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ABSTRACT

Many preservice teachers confront their own lack of confidence and actual mathematics phobia for the first time in their math procedures classes. This study was designed to explore the application of a confluent education intervention, a model based on the premise that all learning is accompanied by an affective as well as a cognitive component, to the problem of improving the disposition towards mathematics of 70 student teachers enrolled in a fifth-year multiple subject teaching credential program at the University of California. Using the framework of constructivist theory as a foundation, the paper discusses the effects of prior experience on affective disposition towards mathematics and teachers' sense of self-efficacy. Data were collected in three stages following "The Mathe Teakst Buk," an intervention that involves students in a simulation to reconstruct prior experience by coupling it with affective processing. Results indicate types of changes in disposition and self-efficacy experienced by students after the confluent intervention. A complete description of the intervention is appended. (Contains 29 references.) (LL)

Ambition , Distraction, Uglification and Derision: The Case for Confluent Education in Math Procedures

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Ambition, Distraction, Uglification and Derision[1]: The Case for Confluent Education in Math Procedures

Abstract: This study explores the application of a Confluent Education intervention to the problem of improving disposition towards mathematics in multiple subject teacher credential students. It is argued that attention to the reconstruction of disposition towards mathematics is an essential component of professional teacher education programs if we are to overcome the lack of self-efficacy in many beginning teachers. The author presents the types of changes in disposition and self-efficacy experienced by student teachers after a Confluent intervention. Description of a simulation activity coupled with the results of meta-processing is included as a model to address the affective dimension of the mathematics procedures class.

"Most students (and most adults) can't interpret graphs, don't understand statistical notions, are unable to model situations mathematically, seldom estimate or compare magnitudes, are immune to mathematical beauty, and, most distressing of all in a democracy, hardly ever develop critical, skeptical attitude toward numerical, spatial, and quantitative data or conclusions." (Paulos, 1991)

The California State Board of Education's recently adopted curriculum framework in Math, drawing on the work of the National Council of Teachers of Mathematics (NCTM, 1991), and the National Research Council, (1990), proposes substantial changes in the content emphasis of mathematics instruction as well as changes in pedagogy (CDE, 1992). While instructional reform is necessarily initiated at many levels, it is evident that pre-service teacher preparation programs must become key players in promoting change in mathematics instruction.

Many multiple subject credential students confront their own lack of confidence and actual math phobia for the first time in their math procedures classes. Given that student teachers' personal disposition towards mathematics influences competence, this paper argues that attention to the affective domain of learning is essential. If teacher education programs are to influence a change in how math is taught and learned, it is necessary to design successful interventions to increase both competence and positive disposition in mathematical thinking during the preparation of these new teachers. This paper is an exploration of an application of Confluent Education to the problem of improving the disposition towards mathematics of student teachers during their preservice year.

A growing number of educators recognize the centrality of student constructed meanings in the learning process (Grennon-Brooks, 1990; Kaplan, Yamamoto and Ginsberg, 1989; Kamii, 1982; Resnick and Klopfer, 1989). From a constructivist framework, learning is no longer defined as the mere acquisition of factual knowledge to be recalled at a later date. Learning is increasingly being understood as a constructive process, occurring within the individual as new

[1] Paulos (1991, p. 52) attributes this reference to the different branches of arithmetic to the Mock Turtle of Lewis Carroll's *Alice's Adventures in Wonderland.*

experience is related to past learnings and both are reorganized in meaningful patterns.

While learning theory has been dominated by cognitive psychology, the role of affect including feelings, beliefs, and values in the learning process has had less attention (Krathwolh, Bloom & Masia, 1964; Martin & Briggs, 1986). Constructive knowing acknowledges the feeling aspect of experience and the passionate participation of the knower as equally critical to the learning process (Brown, 1990; Belenky, Clinchy, Goldberger and Tarule, 1986; Polanyi, 1958). Across disciplines, in the fields of mathematics, science, second language acquisition, and early childhood education, the importance of the individual's affective state in knowledge construction is well recognized as a significant variable, contributing to students' successful learning (Kamii, 1984, Tobias, 1985; Gaudry and Spielberger, 1971; Sieber, O'Neil and Tobias, 1977; NCTM, 1991; National Research Council, 1990; Snow, 1992).

Constructivist learning theory has historical roots in the work of Jean Piaget and Lawrence Kohlberg. Piaget's work to understand the development of human thought offered a powerful alternative to behaviorist psychology. Kohlberg, building on Piaget's theories of epistemology offered important insights to the development of moral judgment. Early childhood educators such as Rheta DeVries and Constance Kamii, influenced strongly by Piaget and Kohlberg, have contributed to an understanding of constructivist theory and its application to the field of curriculum and instruction. For example, DeVries' and Kohlberg's application of Piaget's theories of how children construct knowledge has informed and greatly influenced our understanding of Developmentally Appropriate Practice[2] (DeVries and Kohlberg, 1987; Bredekamp, 1987).

