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ABSTRACT

This study examined recent literature related to constructivist teacher education, focusing on descriptions of programs and research on program efforts and effects. The study involved literature published from 1990 to the present on constructivist teacher education. This included 20 preservice programs and 15 inservice programs. The studies were cataloged according to the focus of the study, the role of the researcher, participants, methods, and findings. Data analysis resulted in eight common elements of constructivist preservice and inservice teacher education programs: reflection, learner-centered instruction, collaborative learning, posing relevant problems/problem solving, cohort groups, extensive field placements, authentic assessment/professional portfolios, and action research. Key mediational experiences for learners included: social interaction, meaningful learning experiences, shared ownership, reflective analysis, developing a personal theory of teaching and learning, and supportive environment. Research on inservice and preservice programmatic efforts suggested two major effects: change in teacher-learners' beliefs about teaching and learning and/or change in their pedagogy. (Contains 52 references.) (SM)

Expanding Our View of Teaching and Learning:

Applying Constructivist Theory(s) to Teacher Education

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Paper presented at the Annual Meeting of the American Association of Colleges for Teacher Education, January 2003, New Orleans, LA

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Applying Constructivist Theory(s) to Teacher Education

Each day we practice the principles of constructivist theories (Fosnot, 1996; Lambert et al., 1995) in our teacher education programs. Interpreting those theories is inexact and we continually question and reflect on our practice. Reviewing the literature on constructivist teacher education provides practical information and research-based support for expanding our view of teaching and learning, including efforts that facilitate teachers' understanding and practice of constructivist pedagogy. In this review, the authors are situated as teacher educators who know and have experience in constructivist teacher education but who also want to know more about the effects of their work and the work of others. The purpose of this paper is as "a way of knowing", and we use writing as a method of inquiry or coming to know (Lather, 1999, p. 4).

Based on the importance of ongoing examination and critique of the literature, our own interests in knowing more about constructivist teacher education, and the growing number of programs based on constructivist theory, our goal was to explore literature about constructivist teacher education, specifically descriptions of programs and research on program efforts and effects. We sought answers to questions that influence our work as teacher educators. Are there common elements of constructivist teacher education programs? What effects do these programs have on teachers? What facilitates teachers' understanding and practicing constructivist pedagogy? To answer our questions, we reviewed the recent literature (1990 to present) in constructivist teacher education that included 20 pre-service programs and 15 in-service programs for a total of 35 programmatic efforts reviewed (See table 1 and 2). We selected programs where the

authors specifically identified and articulated connections to constructivist theories. Of these program descriptions, twenty (thirteen pre-service programs and ten in-service programs) reported research on the effects of constructivist teacher education. We summarized the program descriptions using a template that included: the focus of the program, a brief description, key features, and any research specified. We cataloged the research studies according to the focus of the study, the role of the researcher, the participants and methods, and the findings. We approached the review process inductively looking for themes and patterns and allowing them to emerge from data. An initial analysis of programs provided descriptive categories of common elements in constructivist teacher education programs. From a deeper level of analysis of the research emerged findings related to the effects of these programs and a more focused look at key mediational experiences in constructivist teacher education.

Prior Reviews and Studies Informing Our Work

Our review builds on the reviews and studies of Gunstone and Northfield (1988), Richardson (1996, 1997), Wideen, Meyer-Smith and Moon (1998), and Tatto (1998) and the research they reported on the issues and effects of pre-service, in-service, and staff development efforts on teachers' beliefs and understandings. These bodies of work suggest that constructivist teacher education may be more influential on teachers than conventional programs. Wideen, et al. (1998) and Tatto (1998) concluded that long-term programs were effective when teacher educators maintained a consistent focus. They suggested that while there is a need for caution and more research, a positive feature of the work in constructivist teacher education is that it may provide "conceptual consistency to a diverse and ambiguous field" (Wideen, et al., p.161). Wood (1995)

suggested "The alternative perspective that constructivism offers by defining learning as a process of personal construction of meaning offers a potentially powerful way in which to rethink teacher education" (p. 336).

What are the Common Elements of Constructivist Teacher Education Programs?

The features of the 35 constructivist teacher education programs in the professional literature were analyzed for this section. Of the 20 descriptions of preservice constructivist teacher education programs, eleven described long-term interventions (programs) and nine described short-term interventions (courses or semester long field experiences). Fourteen occurred in the context of early childhood/elementary education, five in a secondary education context, and one in a K-12 ESOL context. Fourteen efforts occurred in institutions in the United States and six occurred in international settings. Thirteen of the 20 articles reported research on the interventions. We also reviewed 15 descriptions of in-service constructivist teacher education efforts. Nine described long-term interventions (programs or institutes) and six described short-term interventions (courses). Eight occurred in the context of early childhood/elementary education (one specifically focused on mathematics), one in a secondary science education context, and six in a K-12 context. Twelve efforts occurred in institutions in the United States and three occurred in international settings. Ten of the 15 articles report research on the interventions. Analysis of these 35 programs revealed categories of features or eight common elements, with the categories of features appearing in both pre-service and in-service programs described in order of their prominence in the literature. While reported categorically, there are many connections among these features.

Reflection

Reflection is seen by many constructivist teacher educators as a sort of glue that connects the various components or tasks within a teacher education program. Reflection is viewed as a necessary catalyst in the active process of reconciling new and potentially dissonant experiences with the prior beliefs and understandings of the learner. Many programs include opportunities for reflection about the various readings, discussions, and experiences that the teacher-learners are involved in. Often these opportunities take the form of writing in reflective journals, in which the student can interact on paper with the instructor in a dialogue about individual concerns, observations, and questions. Other times the opportunities for reflection require discourse with teacher-learners forming circles of reflection to share thoughts about their practice and related theoretical issues. Reflection is also a key component of authentic and meaningful assessment. Whatever their form, constructivist teacher education programs build in time for reflective activities because they are considered a crucial part of learning and growing professionally as a teacher.

