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An Emerging Picture of Constructivist Teacher Education

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Many teacher educators around the world are exploring the promises and practices of constructivist theories for preparing teacher learners. As teacher educators we practice the principles of constructivist theories (Fosnot, 1996; Lambert et al., 1995) but 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 programmatic efforts, 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 application of constructivist theories to the practice of teacher education. The purpose of our review is as "a way of knowing", and we use writing as a method of inquiry or coming to know (Lather, 1999, p. 4). This paper describes our findings so that a wider audience might benefit from our emerging understanding of constructivist teacher education.

Prior Reviews and Studies Informing Our Work

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). The work of Rainer and her colleagues (2002) supported this idea and suggested that there are dimensions of constructivist theories that provide a way of reframing teacher education. Our questions stem from these ideas and reviews and studies by Gunstone and Northfield (1988), Richardson (1996, 1997), Tatto (1998), Wideen, Meyer-Smith and Moon (1998), and their research on the effects of preservice, inservice, and staff development efforts on teachers' beliefs, understandings and

practice. These bodies of work indicate that constructivist teacher education may be more influential on teachers than conventional programs. Wideen, et al., suggested that constructivist theories provide a new conceptual ideology for teacher education, and Wideen, et al. and Tatto concluded that long-term programs were effective when teacher educators maintained a consistent focus and message. Wideen, et al. also 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 this conceptual consistency. Their review also suggested that successful programs were built on the epistemological perspective that learning to teach was a deeply personal activity in which the learner examined beliefs and prior knowledge in light of their learning in programs and teaching contexts, what Richardson termed as constructivism.

Purpose, Questions and Methodology

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 the current literature (1990-present) on constructivist teacher education. In this paper we focused specifically on descriptions of constructivist efforts (including assignments, courses and programs) in order to make sense of and extend our thinking on constructivist teacher education.

We sought answers to questions that influence our work as teacher educators. What does constructivist pedagogy look like in teacher education? More specifically, are there common goals and elements of constructivist teacher education programs? How are programs conceptualized? How are they organized? Are there structures, events, and/or processes common to programs? What challenges do teachers and teacher educators find as they implement constructivist pedagogy?

To answer our questions, we reviewed contributions from edited books, journal articles, ERIC documents and conference presentations. Our search produced position papers, program descriptions and evaluations, and research studies. After compiling the program descriptions/evaluations and research studies, we sent a request to eight respected authors of work in constructivism and education for their suggestions for other programs to include. These authors sent suggestions for searching, however, no new programs or research surfaced. We continue to look for well-articulated, constructivist teacher education programs, in particular international efforts, and welcome any suggestions from the reader.

Selecting programs for the review required examining each paper for its conceptualization of constructivism. We found many teacher education programs that focused on democratic or reflective practice in our initial compilation;

however, only programs grounded in constructivist theories were considered for this review. Richardson (1997) suggested there were two different forms of constructivist teacher education: a) teaching teachers to teach according to a constructivist approach and b) working with teacher-learners in a constructivist way to help them understand their tacit beliefs and introduce new conceptions as possible alternatives to those held by the learner. We selected studies that were defined and intentionally guided by constructivist theories (sometimes termed as socially constructed knowledge by the authors) and that represented either form as defined by Richardson.

This review includes 22 preservice programs, 11 inservice/graduate programs and seven inservice/professional development programs for a total of 40 constructivist efforts (See tables 1 -3). Of these program descriptions, 25 (13 preservice programs, 7 in-service programs, and 5 staff development programs) reported research on the effects of constructivist teacher education and analysis of this research is reported in Rainer Dangel (2002).

For this review, we summarized the programmatic efforts using a template that included: the focus of the program, a brief description, key features, and any research specified. We also coded efforts using five general categories:

1. the level (preservice, inservice/graduate programs, and inservice/professional development)
2. the length of the effort – short term efforts included individual courses and assignments; long term efforts included year-long efforts such as complete programs and institutes with year-long follow up
3. the focus of the efforts including elementary or secondary grades
4. the various subject areas, such as math, writing, and science
5. the context of the effort, whether an international or national effort

We approached the review process inductively looking for themes and patterns allowing them to emerge from data. An initial analysis provided descriptive data about the types, contexts, conceptualizations, and models of constructivist efforts. From a deeper level of analysis, we were able to identify common elements that facilitate constructivist teacher education and the challenges inherent in this process. Together these provide an emerging picture of constructivist teacher education.

Overview of constructivist teacher education efforts

In this section we provide an overview of the efforts reviewed, including the duration of models (short or long term), the type of programmatic efforts (grade level and academic area), the context for the programs (national or international), and the degree to which they included research. Table 4 provides descriptive statistics of these programs.

