	95	33	24	68	61	49	49	82	11	21	47	61	26	34	91	9	18	23
UNCG	30-12-14	55	89	34	26	62	97	18	31	53	30	11	6	54	13	1	2	30	2	11	77	1
UNCG	29-9-19	99	53	81	96	91	82	13	69	21	39	50	27	60	13	75	30	73	71	54	67	13
UNCG	19-8-26	87	76	84	55	39	60	55	81	59	73	50	20	36	18	55	61	87	71	33	48	47

SITE	CODE	ADMINISTRATION #1 CFSoCQ: Percentile Scores ----------Stages of Concern----------							ADMINISTRATION #2 CFSoCQ: Percentile Scores ----------Stages of Concern----------							ADMINISTRATION #3 CFSoCQ: Percentile Scores ----------Stages of Concern----------						
		0	*1*	*2*	*3*	*4*	*5*	*6*	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*0*	*1*	*2*	*3*	*4*	*5*	*6*
UNCW	42-8-22	61	34	34	15	13	54	13	81	5	12	22	13	54	13	91	13	7	5	5	82	13
UNCW	38-11-14	69	89	77	44	27	82	1	69	49	84	30	39	82	1	31	53	84	35	62	67	1
UNCW	30-8-30	81	61	79	50	27	77	18	48	37	79	35	20	82	13	14	37	24	11	74	91	13
UNCW	42-12-22	0	99	39	60	16	97	0	0	87	24	19	33	97	0	14	56	62	5	20	97	13
UNCW	21-10-11	48	87	93	71	74	97	23	31	43	62	22	13	97	13	40	3	49	74	46	97	13
UNCW	23-1-19	40	69	12	11	39	82	13	22	59	24	8	11	85	13	31	87	73	15	46	72	18
UNCW	25-3-21	69	53	34	11	16	43	5	55	56	56	50	16	43	13	69	61	68	50	33	36	13
WCU	24-1-4	55	40	24	15	39	77	13	61	30	24	8	20	91	13	48	30	12	8	46	91	13
WCU	23-12-16	4	13	68	19	54	67	8	4	3	99	30	91	97	5	55	18	81	35	97	97	13
WCU	26-10-26	40	99	49	50	74	97	18	0	34	62	44	74	97	3	14	53	77	35	33	97	13
WCU	13-9-18	94	61	84	35	13	18	23	48	34	99	35	27	36	18	48	5	18	26	27	48	8
WCU	26-6-30	48	64	77	40	20	85	8	31	53	68	19	46	60	13	31	49	49	50	62	77	13
WCU	25-1-23	31	59	43	19	54	72	13	14	21	39	22	9	72	18	55	13	30	11	5	85	8
WCU	26-3-31	94	59	87	19	68	77	55	31	34	84	35	74	67	13	31	40	68	8	9	91	13
WCU	26-1-3	48	43	24	30	7	72	31	40	43	18	11	27	72	31	55	61	24	22	16	60	63
WCU	23-5-12	96	66	79	55	13	32	63	81	49	73	74	27	36	39	48	5	30	40	39	54	3
Percentile Means	(N=45)	61.4	56.3	54.9	39.4	35.4	66.0	19.9	45.9	36.0	50.8	32.6	28.8	63.0	13.8	42.0	28.5	44.6	29.9	32.1	70.5	15.2
Number of Individuals with Highest Stage of Concern		18	5	4	2	0	16	0	11	1.5	12.5	1	0	19	0	10.5	1	5	1	0.5	26	1