Learner-Centered Instruction

Many constructivist teacher education programs promote learner-centered instruction because of their understanding that learning is maximized by educational settings that take student interest and ownership into account. This is not to say that the student alone decides the topics and pacing of teacher activities, but that such decisions are made as part of a collaborative, democratic process in which the teacher educator becomes more of a facilitator or coach in the learning process. A constructivist teacher educator finds ways to structure the classroom environment so that student input about

course content and their own evaluation is valued and has a real impact. The teacher educator also works hard at assessing teacher-learners prior knowledge and understandings throughout instruction with an aim to helping them develop a deeper, richer conception of the topic. Learner-centered teaching requires an atmosphere where trust, risk-taking, voice, and differing points of view are encouraged, which in turn, requires a supportive environment and collaborative relationships.

Collaborative Learning

Constructivist classrooms and programs that emphasize a learner-centered approach often incorporate a collaborative role orientation to learning rather than a private practice of individual learners. Experiences such as small-group problem solving, collaborative projects, book groups, and collegial activities are evident. This collaborative orientation requires social interaction on the part of learners that in turn leads to a deep and diverse understanding of the topic at hand. Collaborative learning groups also provide the contexts and processes for developing positive social skills such as being able to rationally justify an idea or solution to one's peers and to listen critically yet respectfully to the opinions and perspectives of others. Collaborative learning groups are networks of peers that encourage shared experiences and facilitate connections to be made with other people's ways of making meaning.

Posing Relevant Problems / Problem Solving

This element emerges from the way a constructivist teacher education program views the role of the teacher. In many constructivist programs, the teacher educator is viewed as a facilitator of problem-solving situations, a poser of problems that teacher-learners see as real and important to them. He or she structures learning experiences

around the big ideas, or primary concepts of the curriculum, making sure those concepts are taught in a context that teacher-learners view as relevant and significant to them. These learning experiences are designed to promote cognitive dissonance in the teacher-learners, leading them to examine and possibly restructure their understanding of the topic at hand. Effective problem-solving experiences offer open-ended questions that allow for multiple solutions, foster group collaboration, and require active student involvement in the development of solution strategies.

Cohort Groups

In traditional teacher education programs, teacher-learners often take discrete classes with shifting student populations under various professors with differing educational philosophies and approaches. In contrast, several constructivist teacher education programs require their teacher-learners to take courses together in a prescribed sequence as a cohort group. This kind of long-term, shared learning experience fosters a sense of collegiality and cohesion that allows them to take the risk of engaging one another in meaningful dialogue about their beliefs and teaching practices. It also allows teacher-learners to hear viewpoints from people they have come to know on a deeper level than that of a mere acquaintance. Cohort grouping provides significant opportunities for collaborative learning, for peer scaffolding, and for building a learning community that supports and yet challenges its members to grow professionally as teachers.

Extensive Field Placements

Constructivist teacher education programs place a high value on field work because of the belief that participatory learning in a relevant setting helps a student to

make better sense of theories. Many constructivist programs provide pre-service teachers with supervised field placements and seminars every semester, with classroom responsibilities growing from observation and reflection to teaching one or two lessons per day, culminating in full time experiences where the student teacher manages the classroom all day for several weeks. The reflective and collaborative nature of this field work distinguishes it from traditional experiences, with teacher educators and teacher-learners focused together on children's learning. Such cooperative field placements over long periods of time provide opportunities for pre-service teachers to construct their own theories of teaching and learning, based upon real experiences in real schools. In some programs, work in several different settings allows student teachers to gain diversity of experience helping them build multiple connections between teaching theory and practice. For in-service teachers, an internship or practice in their own classrooms is an integral part of constructivist programs. Goal setting and inquiry by teachers and coaching by teacher educators are features of the internships. Coaching, reflection, action research and portfolios are closely coupled with pre-service and in-service field experiences.

Authentic Assessment/Professional Portfolios

An outgrowth of the constructivist viewpoint that learning is an active and reflective process is the notion that assessment strategies should be integral and ongoing parts of the professional growth plan, rather than just evaluative and at the end of the course of study. Benchmarks, capstones, and professional portfolios are evident in several constructivist teacher education programs as techniques that provide opportunities for both formative and summative evaluation, and which allows a large degree of student

input and creativity. The process of documenting one's own growth over time (for example, in a professional portfolio) also allows teacher-learners to work collaboratively and to receive non-graded feedback from the instructor(s), making it in itself a part of the teaching and learning process.

Action Research

Action research or an inquiry approach to teaching is another common element of constructivist teacher education programs. Gathering classroom evidence for fact-based decision making is seen as an effective tool for constructivist teachers because it helps them analyze and reflect on their practice and focus on the needs of learners. Action research encourages teachers to assess the understandings of the teacher-learners so that lessons may be developed that maximize the potential for concept development. Action research also is used to evaluate teaching strategies with an eye for improvement. Such classroom-based evidence provides the teacher with the knowledge necessary to meet the learning needs of both individual students and the class as a whole. Action research is often coupled with the components of reflection and problem-based learning.

While these eight programmatic elements represent the most often cited features of constructivist teacher education programs, they are neither exhaustive nor independent of each other. As reported in program descriptions, we were left to question the connections to the success of teacher-learners and the efforts that facilitate their understanding and practice of constructivist theory.

What Efforts Facilitate Understanding and Practicing Constructivist Theory and Pedagogy?

The literature on constructivist teacher education also includes research and discussion on what facilitates teachers' development. Looking at this research offers some direction for what needs to occur in programs to enable beliefs and practice to shift. We analyzed each research study (thirteen preservice and ten inservice) to suggest key mediational experiences for learners.

Social interaction

Social interaction plays a strong role in constructivist theories and programs based on its principles. It calls attention to the important role that language plays in mediating our interactions and is characterized by professionally relevant discourse. Several authors (Castle, 1997; Chen, 2001; Condon, et al., 1993; Fosnot, 1996; Graham, et al., 1997; Jadallah, 1996; Magliaro, et al., 1996; Parsons-Chatman, 1990; Steele, 1994) suggested that social interaction, including the use of discourse, instructional conversations, collaborative projects, and peer coaching, are key experiences for preservice teachers, teacher educators and researchers. Parsons-Chatman and Steele found that peer discussions were particularly important in social interaction and Condon, et al., Graham, et al., and Rainer and Guyton (2001) concluded that collaboration and strong personal and professional relationships were also critical elements. There were also specific recommendations for cohorts groups (Rainer and Guyton; Wideen, et al., 1998) and for learning communities (Fosnot; Rainer and Guyton) as a means of encouraging social interaction.