We reviewed 22 descriptions of preservice constructivist teacher education programs. Eleven descriptions are of long-term interventions (defined as complete programs for initial certification of at least a year in length) and 11 articles described short-term interventions (defined as projects, courses or semester long field experiences). Fourteen occurred in the context of early childhood/elementary education, six in a secondary education context, and two in a K-12 context. Eighteen efforts occurred in institutions in the United States and four occurred in international settings. Thirteen of the 22 program reports included research on the preservice interventions or evidence of teacher change. All research was qualitative in nature.

We also reviewed eleven descriptions of inservice/graduate constructivist teacher education efforts (defined as efforts with practicing teachers in a university setting). Five described long-term interventions (programs or institutes) and six described short-term interventions (projects or courses). Five occurred in a K-12 context, five occurred in early childhood/elementary, and one occurred in secondary science education. Seven efforts occurred in institutions in the United States, and four occurred in international settings. Seven of the eleven descriptions reported qualitative research on the interventions.

There was also evidence in the literature of seven comprehensive inservice/staff development efforts (defined as work with practicing teachers in a school setting) to encourage constructivist thinking and pedagogy. Each is structured as an intensive summer institute or workshop with additional follow up components during the academic year. Five occurred in the context of early childhood/elementary education, and two occurred in a K-12 context. One emphasized writing, one focused on mathematics, two addressed science and all others addressed curriculum in general. Five reported extensive research, and all occurred in settings in the United States.

Looking across all levels of efforts indicated that the number of long term efforts (21) is comparable to the number of short term efforts (19). The majority of efforts focused on elementary education (24 out of 40) and crossed all academic areas (26 out of 40), although math (4) and science (9) efforts represented another large category (together equaling 32%). Twenty five programs reported research with all but 3 using qualitative methods exclusively.

Conceptualizations of Constructivism in Teacher Education

To discern the conceptualizations of programs, we looked at the theoretical and conceptual frameworks provided by authors and the program goals identified in the descriptions. Designers conceptualized programs around a variety of constructivist

frameworks developed from theorists such as Dewey, Piaget and Vygotsky and researchers such as Constance Kamii, Rheta DeVries, Linda Lambert, Eleanor Duckworth, Ernest von Glaserfeld, and Catherine Fosnot. Most often cited were Piaget's epistemological work (1970, 1977) and/or Vygotsky (1978) socio-cultural approach as foundational for their thinking. Despite a range of descriptions, a pattern in the conceptualizations was that learning was a knowledge-building process that is mediated by experience and the socio-cultural context. The conceptualizations emphasized:

- an interactive view of how learners construct meaning,
- the perspective that knowledge is actively constructed by individuals in interaction with the environment and others,
- the primary role of learners in constructing new knowledge,
- the critical responsibility of a more knowledgeable other,
- the integral role of experience in learning,
- participation in learning that is relevant, and
- an emphasis on the recursive nature of learning.

These ideas amassed from the program descriptions are similar to the ideas generated by authors of conceptual pieces who attempt to translate constructivist theory into the social context of schooling (Brooks & Brooks, 1993; Fosnot, 1996; Gunstone & Northfield, 1988; Hwangbo & Yawkey, 1994; Lambert, et al., 1995; Rogoff, 1990).

The course/program descriptions offered varying degrees of articulation of their goals and how the principles of constructivist theories were conceptualized in and connected to their practice of teacher education. While each study addressed their conceptualization of constructivist theory, a few studies (Chen, 2001; Fosnot, 1996; Mayer-Smith & Mitchell, 1997) explicitly articulated their definition of constructivist pedagogy for teacher education, often referring to the work of Driver and Oldham (1986). Other authors offered frameworks (Black & Ammon, 1992; Hand & Treagust, 1994; Phillips & Hatch, 2000; Rainer & Guyton, 2001; Steele, 1994) or specific descriptors (Mayer-Smith and Mitchell, 1997; Nugent & Parker, 1998). Mayer-Smith and Mitchell (1997) and Chen (2001) provided cogent discussions of the difficulty in translating a constructivist perspective into the practice of teaching and offered suggestions by describing features of their practice related to constructivist theory. Key features for all efforts can be found in Tables 1-3 and are discussed in a later section of this paper.

While specific goals of constructivist efforts were not reported in the literature, goals for programs based on constructivist theories were fairly consistent if considered from a broad perspective. A focus on teacher change was evident in the overall goals of each program. Efforts focused on changing teacher-learners' beliefs, thinking and practice, what Fosnot (1996) calls meaningful change, as well

as encouraging this change from a constructivist perspective. Other programs emphasized that teachers need to rethink not only what it means to know subject matter, but also what it takes to foster this sort of understanding. A few programs added another layer of goals by considering the discipline, for example, encouraging teacher-learners to consider the application of constructivist learning in science, early childhood, mathematics, or leadership.