Meaningful learning experiences

A meaningful learning experience refers to opportunities to connect conceptual understanding to classroom practice, including field experiences for pre-service teachers and internships for in-service teachers, and a focus on authentic issues and problems encountered in teaching. It highlights the importance of context in teaching and learning. Jadallah (1996) and Fosnot (1996), looking at pre-service programs, and Castle (1997), Hand & Treagust (1994) and Rainer and Guyton (2001), investigating in-service programs, suggested that if teachers were to construct knowledge from their experiences and social interactions, then collaborative and relevant learning experiences that allowed for investigation and experimentation were critical in facilitating constructivist teaching. More specifically, Castle (1997) and Chen (2001) identified situated learning tasks as facilitating the practice of a constructivist approach in teacher education. Fosnot suggested that meaningful learning experiences help teachers' to illuminate, discuss, and challenge their beliefs. Fosnot further suggested school partnerships that support an integrated, learner-centered approach to curriculum are one way to provide the supportive environment that Mayer-Smith & Mitchell (1997) found as essential for meaningful learning. Parsons-Chatman (1990) documented two constraints to meaningful learning experiences that should be considered: lack of support in practicum settings and the performance for grades approach that takes place in most university courses.

Shared Ownership

Many studies describe constructs (autonomy, voice, empowerment, democratic practices) that taken together we term shared ownership. Shared ownership refers to balancing the power in constructivist teacher education and suggests joint productive activity as means to facilitate to teachers' conceptual understanding and constructivist

practice. Condon, et al., (1993) recommended role redefinitions for teacher educators and prospective teachers where both take on more active roles as learners. O'Loughlin (1992) discussed the importance of sharing power with teachers to empower them in their own learning and in turn encourage them to give control to children as learners. Fosnot (1996) found the importance of empowerment in teachers developing new ideas about their learning and how others learn. Black and Ammon (1992) and Kroll and Black (1993) suggested the importance of providing teachers with a strong enough grounding in developmental theory and research (including linkages between developmental constructs and teaching methods) to make them autonomous professionals and decision makers about what and how to teach. They concluded that an approach based on developmental theory provided a way to think differently about teacher education - as preparation that empowers teachers. This notion of shared ownership is congruent with Richardson's argument (1997) that constructivist teacher education requires "radically altering power relationships" (p. 11).

Reflective Analysis

Reflective analysis describes the processes of exploring and growing from experience by thinking critically about ideas practice. Most programs included reflection as a key component and many studies (Castle, 1997; Fosnot, 1996, Jadallah, 1996; Rainer and Guyton, 2001, Nugent and Parker, 1998) found it to facilitate conceptual understanding and constructivist practice. Mosenthall & Ball (1992) suggested the importance of examining the relationship between deep content and good teaching through reflection. Jadallah concluded that "knowledge about teaching and learning is constructed and reconstructed through the reflective analysis of experiences" (p. 83).

Most often, authors (Fosnot, 1996; Jadallah, 1996; Kroll and Black, 1993; Nugent & Parker, 1998; Simon and Schifter, 1991) cited reflection as a strategy to analyze and confront your own thinking and create a personal theory of teaching and learning.

Developing a personal theory of teaching and learning

Research suggests that teacher-learners need to examine their beliefs and reflect on their practice in light of constructivist theory and then develop their own theories of learning (Fosnot, 1996; Simon & Schifter, 1993). Their research supports teachers' development of their own epistemological view enabling them to make decisions informed by their own professional judgment. Jadallah (1996) and Simon & Schifter (1991) found teachers who were able to go beyond conceptual labels and clearly explain their reasoning for using particular instructional practices were more likely to develop and implement lessons consistent with constructivist conceptual understandings. Several authors (Fosnot, 1996; Goodman and Fish, 1997; Meyer-Smith and Mitchell (1997) pointed out the need to use constructivist-based approaches to teach about constructivism. Goodman and Fish further suggest "instructors' inability to implement against-the-grain perspectives in their own pedagogy may have caused the students' negative reactions" (p. 10).

Supportive Environment

Many authors (Chen, 2001; Condon, et al., 1993; Fosnot, 1996; Meyer-Smith & Mitchell, 199 7; Nugent & Parker, 1998; O'Loughlin, 1992; Parsons-Chatman, 1990) suggested the importance of a supportive environment for teacher learners as they reconstruct their ideas and practice. Their recommendations for a supportive environment included ideas such as learning communities, cohort groups, respectful

relationships between faculty and teacher-learners, democratic practices, partnerships for quality field experiences, mentor programs for first year teachers, and sharing theoretical issues and pedagogical practices with supervising and cooperating teachers. In order to sustain changes, O'Loughlin provided a clear imperative for teacher educators as we engage teachers in constructivist processes. He concluded that we have an obligation to support them in confronting the challenges and political changes necessary to rethink their teaching practice, especially in light of the findings that change often is limited to single classrooms.

The key mediational experiences discussed above provide a framework for considering the common elements that characterize constructivist programs. Figure 1 is a juxtaposition of our findings that indicates the interconnectedness among the mediational experiences and between the programmatic features. For example, shared ownership is a mediational experience that can be accomplished through four common elements: collaborative learning, cohort groups, authentic assessment and learner-centered instruction. However, it also requires another mediational experience, a supportive environment. In the following section, we explore the research on programs to discern the effects of these experiences on preservice and inservice teachers.

What are the effects of constructivist teacher education?

The Effects of Pre-Service Constructivist Teacher Education Efforts

A synthesis of the 13 research studies on pre-service constructivist teacher education (short and long term interventions) suggests two major effects: change in teacher-learners' beliefs about teaching and learning and/or a change in their pedagogy. Condon, Clyde, Kyle and Hovda (1993), Kilgore and Ross (1993), Graham, Hudson-Ross

and McWhorter (1997) and Andersen and Piazza (1996) reported changes in teachers' beliefs. Meyer-Smith and Mitchell (1997), Jadallah (1996), Black and Ammon (1992) and Kroll and Black (1993) and Chen (2001) reported changes in knowledge, beliefs and pedagogy. Table 3 summarizes the effects of short and long term interventions. This overview alludes to the complexity and richness of the effects of constructivist teacher education.