Another broad but consistent goal across all programs was for learners to experience the knowledge construction process as they learned to teach. None of the programs reviewed referred to traditional goals such as accumulating knowledge. All authors addressed the need to use a constructivist-based rather than a didactic approach to introduce teacher-learners to a constructivist paradigm in order to facilitate constructivist pedagogy in K-12 classrooms.

Common Elements of Constructivist Teacher Education

Constructivist principles are being applied to a variety of efforts creating a range of models from single assignments to courses with practica to extended programs and institutes that are completely reorganized to facilitate learners constructing their own knowledge. Despite the range of structures of experiences, there are patterns that emerged providing specific elements that are common among constructivist efforts.

Through analysis of the 40 efforts to teach according to principles of constructivist theories, we synthesized the key features appearing in both preservice and inservice programs, a first step to identifying constructivist pedagogy for teacher education. The categories of features we identified represent a variety of beliefs and practices that taken together suggest common elements of constructivist teacher education. They are described in order of their prominence in the literature.

Reflection. Reflection is evident in a majority of the programmatic efforts and is seen by many constructivist teacher educators as a sort of adhesive that connects and cements the various components or tasks within a teacher education program. Reflection also 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. Programs include opportunities for reflection about the various readings, discussions, and experiences. Writing in dialogue journals, discourse with other teacher-learners, and video-taping coupled with reflection provide other sources of examining practice. 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. From our experience reflection is a key element, but providing requirements and

opportunities alone does not ensure deep reflection. We suggest there is a need to continually model reflection and coach teacher-learners in the process of reflection, providing a variety of models and feedback on reflective efforts.

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, sharing intellectual control with teacher-learners. Topics and pacing of teacher activities 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 teacher-learner input and feedback about course logistics (scheduling, assignments), content, and their own evaluation is valued and has a real impact. Faculty also work hard to assess teacher-learners' prior knowledge and understandings throughout instruction in order to help them develop a deeper, richer conception of the topic. These ideas emerge from the many references to student autonomy in program descriptions.

Collaborative Learning. As constructivist pedagogy emphasizes a learner-centered approach, it also emphasizes discourse and collaboration. This requires social interaction on the part of learners, assuming that active learning and discourse are more likely to produce connections between new concepts and prior knowledge, which in turn leads to a deeper understanding of the topic at hand. Collaborative learning groups provide 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, and to develop networks of peers that allow connections to be made with other people in a shared experience. In some programs (Rainer & Guyton, 2001; Watson, 1995), the concept of community is a more accurate descriptor that includes the ideas of social interaction with an added emphasis on relationships, belonging, autonomy, a warm and supportive environment, and honoring intrinsic motivation.

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 is viewed as a creator of problem-solving situations, a poser or solicitor of problems that students see as real and important to them. Teacher educators structure learning experiences around the big ideas of the curriculum, making sure those concepts are taught in a context relevant and significant to teacher-learners. These learning experiences are designed to promote cognitive dissonance, leading learners 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.

Relevant 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 teacher-learner to make better sense of and construct their own theories. Many constructivist programs provide preservice 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 and is focused on children's learning. Different settings also allow student teachers to gain diversity of experience helping them make stronger and more useful connections between teaching theory and practice. For inservice teachers, internships or practice in their own schools are an integral part of constructivist programs.

What makes these field experiences different from field experiences in other programs is the integration of other common elements, such as collaboration, reflection, inquiry, and authentic assessments. Goal setting and inquiry by teacher learners and coaching by teacher educators are features of the internships. Project work occurs in school-based settings and coaching by university faculty and peers provides feedback to teachers. Reflection and performance-based assessments are integral components of pre-service and inservice 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 allow a large degree of student input and creativity. Teacher-learners work collaboratively and receive non-graded feedback from the instructor(s), making the feedback a part of the teaching and learning process. Teacher-learners are encouraged to take an active role in assessment, including negotiating assessment processes, self-assessing growth, participating in conferences, and learning from successes and struggles. To facilitate ongoing and continuous assessment, constructivist efforts often utilize flexible grading systems, for example using "in-progress" grades.

Inquiry/Action Research. Gathering classroom evidence for data-based decision making is seen as an effective tool for teacher-learners because it helps them analyze and reflect on their practice and focus on the needs of children. In constructivist teacher education, action research encourages teacher-learners to assess the understandings of children 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 teacher-learners with the knowledge necessary to meet the needs of both their individual students and their class as a whole. Action research is often coupled with the elements of reflection and problem-based learning.

Content plays a strong role in constructivist theory and programs based on its principles. Authors suggest that developing content should not only include providing information but also incorporate an active process of creating knowledge. There are specific ideas and efforts identified in the literature for approaching knowledge construction: focusing on content and process, valuing depth over breadth, integrating content within and among disciplines, immersing oneself in content, and emphasizing exploration and reasoning around learners' interests. Programs are organized to allow teacher-learners to experience integrated curriculum as well as facilitating participants' understanding and implementation of integrating content. Teacher-learners immerse themselves in content, delve deeply in new understandings, consider the "big ideas" in content areas, and explore interdisciplinary connections. In constructivist efforts teacher-learners are provided with time and opportunities to explore their interests and needs and build on their previous understandings. These opportunities are designed to foster understanding beyond facts and encourage learners to reason and think critically about new understandings. This strong grounding in both content and process provides a foundation for decision making and for teachers to function as autonomous learners.

Personal Engagement. The use of the term "self" in referring to the importance of teacher-learners' is common in descriptions of features of constructivist teacher

education programs. Authors refer to self-direction, self-monitoring, self-assessment, and self-reflection to describe the many ways that they engage learners on a personal level. This emphasis on the important role of the learner leads us to this category of personal engagement. This category converges with the category on learner-centeredness and the many references to the importance of autonomous learners. This category also includes features such as a) making learning personally relevant, b) providing learners with opportunities to examine, analyze, and reflect on their own thinking, c) helping learners confront personal beliefs and create their own theories of learning, and d) encouraging learners to self-assess, learning from their successes and mistakes.

We also find an interesting connection between personal engagement and the role of dissonance in constructivist learning. Several authors (Fosnot, 1996; O'Loughlin, 1992) note that the shift in responsibility for learning from a teacher directed to learner centered approach was significant in causing much of the dissonance teacher-learners encountered. While they enjoy having more autonomy, new responsibilities, and increased decision making in their learning, they find it a significant, and often disconcerting, change from their previous school experiences. Personal engagement produces dissonance which requires teacher-learners to reflect on the dissonant practice.

In conclusion, while these ten programmatic elements represent the most often cited features of constructivist teacher education programs, they are neither exhaustive nor independent of each other. There seems to be no relationship between the importance of the elements and their frequency in the literature. We also do not want to suggest that using these elements without changing structures, language, roles of participants, and power differentials would result in constructivist teacher education.

There are different ways that these elements are implemented in each effort. That is as it should be; faculty and teacher-learners participating in these efforts have different understandings and applications of constructivist theories, as well as a variety of contexts for implementation. More study and discussion of these issues are needed to extend the literature.

Challenges for Teacher Educators and K-12 Teachers

Successful change requires making a commitment to the intense work around reconstructing thinking and practice, whether for teacher educators or K-12 teachers. As authors recount their experiences using constructivist principles to guide their efforts in teacher education, they not only share the successful elements but also express the challenges in this type of work.

The reality of constructivist teacher education is that it functions in a university setting and this traditional context provides challenges for teacher educators and teachers (Peterman, 1997; Rainer & Guyton, 1999). Condon, et al., (1993) find that simply accommodating innovation in the existing institutional structures does not provide the type of support necessary for lasting change. Simon & Schifter (1991) suggest that if visions such as those advocated by constructivist theorists are to become reality, we need to rethink the nature of teacher education efforts (the experiences, opportunities, support) and the challenges inherent in change.

Pfannenstiel and Schattgen (1997) find that efforts are cost, labor and time intensive and they question whether these efforts can continue or preferably, occur on a larger scale. Two authors (Condon, Clyde & Hovda, 1993; Goodman and Fish, 1997) recommend areas that need to be challenged if this work is to continue, including, traditional teacher and student roles, rewards, resources, policies, and the history of isolation in higher education.

Examining our own practice as teacher educators is a challenge we also must address. Fosnot (1996), Goodman and Fish (1997) and Meyer-Smith (1997) conclude from their findings (as do many others) that teacher educators who advocate for a different kind of preparation cannot overlook their own pedagogy in particular as related to authority in the classroom. Instructors must understand and be able to implement constructivist pedagogy. Authors also suggest strategies to help teacher educators deal with challenges, for example:

- rethink the structures, content and processes (including assessment) of traditional programs, courses, institutes, etc. (Chen, 2001; Gunstone & Northfield, 1988; Rainer & Guyton, 2001)
- continually reassess the goals and content of programs to remain true to commitments (Phillips and Hatch, 2000)
- re-evaluate roles (faculty and students), rewards, resources (Condon, et al., 1993)
- understand and implement the model that they advocate (Appleton & Asoko, 1996; Fosnot, 1996; Meyer-Smith & Mitchell, 1997; Rasch, 1992; Steele, 1994)
- develop the ability to carefully and constantly question themselves (Rasch, 1992)
- consider the cost, labor and time intensive nature of work (Pfannenstiel & Schattgen, 1997)
- determine whether methods we identify as appropriate are equally applicable in all educational settings (Chen, 2001; Kroll & Black, 1993)