The Effects of In-Service Constructivist Teacher Education Efforts

In the research available on ten in-service programs there is evidence of both similarities and variations in findings. Table 4 summarizes key findings on inservice constructivist teacher education using a typology of change (Rainer & Guyton, 2001) to organize the types of identified changes. An analysis of these findings indicates that all studies reported changes in teachers' beliefs and knowledge about constructivism and changes in classroom practice. Three studies (Castle, 1997; O'Loughlin, 1992; Rainer & Guyton, 2001) indicated personal change for teachers, such as developing voice and increasing enthusiasm and confidence. Four studies (Castle, 1997; Hand & Treagust, 1994; Rainer & Guyton, 2001; Simon & Schifter, 1991) found that teachers changed their views of children. Only one study (Rainer & Guyton, 2001) reported interpersonal changes (group dynamics, caring relationships) among teachers. The similarities are most likely a function of the common focus in most programs on teachers' thinking and practice. The variety of effects may be consistent with the varying conceptions of constructivism, the different goals and objectives of the various programs, the diversity of the populations of teachers who enter our programs, and the varying conceptions of the teaching and learning that teachers bring to their work.

Summary and Implications

From the literature describing programs, we identified eight of the most common elements in constructivist teacher education programs. The research on the effects of constructivist teacher education programs suggested six categories of mediational experiences. To suggest implications of this literature for teacher educators required us to juxtapose these findings and identify connections among the common elements and the key mediational experiences. This juxtaposition indicates the interconnectedness among the mediational experiences and between the programmatic features and suggests a framework for expanding our view of teaching and learning by looking at constructivist teacher education programs. The research on preservice and inservice programmatic efforts suggested two major effects: change in teacher-learners' beliefs about teaching and learning and/or a change in their pedagogy. The research on inservice efforts indicated a broader range of effects that included personal change, change in views of children and to a limited extent, change in interpersonal knowledge and performance.

These findings are encouraging for those of us who know intuitively and from experience the excitement of working in a constructivist teacher education program. They suggest that with a) a clear focus and explicit attention to a constructivist approach and b) using effective mediational experiences, teachers report changes in beliefs and pedagogy. The implications from the literature are also challenges for teacher educators to:

•rethink the structures, content and processes (including assessment) of programs, courses, institutes, in light of constructivist theories
•re-evaluate roles, rewards, resources (Condon, et al., 1993)
•understand and implement the model that they advocate, in particular as related to ownership in the classroom (Fosnot, 1996; Goodman & Fish, 1997; Meyer-Smith & Mitchell, 1997)
•consider the cost, labor and time intensive nature of work (Pfannenstiel & Schattgen, 1997)
• honor the obligation to support teachers as they confront the challenges necessary to rethink their teaching practice (Fosnot, 1996; O'Loughlin, 1992)

Bentley in Larochelle, Bednarz and Garrison (1998) suggested that constructivism can serve as a useful referent for education but that practice is never a simple application of general rules to concrete situations. Citing Betttencourt (1993), he described the relationship of theory and practice as a relationship of "mutual adaptation, of mutual questioning and of mutual illumination" (p.47). Coming back to the purpose of this review as a way of knowing more about constructivist teacher education, we have a mutual illumination based on recent efforts.

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ıble 1. Constructivist Teacher Education Programs (Pre-Service)

Program	Organization	Focus	Description	Features	Research
Constructivist Mathematics Teacher Education Course [Anderson & Piazza, 1996]	Boise State University	Elementary school mathematics	Focuses on changing pre-service teachers' beliefs about teaching mathematics during a constructivist-based mathematics teacher education **course**; describes four layers of learner commitment to constructivism	Student autonomy, posing problems of emerging relevance, learning structured around primary concepts, self-reflection, active learning through group problem solving, using physical models to develop understanding, emphasis on writing in mathematics	*Qualitative analysis of responses in 50 randomly selected journals (out of 154)
Developmental Teacher Education (DTE) [Black & Ammon, 1992; Kroll & Black, 1993]	University of California at Berkeley	Elementary grades, all content areas	Two-year postgraduate master's level initial certification **program** using developmental theory and research as its unifying conceptual core	Small cohorts of students, course work addresses topics repeatedly and hierarchically, multiple student teaching placements in diverse settings, master's project on a teaching-learning issue	*See Kroll & Black for methods; comparison of traditional and DTE graduates using observation and rating protocol
Undergraduate Constructivist Teacher Education Course [Burk & Dunn, 1996]	Department of Early Childhood Education, University of Oklahoma	Elementary Grades, all content areas	A college **course** developed to promote active learning about constructivist theory through a high degree of student autonomy, social interaction, and personal reflection	Based on Constance Kamii's (1985) "Young Children Reinvent Arithmetic: Implications of Piaget's Theory"; features include questioning and supporting answers, discussion, student autonomy over assignments and grades, reflect on own thinking, making connections with practice	Feedback from student journals and a graduate assistant who also took the course
Problem-Centered Approach to Teaching [Casey & Howson, 1993]	Boston College	K-3 grades, all content areas	A **course with a clinical component** is described as part of a program emphasizing a systematic and intensive problem-solving model of teaching (based on constructivist and information processing theory) using open-ended questions, scientific reasoning, a focus on process (rather than on outcomes) and on student discovery (rather than direct instruction)	Designing content-based / problem-solving units, scaffolding from university professors and cooperating field placement teachers in lesson development, an emphasis on explanation and reason rather than right-or-wrong answers, reflection, journal writing, detailed lesson self-evaluation and re-design, videotaped lessons	None specified in reference
[Chen, 2001] See also inservice course	National Tawain Normal University	Elementary education	Author designed a **course** (17 weeks) based on constructivist principles	Features a student-centered, inquiry-oriented collaborative learning environment to assist in the active engagement of students; including , inquiry, group discussions, self-reflection and examination of personal practice and thinking.	*A two year qualitative study includes participant observations (including video-taping), focus group interviews, document analysis and self-evaluations,
[Cheung, 1990]	Institute of Education in Singapore	Primary School	A ten week, supervised **student teaching experience** based on a proposed constructivist model of teacher professional development	The proposed model is based on humanistic constructivist pedagogy, instructional roles, reflection on classroom practice, internalization of educational principles, and action research for teacher renewal	A student teacher's written reflections/self-appraisals of critical incidents presented as evidence of growth
Committee for Alternative Programs in Teaching and Learning-CAPITAL [Condon, et al, 1993]	University of Louisville, Kentucky, and Jefferson County (Kentucky) Public Schools	K-4 grades, all content areas	A two summer, two semester Master of Arts in Teaching **program** for career change (non-traditional) students in which cross-disciplinary teaching/ learning and intensive field work are emphasized	Cohort groups, pass-fail grading, four 8-week field placements, close collaboration between university and local school personnel, solo teaching in each field placement, research-based decision making, encouragement of risk-taking and learning from successes and mistakes, student developed portfolios	*Qualitative analysis of an individually administered free-response interview, repeated several times
The School Age Child Practicum [DeJong & Groomes, 1996]	Department of Family and Child Services, Florida State University	Elementary grades, all content areas	A constructivist teacher education program includes a **practicum** designed to strengthen the preparation of teachers for work in schools with children at risk due to poverty, emphasizing integration of university classroom instruction with community service experiences	Participation in a classroom setting (reflection/lecture/discussion) and community service experience working directly with children at a local elementary school (2-3 hours weekly at a Chapter One school)	None specified in reference