- honor the obligation to support teachers as they confront the challenges necessary to rethink their teaching practice (Fosnot, 1996; O'Loughlin, 1992; Parsons-Chatman, 1990)
- explore how collaborative inquiry communities can continue into first years of teaching (Graham, Hudson-Ross & McWhorter, 1997)
- find or develop alliances with schools and cooperating teachers who are committed to reform practice (Fosnot, 1996)
- develop or expand instruments for assessing constructivist approaches (Oldfather, 1994; Phillips & Hatch, 2000)
- remind themselves not to oversimplify or romanticize about a constructivist approach (Chen, 2001)

There are also challenges for teacher-learners as they experience a constructivist approach to learning. O'Loughlin (1992) documents that teachers feel uneasy, afraid, disturbed, and exhausted during periods of transformation. Lewis and Lewis (1995) describe the process as lonely. The ambiguity involved in constructivist models is difficult for those teacher-learners who have been successful in traditional models and are looking for structure and direction. Authors such as Black and Ammon (1992) and Hand and Peterson (1995) suggests that teacher-learners have difficulty taking on new roles, initiating direction of their own learning, considering peer interaction as a source of knowledge, and focusing on and examining their learning. Mosenthal and Ball (1992) suggested that another unresolved dilemma is the importance of helping teachers "develop commitments and dispositions to give up control and to let teacher-learners explore" (p.354), and bring to the forefront the relationship between deep content knowledge and good teaching. Goodman & Fish (1997) find that interdisciplinary teaching and teacher leadership in schools is still a challenge. Pfannenstiel and Schattgen (1997) suggest other challenges for teachers also include isolation, time, compartmentalized curriculum, and parent education.

O'Loughlin (1992) also finds an idea we have contemplated in our work with teacher-learners – that of innovative ideas being a double edge sword; the more teachers are aware of possibilities, the more they become aware of their isolation in schools. O'Loughlin concludes that we have an obligation to support teachers in confronting the political changes necessary to carry out the reconstructed practices in their classrooms and schools. Kilgore and Ross (1993) suggest that teacher educators also need to help teachers develop a long-term view of professional development and understand their role in creating a context for future growth. These challenges, and others such as issues of resistance, assessment, and the tension between breadth and depth in the curriculum, are areas that deserve further attention and study for both teacher educators and prospective and practicing teachers.

Summary and Implications for Teacher Educators

The literature is rich with description of constructivist efforts in teacher education including the voices of faculty and teacher-learners. Given the limitations of courses and programs that present or transmit knowledge about teaching (Wideen et al., 1998), it is encouraging to see the variety of efforts that support learners in constructing informed views of teaching. The findings from our analysis of constructivist efforts are validating for those of us who know intuitively and from experience the excitement and frustration of working in a constructivist teacher education program.

We now have a richer understanding of the complexities of practicing or living a constructivist perspective. We found programs shaped by clear principles rather than deriving principles to fit programs. We heard teacher educators articulating what they believe matters in teacher preparation and struggling with the responsibility for bringing about transformative practices. We have a clearer understanding of the models, contexts, and conceptualizations of constructivist teacher education. We have more specific insights about constructivist pedagogy, including successful elements to consider as we continue our work. We learned that despite limitations of university cultures (Rainer & Guyton, 1999; Peterman, 1997), it is possible to redesign courses and programs according to constructivist principles. We see educators describing and testing these promising pedagogical practices. The implications are that despite the difficulty of deducing constructivist pedagogy from constructivist theories, there are models and common elements to consider in planning new programs and studying their effects. Logical next steps include examining the effects of constructivist teacher education (on university faculty, teacher-learners, and children), investigating strategies and tools that effectively operationalize constructivist pedagogy, and exploring the processes of change for those interested in constructing new visions of teacher education.

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

Code	Program	Organization	Description	Features	Research
ST Elem Math US	1. Constructivist Mathematics Teacher Education Course [Anderson & Piazza, 1996]	Boise State University	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	Features include 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)
LT Elem All subj US	2. DTE Developmental Teacher Education [Black & Ammon, 1992; Kroll & Black, 1993]	University of California at Berkeley	Two-year postgraduate master's level initial certification program using developmental theory and research as its unifying conceptual core	Features include 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
ST Elem All subj. US	3. Undergraduate Constructivist Teacher Education Course [Burk & Dunn, 1996]	Department of Early Childhood Education, University of Oklahoma	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

ST Elem All subj. US	4. Problem-Centered Approach to Teaching [Casey & Howson, 1993]	Boston College	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)	Features include 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
ST Elem All subj. Internat'l	5. Constructing Constructivist Teacher Education [Chen, 2001] See also inservice course	National Taiwan Normal University	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,
ST Elem All subj. Internat'l	6. [Cheung, 1990]	Institute of Education in Singapore	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
LT Elem	7. Committee for Alternative	University of Louisville,	A two summer, two semester Master of Arts in Teaching	Cohort groups, pass-fail grading, four 8-week field	*Qualitative analysis of an individually administered free-

All subj. US	Programs in Teaching and Learning-CAPITAL [Condon, et al, 1993]	Kentucky, and Jefferson County (Kentucky) Public Schools	program for career change (non-traditional) students in which cross-disciplinary teaching/ learning and intensive field work are emphasized	placements, 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	response interview, repeated several times
ST Elem All subj. US	8. The School Age Child Practicum [DeJong & Groomes, 1996]	Department of Family and Child Services, Florida State University	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	Features 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
LT Elem All subj. US	9. Teacher Preparation Project [Fosnot, 1996]	Center for Constructivist Teaching	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 emphasis on the change process	*Teachers' writing (papers, journal entries) used as evidence of teachers' growth and example of what needs to occur in programs

LT Secondary All subj. US	10. Collaborative Inquiry Community [Graham, et al, 1997]	National Reading Research Center, University of Georgia	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	Features collaborative planning and curriculum decision-making among teams of school-based mentor teachers and university faculty, integration of methods courses, professional readings, weekly think pieces, teacher talk, 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
LT Secondary Science Internat'l	11. Diploma in Education (Dip.Ed.) Gunstone, R., Slattery, M., Baird, J. & Northfield. J. (1993)	Monash University, Clayton, Australia	A one year preservice program for teachers with a degree in science.	Features include integrated content, variable timetables, reflection, interaction with colleagues, seminars, social and personal relationships, student control over their own learning, assess and build on learners' strengths, continuous feedback, long-term learning, relevant experiences, and faculty who teach in concert with constructivist pedagogy.	A case study of a small group (13) during the program and follow through two years of teaching
LT Elem Science. Internat'l	12. Hand & Peterson, 1995	Latrobe University Victoria, Australia	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'	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	*Four students per class (?) were chosen to follow through the 2 semesters using interviews, journals, course evaluations and participants observations – benefits and concerns reported

			understanding of science and constructivist pedagogy	such as exploring students understanding, questioning, discussing and planning. Students developed teaching plans for the self-selected topics they investigated.	
ST Secondary All subj. US	13. Theory and Practice of Secondary Education [Jadallah, 1996]	Bowling Green State University	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
LT TESOL All subj. US	14. Constructivist-based Teacher Education Course [Kaufman, 1996]	State University of New York at Stony Brook	Constructivist-based instruction in a pre-service TESOL program is employed in the belief that teacher candidates will employ constructivist principles in their own classrooms later.	Features include immersion in coursework and rich field experiences, interdisciplinary and collaborative networks, and reflective practice. Opportunities for students include autonomy as a teacher-learner, peer collaboration and support, learner-generated problems, self-observation and evaluation, and reflection. New roles for teachers and teacher educators are identified.	None specified in reference
LT K-12 All subj. US	15. Graduate Teacher Education [Kroll & Laboskey, 1996]	Mills College, CA	One-year graduate program in multiple subjects (elementary) or single subject (secondary) education leading to a CA teaching	Features include journal writing, developmental theory, teaching reading and writing, curriculum and instruction, field placements in morning	None specified in reference

			credential	with on-campus classes in afternoons	
LT Secondary Science US	16. Stream 3 Integrated Sciences Program [Loughran & Russell, 1997]	Monash University, Australia	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
LT Elem All subj. US	17. Social Construction of Learning in Elementary Education [Magliaro, et al, 1996]	College of Human Resources and College of Education, Virginia Tech	Undergraduate preservice teacher education program that emphasizes language-based, socially-constructed learning experiences	Features 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
ST Secondary Science US	18. Science methods course [Mayer-Smith & Mitchell, 1997]	University of British Columbia, Canada	A methods course in a one-year postgraduate teacher education program for science undergraduate majors without prior preservice teacher training	Features of teaching include sharing intellectual control, encouraging questions that assist students in linking knowledge with their personal life, designing tasks that promote problem solving, self-	*Qualitative data: journals, reflective writing, observations of student teaching, structured interviews

			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 One course in a 3 course post-graduate sequence in science; constructivism was a theme running throughout course rather than a topic	monitoring and self-direction, increase opportunities for student talk, changing assessment to be consistent with teaching… Course structure is non-transmissive and non-didactic content as possible; debriefing sessions, reflective writing, and provide (selecting and modeling) candidates with teaching procedures developed to promote constructivist learning; wrestled with assessment dilemmas	
LT Secondary Science US	19. Secondary Science Education Program [Parsons-Chatman, 1990]	St. Francis Xavier University, Nova Scotia, Canada	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
ST Elem All subj. US	20. Inclusive Early Childhood Education (IECE) [Phillips & Hatch, 2000; Lesar, et al.,	University of Tennessee at Knoxville	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