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Table 1 (cont.). Constructivist Teacher Education Programs (Pre-Service)

Program	Organization	Focus	Description	Features	Research
Teacher Preparation Project [Fosnot, 1996]	Center for Constructivist Teaching	K-6 Elementary	A two year, 45 credit, graduate certification/MS degree **program** in collaboration with five K-6 field sites; model includes a summer institute, clinical fellowship year, and a final summer institute	Features include shared opportunities to analyze their own learning and thinking, construct pedagogy from analysis of children's thinking, to cooperate in field experiences, explore topics in depth, mentors to support clinical (1st year of teaching), and an emphais on the change process	*Teachers' writing (papers, journal entries) used as evidence of teachers' growth and example of what needs to occur in programs
Collaborative Inquiry Community [Graham, et al, 1997]	National Reading Research Center, University of Georgia	Secondary English	Teacher candidates volunteer for this experimental field center, in which they are placed for an entire **school year** with a mentor teacher, beginning with a two-week practicum, 12 hours per week during fall and winter, and full-time student teaching during spring	Collaborative planning and curriculum decision-making among teams of school-based mentor teachers and university faculty, integration of methods courses, professional readings, weekly Athink pieces,@ six research projects, professional conference presentation of research, video and audio tapes of practice teaching, dialogue journals, synthesis papers, portfolios	*Case study of six candidate teachers, part of a larger NRRC study of how preservice and mentor teachers= knowledge about literacy teaching is acquired and developed
{Hand & Peterson, 1995]	Latrobe University Victoria, Australia	Elementary Science	This paper describes a **two semester science** sequence taught as part of a **preservice** program and research to investigate if a constructivist approach would improve preservice teachers' understanding of science and constructivist pedagogy	Features include student selected science investigations including concept maps and study of the process of learning. Faculty model constructivist pedagogy using a sample topic and strategies such as exploring students understanding, questioning, discussing and planning. Students developed teaching plans for the self-selected topics they investigated.	*Four students per class (?) were chosen to follow through the 2 semesters using interviews, journals, course evaluations and participants observations – benefits and concerns reported
Theory and Practice of Secondary Education [Jadallah, 1996]	Bowling Green State University	Secondary grades, all content areas	Attempts to change pre-service teachers' conceptual understandings about teaching and learning through a one semester **course** based on constructivist principles and related field experiences	Focus is on reflective practice including two-hour weekly seminar discussions, planning and teaching four formal lesson plans, writing a reflective analysis paper	*Qualitative analysis of 6 (from 16) teachers' lesson plans, reflective paper, videotaped lessons, and interview
Constructivist-based Teacher Education Course [Kaufman, 1996]	State University of New York at Stony Brook	TESOL, all grade levels	Constructivist-based instruction in a pre-service TESOL **program** are employed in the belief that teacher candidates will employ constructivist principles in their own classrooms later	Student autonomy for their own learning, peer collaboration and support, leaner-generated problems drive the curriculum, self-observation and evaluation, reflection	None specified in reference
Stream 3 Integrated Sciences Program [Loughran & Russell, 1997]	Monash University, Australia	Secondary science	A one-year postgraduate teacher education **program** leading to a Diploma in Education degree	Organized around several principles, including student-centered education, peer collaboration, active construction of knowledge, and reflective practice. Also includes micro-teaching experiences, hands-on sciences in natural settings, portfolios, and journal writing	Instructor and prospective teacher journal data
Social Construction of Learning in Elementary Education [Magliaro, et al, 1996]	College of Human Resources and College of Education, Virginia Tech	Early childhood (preschool) and elementary grades, all content areas	Undergraduate preservice teacher education **program** that emphasizes language-based, socially-constructed learning experiences	Large and small group discussions; formal and informal reading and writing; group projects through which roles, tasks, and meanings are negotiated; hands-on learning experiences through collaborative working groups; senior-year cohort grouping; large seminar problem-solving and planning discussions; school-based decision-making during student teaching field experience	*Qualitative data analysis of eight participants; data includes individual and focus group interviews, observations in field placements, documents
Science methods course [Mayer-Smith & Mitchell, 1997]	University of British Columbia, Canada	Secondary science	A methods **course** in a one-year postgraduate teacher education program for science undergraduate majors without prior preservice teacher training	Three central objectives for prospective teachers: 1) to encourage reflection on prior beliefs about science education, 2) to promote a constructivist perspective of learning, and 3) to examine prospects and problems of applying constructivist theory to teaching	*Qualitative data: journals, reflective writing, observations of student teaching, structured interviews

Table 1 (cont.). Constructivist Teacher Education Programs (Pre-Service)

Program	Organization	Focus	Description	Features	Research
Secondary Science Education Program [Parsons-Chatman, 1990]	St. Francis Xavier University, Nova Scotia, Canada	Secondary science	A one-year postgraduate teacher education **program** leading to a Bachelor of Education degree	Students spend one semester exploring the nature of science education, instructional strategies, and learning theory; a second semester of teaching methods, and a ten-week practicum experience with the purpose of implementing a constructivist approach to science teaching.	*Qualitative analysis of ten participants comparing preservice teacher beliefs with observations of practicum teaching
Inclusive Early Childhood Education (IECE) [Phillips & Hatch, 2000]	University of Tennessee at Knoxville	Early Childhood Education and Special Education	This paper describes a 5-year licensure **program** based on constructivism and reflective decision-making.	Key features include selective admissions process, participation in a learning community, field based schedules, integrated curriculum, and alternative assessment and grading.	Students experiences recorded, no research reported in this reference
[Rasch, et al, 1992]	Maryville University (Missouri)	Elementary mathematics education	Mathematics is a component of constructivist **programmatic model**; the mathematics component emphasizes mathematical literacy as a way to empower teachers	Features: immersion in math experiences, speaking, writing about, sharing ideas confusions, reconceptions; value of process; encouraging dissonance and reflection	Results are reported (briefly), however, methods are not articulated
Steele, D. (1994	U. of Florida	Elementary mathematics education course	This paper provides an overview of a **preservice course** and **research** on whether modeling constructivist teaching affect change in students conceptions of mathematical learning	Features include inquiry and investigation through problem solving in cooperative groups and whole-class discussion. Using manipulatives and reading research were also components. The teacher/research chose the readings, problems and assignments.	*A mix of quantitative (pre-post survey using Mathematics Belief Scale N=19) and qualitative (participant observation, interviews and artifacts from 5 randomly selected students)

A:\review of research\CTE only matrix

Table 2. Constructivist Teacher Education Programs (In-Service)

Program	Organization	Focus	Description	Features	Research
Field-Based Masters Program [Burnaford & Hobson, 1995]	National-Louis University	All grade levels and content areas	Graduate **program** in which experienced teachers meet once per week for four hours over 22 months in an integrated curriculum involving instructional theory and teacher action research	Field-based, collaborative cohort groups, dialogue journals, shared teaching, no formal tests or final examinations, classroom-based action research project, portfolios, self-evaluation, authentic assessment	None specified in reference
Constructing knowledge of Constructivism [Castle, 1997]	Oklahoma State University	Early Childhood Education	Seventy-five teachers in three **courses** participated in an assignment to deepen their understanding of constructivism (moon project).	Inquiry based project (moon watching) that requires developing questions, recording observations and experiences, and reflective writing	Data included class discussions, journals and reflective papers at the end of the project.
Constructing Constructivist Teacher Education [Chen, 2001]	National Taiwan Normal University	Elementary Education	46 in-service teachers involved in author's constructivist design **course** (17 weeks).	Features a student-centered, inquiry-oriented collaborative learning environment to assist in the active engagement of students; including, inquiry, group discussions, self-reflection and examination of personal practice and thinking.	A two year qualitative study includes participant observations (including video-taping), focus group interviews, document analysis and self-evaluations,
Learning and Language Across the Curriculum [Dillon, et al, 1995]	McGill University	All grade levels and content areas	Graduate level **course** centered on an approach to teaching that fosters students' ownership of learning	Organized around four conceptual "pillars": constructivism, experiential learning, pluralism, personal and social transformation. Students are encouraged to discuss their own learning, to pose questions about what they are uncertain of knowing, to practice in their own classrooms what they learn, and to share in the holistic evaluation process in the in the course.	Qualitative journal data
Experienced Teachers Program (ETP) [Duckworth, et. al., 1997]	Harvard Graduate School of Education	All grade levels and content areas	Graduate **program** including an integrative seminar, two required courses, three focused electives, and two open electives	Integrative seminar of two hours every other week, planned by participants, classroom ethnography using visual analysis, courses dealing with content knowledge, philosophical orientation, and organizational orientation	Reflective journal writings
Changing to constructivist teaching [Hand & Treagust, 1994]	La Trobe University College of Northern Victoria, Australia	Junior Secondary science program	An 18 month inservice **program** centered on constructivist teaching and learning approaches both as a philosophical base and as a process for teachers to model	Opportunities provided for teachers to discuss and define good science teaching, read and discuss articles on constructivist approach, explore students understanding of a topic, plan and implement a teaching unit using new approaches	18 month qualitative study including classroom observation, interviews, journals and child interviews
SummerMath for Teachers Teachers College Writing Project [Mosenthal & Ball, 1992]	Mount Holyoke College, MA Columbia Teachers College, NY	Mathematics, elementary grades Writing, elementary grades	Two **programs** designed to help teachers develop constructivist teaching practices, both part of the Teacher Education and Learning to Teach Study by the National Center for Research on Teacher Education	Increased use of manipulatives, improved questioning, problems that challenge kids, extensions to problems, demonstration lessons Writing workshops with peer and teacher interaction, notebook writing, mini-lessons, conferencing	Interviews and questionnaires with program staff members, observations of their work with teachers

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Table 2. cont. Constructivist Teacher Education Programs (In-Service)