	1996]				
ST Elem Math US	21. Rasch, et al, 1992	Maryville University (Missouri)	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 math, sharing ideas and confusions, reconceptions, value of process; encouraging dissonance and reflection	Results are reported (briefly), however, methods are not articulated
ST Elem Math US	22. Steele, D. (1994	U. of Florida	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/researcher 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)

Table 2. Constructivist Teacher Education Efforts (In-Service/Graduate Education)

Code	**Program**	**Organization**	**Description**	**Features**	**Research**
ST Elem. Science Internat'l	1. Using a constructivist view of learning to inform teaching in elementary science [Appleton & Asoko, 1996]	University of Leeds	A 20 day inservice course (four blocks of 5 days over a 10 week period).	Program focused on understanding processes and concepts of science, exposing and building on teachers' conceptions, implications of constructivist theory for children's learning, school-based tasks, working with peers, and reflection.	A case study of a teacher's progress using a constructivist view of learning to inform teaching elementary science
LT	2. Field-Based	National-Louis	Graduate program in which	Features field-based,	None specified in reference

K-12 All subj. US	Masters Program [Burnaford & Hobson, 1995]	University	experienced teachers meet once per week for four hours over 22 months in an integrated curriculum involving instructional theory and teacher action research	collaborative cohort groups, dialogue journals, shared teaching, no formal tests or final examinations, classroom-based action research project, portfolios, self-evaluation, authentic assessment	
ST Elem All subj. US	3. Constructing knowledge of Constructivism [Castle, 1997]	Oklahoma State University	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.
ST Elem All subj. Internat'l	4. Constructing Constructivist Teacher Education [Chen, 2001]	National Taiwan Normal University	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, alternative assessments, 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,
ST K-12 All subj. Internat'l	5. Learning and Language Across the Curriculum [Dillon, et al, 1995]	McGill University	Graduate level course centered on an approach to teaching that fosters students' ownership of learning	Organized around four conceptual "pillars": constructivism, experiential learning, pluralism, and personal and social transformation. Students are encouraged to discuss their own learning, to pose questions about what they are uncertain of knowing, to	Qualitative journal data

				practice in their own classrooms what they learn, and to share in the holistic evaluation process in the course.	
LT K-12 All subj. US	6. Experienced Teachers Program (ETP) [Duckworth, et. al., 1997]	Harvard Graduate School of Education	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
LT Secondar y Science. Internat'l	7. Changing to constructivist teaching [Hand & Treagust, 1994]	La Trobe University College of Northern Victoria, Australia	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
LT K-12 All subj. US	8. Teacher Action Research [Nugent & Parker, 1998]	Florida Regional Center, National-Louis University	Eighteen-month action research projects in the classrooms of the teacher-participants, as part of a Master of Education degree program – program is cohort and field-based	Features empowering teachers and students through more democratic, dialogical, student-centered and self-directing practice. Includes reflection paper, journal writings, project drafts and completed action research	Qualitative, ethnographic review of one action research project

				project, informal interviews, self- and program evaluations, portfolios	
ST Elem All subj. US	9. Children's Thinking Project [Oldfather, et al, 1994]	National Reading Research Center, University of Georgia	Project (action research) is part of a Master's level course in early childhood education, designed to deepen the participants' understanding of constructivism, and its implications for teaching	Features 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
ST K-12 All subj. US	10. Summer Institute for Teachers [O'Loughlin, 1992]	Hofstra University, NY	One week, 3-credit graduate-level course in a retreat-like atmosphere where teachers critically reconstruct their visions of teaching	Includes 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
LT Elem All subj. US	11. Collaborative Masters Program (CMP) [Rainer & Guyton, 1998]	Department of Early Childhood Education, Georgia State University	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 – program is cohort and field based	Features include an initial three-day retreat, cohort groupings throughout program, collaborative decision-making about curriculum and assessment experiences which synthesize and demonstrate teacher knowledge, skills, and attitudes	Qualitative research (N=26) using field notes, interviews, written responses, classroom observations and faculty ratings

Table 3. Constructivist Teacher Education Efforts (Inservice/Professonal Development)

	Program	Organization	Description	Features	Research
ST Elem Science US Research not specified	1. Twin Tandem Science Initiative [Jones, Kisisel & Dalhoumi, 1996]	Dwight D. Eisenhower Mathematics and Science Education Project , Northwest Indiana	Summer workshop to improve science learning through science teaching; a follow-up workshop on assessment was offered to participants	Teachers experienced activity based science learning and engaged in cooperative planning, science concept enrichment, process skills development, computer application and interdisciplinary learning	Teachers designed assessments of project lessons and reported results. No methods are reported.
LT Elem Science US Qualitative	2. SummerMath for Teachers	Mount Holyoke College, MA	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	Features increased use of manipulatives, improved questioning, problems that challenge kids, extensions to problems, demonstration lessons	Interviews and questionnaires with program staff members, observations of their work with teachers Two case studies, one from each project, based on interview and observational data
LT Elem Writing US Qualitative	3. Teachers College Writing Project [Mosenthal & Ball, 1992] Mosenthal, 1995 Wilson & Ball, 1991	Columbia Teachers College, NY		Writing workshops with peer and teacher interaction, notebook writing, mini-lessons, conferencing	Teachers are observed and interviewed over 2 year period – two are highlighted to represent change in ideas and dispositions over time
LT	4. Project	Project	Thirty-hour institute	Designed around four guiding	Quantitative research using self-