Program	Organization	Focus	Description	Features	Research
Teacher Action Research [Nugent & Parker, 1998]	Florida Regional Center, National-Louis University	All grade levels and content areas	Eighteen-month action research projects in the classrooms of the teacher-participants, as part of a Master of Education degree **program**	Reflection paper, journal writings, project drafts and completed action research project, informal interviews, self- and program evaluations, portfolios	Qualitative, ethnographic review of one action research project
Children's Thinking Project [Oldfather, et al, 1994]	National Reading Research Center, University of Georgia	Elementary grades, all content areas	Part of a Master=s level **course** in early childhood education, designed to deepen the participants= understanding of constructivism, and its implications for teaching	Informal taped interviews with children, designed largely by the teacher participants, group discussions about the interviews, short papers written about the interview context, approach, content, findings, a summary of what was learned, and self-critique	None specified in reference
Summer Institute for Teachers [O'Loughlin, 1992]	Hofstra University, NY	All grade levels and content areas	One week, 3-credit graduate-level **course** in a retreat-like atmosphere where teachers critically reconstruct their visions of teaching	Six hours daily, suggested reading list, collaborative group projects, nondidactic group presentations, journal writing, dialogue, recitation, sharing of journals and poetry	Anonymous course evaluations, transcribed interviews, phone survey
Collaborative Masters Program (CMP) [Rainer & Guyton, 1998]	Department of Early Childhood Education, Georgia State University	Elementary grades, all content areas	Masters degree **program** for practicing elementary teachers over fifteen months, emphasizing constructivist theory and practice, deep engagement of content, reflection and inquiry, the importance of community, and a framework for learning	Initial three-day retreat, cohort groupings throughout program, collaborative decision-making about formative and capstone experiences and about benchmarks (formal periodic assessments) which synthesize and demonstrate teacher knowledge, skills, and attitudes	Qualitative research (N=26) using field notes, interviews, written responses, classroom observations and faculty ratings
Project Construct Institute [Schattgen, 1997; Pfannenstiel & Schattgen, 1997]	Project Construct National Center, University of Missouri at Columbia	Elementary grades, all content areas	Thirty-hour **institute** experience, plus follow-up experiences, advanced institutes on specific topics such as literacy, mathematics, and assessment	Designed around four principles: 1) children have an intrinsic desire to make sense of the world, 2) children actively construct knowledge and values by acting on the physical and social world, 3) children's thinking will contain predictable errors, and 4) developmental domains are interactive and interrelated	Quantitative research using self-report surveys, classroom observations, teacher assessments of student learning, standardized achievement test data
Simon, 1989; Simon & Schifter, 1991, 1993]	Educational Leaders in Mathematics (ELM) Project at Mt Holyoke College	Mathematics, elementary and secondary grades	An intensive two-week summer **institute** and weekly classroom follow up during one academic year	Key features included mathematics lessons that value the construction of meaning followed by discussions and assessments of students' understanding. Collaborative planning of problems, tasks and lesson sequences in grade level groups	Interviews, teachers' writing, questionnaires, observations of participants' work, standardized tests, teacher report of students' growth
Foxfire Level One Course [Teets & Starnes, 1996]	Foxfire Fund Inc., Mountain City, GA	All grade levels and content areas	Constructivism is seen as the theory undergirding the Foxfire **course** specifically its 11 core practices	Discussion of core practices, regular reflection, increased student autonomy, visiting experienced teachers' classrooms, observations and conferences, support group network	None specified in reference
Child Development Project (CDP) [Watson, 1995] See Battistich & Solomon (1995)	Developmental Studies Center, Oakland, California	Elementary grades, all content areas	Summer **institute**, plus four day-long workshops during the following school year, including on-site teacher support and curriculum/teaching materials	Emphasis on explicit social and ethical learning in addition to intellectual development, literature-based reading and language arts, collaborative classroom learning, developmental discipline, parent involvement, and inclusive, non-competitive school-wide activities	Quasi-experimental design with two program and two comparison schools in each of six districts

Table 3. Research on effects of short and long term pre-service constructivist teacher education

Pre-service teachers who experience short-term interventions...	Pre-service teachers who experience long-term interventions...
▪ distinguished didactic from learner centered teaching approaches and demonstrated a familiarity with teaching for understanding. (Meyer-Smith and Mitchell, 1997)	▪ came to a) view learner-centeredness as essential; b) make informed decisions based on observing children and action research; and c) develop a sense of efficacy that was more context specific than global. (Condon, et al., 1993)
▪ experimented with a range of procedures introduced in the course, including probing the prior views of pupils, fluid discussions, pupils' examinations of their beliefs, role plays, and concept maps. (Meyer-Smith and Mitchell, 1997)	▪ made a commitment to student learning, took a view of themselves as learners, and a espoused a view that teaching is complex and teachers have a responsibility in children's success (Kilgore & Ross , 1993)
▪ demonstrated espoused beliefs and understanding and classroom practice consistent with constructivist ideas. (Meyer-Smith and Mitchell, 1997)	▪ knowledge changed in three ways: it shifted dramatically from a teacher and content-centered approach to a student-centered classroom, it deepened by adding personal meaning and adding teacher research to their way of life, and it served as theoretical grounding for teaching in a more holistic and integrative way (Graham, et al., 1997) ▪ came to understand the range of resources and support needed and the value of a collaborative inquiry community to enhance understanding, (Fosnot, 1996; Graham, et al., 1997).
▪ perceived questions as essential to promote and challenge thinking, increase motivation, relate content to pupils' interests and experiences and examine pupils' understandings. (Jadallah, 1996)	▪ developed cognitive beliefs about mathematics pedagogy including the importance of manipulatives for enhanced learning, the use of group work, making mathematics make sense, student discussion, and learning and solving problems happens in diverse ways. (Andersen & Piazza, 1996)
▪ related student motivation to a) the extent that a lesson promoted active participation, b) subject matter caused students to	▪ developed affective responses about mathematics pedagogy, for example, teachers were more confident, gained a deeper understanding, enjoyed learning, valued others' ideas and felt they had something to contribute. (Andersen & Piazza, 1996)

experience cognitive dissonance, and c) subject matter related to students' past experiences (Jadallah, 1996). ▪ focused on methods of instruction that accommodated developmental characteristics of pupils and included learning styles through sensory experiences (Jadallah, 1996) ▪ were able to go beyond conceptual labels and clearly explained their reasoning (Jadallah, 1996) ▪ were more likely to involve children in experiential learning and include higher-order thinking in their lessons (Jadallah, 1996)	• improved their conceptual understandings, used thinking to construct understandings consistent with developmental levels, and engaged students in thought provoking activities and guided their thinking toward better understanding. (Black and Ammon, 1992) • identified differences in teaching methods of traditional and DTE teachers in classroom organization (types of grouping, student interactions and lesson products) and in implementing math and literacy curriculum (materials used, integration of skills, communication of purpose, and level of difficulty). (Kroll and Black, 1993) • broadened their definitions of mathematics and deepened their understanding of pedagogy to include the importance of process, ownership, collaboration, and active, in-depth learning. (Fosnot, 1996) • expanded their views of teachers' roles to include providing support, guidance, and probing to encourage children's investigations. (Fosnot, 1996) • acquired positive learning behaviors and attitudes (Chen, 2001) • developed collaborative and active learning habits (Chen, 2001) • established a supportive climate for learning (Chen, 2001) • advanced their pedagogical knowledge and skills (Chen, 2001) • enhanced their capability and sensitivity in reflection (Chen, 2001)