Elem All subj. US Quantitative	Construct Institute [Schattgen, 1997; Pfannenstiel & Schattgen, 1997]	Construct National Center, University of Missouri at Columbia	experience, plus follow-up experiences, advanced institutes on specific topics such as literacy, mathematics, and assessment	principles of constructivism and related teaching practices: features include allowing choice and decision making, creating meaningful activities, fostering collaboration and cooperation, helping learners reflect and evaluate their work, emphasizing and integrated approach to teaching, etc.	report surveys, classroom observations, teacher assessments of student learning, standardized achievement test data
LT K-12 Math US Quantitative and qualitative	5. Simon, 1989; Simon & Schifter, 1991, 1993]	Educational Leaders in Mathematics (ELM) Project at Mt Holyoke College	An intensive two-week summer institute and weekly classroom follow up during one academic year	Key features include 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
ST K-12 All subj US Research not specified	6. Foxfire Level One Course [Teets & Starnes, 1996]	Foxfire Fund Inc., Mountain City, GA	Constructivism is seen as the theory undergirding the 50 hour Foxfire training course specifically its 11 core practices	Features include discussion of core practices, regular reflection, increased student autonomy, visiting experienced teachers' classrooms, observations and conferences, support group	None specified in reference
LT Elem All subj. US	7. Child Development Project (CDP) [Watson, 1995]	Developmental Studies Center, Oakland, California	Summer institute, plus four day-long workshops during the following school year, including on-site teacher	The program emphasizes explicit social and ethical learning in addition to intellectual development,	Quasi-experimental design with two program and two comparison schools in each of six districts

Quantitative	See also Battistich & Solomon (1995)		support, teacher collaboration and curriculum/teaching materials	literature-based reading and language arts, collaborative classroom learning, developmental discipline, parent involvement, and inclusive, non-competitive school-wide activities. Features of staff development include responding to participants' needs for belonging, autonomy and competence, creating a warm and supportive environment, building supportive relationships, attending to the social and ethical dimensions of learning, honoring intrinsic motivation, and teaching for active construction of meaning.	

Table 4: Frequency of characteristics of constructivist teacher education programs

Dimension	Type		Number	Percentage
Short Term / Long Term	Long Term	Pre-Service	11	52
		In-Service	5	24
		Staff Development	5	24
		Total	21	100
	Short Term	Pre-Service	11	58
		In-Service	6	32
		Staff Development	2	10
		Total	19	100
School Level	Elementary	Pre-Service	14	58
		In-Service	5	21
		Staff Development	5	21
			24	100
	Kindergarten through 12th Grade	Pre-Service	1	12
		In-Service	5	63
		Staff Development	2	25
		Total	8	100
	Secondary	Pre-Service	6	86
		In-Service	1	14
		Staff Development	0	0
		Total	7	100
	TESOL	Pre-Service	1	100
		In-Service	0	0
		Staff Development	0	0
100		Total	1	100

Dimension	Type		Number	Percentage
Academic Area	All Subjects	Pre-Service	14	54
		In-Service	9	35
		Staff Development	3	11
		Total	26	100
	Mathematics	Pre-Service	3	75
		In-Service	0	0
		Staff Development	1	25
		Total	4	100
	Science	Pre-Service	5	56
		In-Service	2	22
		Staff Development	2	22
		Total	9	100
	Writing	Pre-Service	0	0
		In-Service	0	0
		Staff Development	1	100
		Total	1	100
United States / International	United States	Pre-Service	18	56
		In-Service	7	22
		Staff Development	7	22
		Total	32	100
	International	Pre-Service	4	50
		In-Service	4	50
		Staff Development	0	0
		Total	8	100

Dimension	Type		Number	Percentage
Type of Research	Qualitative	Pre-Service	13	59
		In-Service	7	32
		Staff Development	2	9
		Total	22	100
	Quantitative	Pre-Service	0	0
		In-Service	0	0
		Staff Development	2	100
		Total	2	100
	Qualitative and Quantitative	Pre-Service	0	0
		In-Service	0	0
		Staff Development	1	100
		Total	1	100
	Research not Specified	Pre-Service	9	60
		In-Service	4	27
		Staff Development	2	13
		Total	15	100