Table 4. Findings from research on in-service constructivist teacher education

	Change in beliefs and knowledge	Personal change	Interpersonal change	Change in views and understanding of children	Change in classroom practice
Chen, 2001	Recognized key characteristics of constructivist teaching Enhanced their understanding of teaching & learning				Willing to experiment with new practices and reflect on it
Rainer & Guyton, 2001	Tested ideas about philosophy and theory Saw new ways of looking at teaching Found new personal learning strategies	Teachers' willingness to change Openness to new ideas Enthusiasm Voice Confidence	Group dynamics Caring relationships	Looked more closely and inclusively at children Trusting children with responsibility	Developed new approaches to teaching Used constructivist teaching strategies Community-based classroom environment
Pfannenstiel & Schattgen, 1997	Beliefs moved toward child-centered learning and changing teachers roles				Classrooms reflected a predominantly constructivist approach
Castle, 1997	Reflected on their own learning Rethink their ideas on teaching Asked their questions and searched for answers			Understand children's learning process better	Report initiating projects in their classrooms

	Change in beliefs and knowledge	Personal change	Interpersonal change	Change in views and understanding of children	Change in classroom practice
Battistich and Solomon, 1995	Teachers' beliefs (in constructivist learning, trust in children, and tendencies to provide more autonomy children) increased significantly from a baseline.				Reported changes in practice, including, increased use of cooperative learning, class meetings, social understanding activities, and student autonomy and declined use of extrinsic control
Hand and Treagust, 1994	Thought about how children learn, Recognized that children learn by actively working on their own ideas More comfortable allowing choice				Tried new approaches to teaching and learning related to who controls learning Provided students with opportunities to explore on their own
O'Loughlin, 1992	The importance of a new way of thinking rather than a new technique. The use of reflection as a way of listening to yourself – validating ideas and identity	Developing voice A renewed sense of energy The anguish of an intensely different experience and the soul searching that change requires in yourself			Tried new approaches to teaching and learning, including who controls learning Provided students with opportunities to explore on their own Were more comfortable allowing students to determine the direction of their own learning

	Change in beliefs and knowledge	Personal change	Interpersonal change	Change in views and understanding of children	Change in classroom practice
Simon and Schifter, 1993	Attitudes and beliefs changed significantly for elementary but no change for secondary				Reported cognitive, affective, and social change in children as result of classroom practice
Simon and Schifter, 1991	Developed new personal theories about learning Articulated their processes of learning. Became more committed to the development of understanding			Teachers viewed children as more active and responsible Teachers listened more to their students, focusing on their ideas and understandings	Implemented new teaching strategies Developed a more critical perspect ve on their own practi:e Learned a new and broader range of teaching strategies; Respected the effect of the learning environment

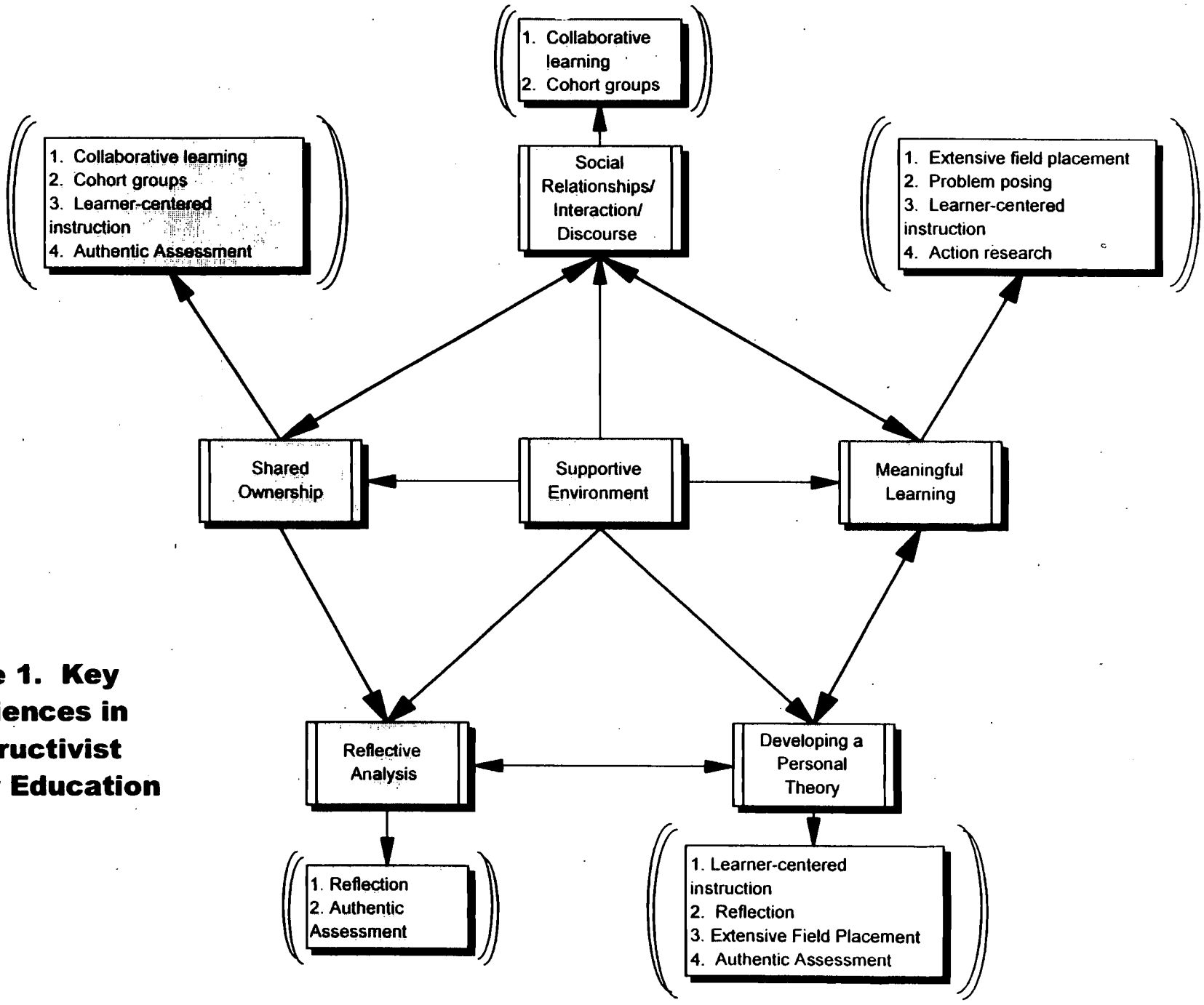

Figure 1. Key Experiences in Constructivist Teacher Education

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