Kamii's studies of how young children construct mathematical understandings offer a theoretical foundation for primary math instruction (Kamii, 1982). A more extensive treatment of Kamii's influence on changing how math is taught and learned is warranted but will not be taken up in this paper. Rather, Kamii's work to understand Piaget's concept of autonomy and its inherent relationship to affect will be discussed. Presuming Piaget's key idea that autonomy is the aim of education, Kamii refers to learning as how "children construct knowledge by creating and coordinating relationships" (p. 80). Kamii argues forcefully that children who are discouraged from thinking autonomously will construct less knowledge than those who are mentally active and confident. Thus, autonomous thinking, the act of constructing meaningful relationships, in her view is directly influenced by the learner's sense of confidence.

Also influenced by Kohlberg, constructivist theory can be traced through Carol Gilligan's work to better understand women's moral development, in *In a Different Voice* (1982). More recently Belenky, , have proposed a continuum of epistemological development in *Woman's Ways of Knowing* (1986). Their work supports the fundamental tenet of constructivist theory "All knowledge is

[2] The model of early childhood education explicated in the position statement of the National Association for the Education of Young Children.

constructed and the knower is an intimate part of the known" (p.137). At the more complex level of their epistemological framework, constructivist learners in their study told of "weaving together the strands of rational and emotive thought and integrating objective and subjective knowing" (p.134).

An apparent paradox in this line of reasoning is that if all knowledge is constructed, how are the women who are not at the more complex level of thinking, those who have not achieved "constructive knowing" learning? Actually, this condition is consistent with Kamii's work, in that, those children who are not encouraged to think autonomously, who are not confident or mentally active, are similar to Belenky, et al's "received," "subjective" or "procedural" knowers. It is a reasonable hypothesis that the student teachers who must confront their aversion to mathematical thinking during their professional preparation, are at these less complex levels of "knowing" mathematics.

A second concept of constructivist theory guides this study. "The epistemology of the cognitive-developmental stream is often called interactionist. This means not only a psychological interchange between the individual and the environment but a dynamic interaction within the individual of multiple aspects of what is known." (DeVries and Kohlberg, 1987 p. 8) Thus, in constructivist theory, if both inter-personal interaction and intra-personal interaction are considered origins of knowing, it may be argued from this point that an intervention to change disposition must necessarily account for both dimensions of experience and their dynamic interaction. A successful intervention will offer an opportunity for learners at the received, subjective or procedural level in mathematical thinking to engage in activities that require both intrapersonal and interpersonal experience.

It has been shown that there is a significant body of epistemological research defined as "constructivist" learning theory derived from the original work of Jean Piaget and Lawrence Kohlberg. Their research continues to inform several fields. While the presentation here is far from exhaustive, the common theme that knowledge is constructed and that both feelings and thoughts are intricately connected in this process of construction, can be argued successfully. It can be taken then, that as student teachers have constructed their knowledge of mathematics, their disposition towards mathematics was constructed as well. In the words of DeVries, "Feeling is conserved in schemes of reaction which, taken all together in a later point in development, constitute the individual's character or permanent modes of reactions." (DeVries and Kohlberg, 1987 p. 34) Since the student teachers have constructed their feelings about mathematics simultaneously with their construction of mathematical concepts and notions, any intervention must make explicit the feeling as well as the intellectual dimensions of experience.

Given the framework of constructivist theory as a foundation, in the next section, research which has focused on the effects of prior experience on affective disposition towards math and teacher's sense of self-efficacy, particularly as it involves attitudes and dispositions, will be discussed.

How student teachers have constructed a negative disposition to mathematics is not a mystery. Intuitive casual attribution is borne out in the literature. Repeated negative experiences with mathematics have resulted in feelings of inadequacy, anxiety and a negative disposition towards the perceived cause of their anxiety (Tobias, 1985; Gaudry and Spielberger, 1971; Sieber, et. al, 1977). Thus, any attempt to change the way mathematics is taught and learned must also confront the ghosts of negative experience for each individual. Without a reconstruction of affect along with changes in cognition, prior negative experience will continue to influence how these new teachers perceive mathematics and their sense of self-efficacy to deliver mathematics instruction to their students.

Following Bandura's early work to define self-efficacy (1977a), some researchers have looked at the effect of self-efficacy as it relates to teaching (Gibson and Dembo, 1985; Chiarelott and Czerniak, 1990), These studies define self-efficacy as a belief that one's abilities are effective. Although Chiarelott and Czerniak's work focused primarily on teachers' self-efficacy in relation to science, their work generally confirms Bandura's finding that poor self-efficacy, often manifested in a state of anxiety, can debilitate performance.

These studies have found relationships among perceived ability (self efficacy), anxiety and disposition. However, the identification of appropriate strategies to reduce anxiety, raise self efficacy and improve disposition requires further study (Chiarelott and Czerniak, 1990). In conjunction with new approaches to constructing mathematical ideas using hands on models and cooperative interaction among learners (interpersonal experience), it is hypothesized that interventions that involve affective processing (intrapersonal experience) may have potential to support the reduction of anxiety, thereby freeing energy to be focused on the central problem of mathematical literacy. (Brown, 1990; Kogelman and Warren, 1978).

It is useful to examine the problem of reconstructing student teachers' disposition towards mathematics from the perspective of Confluent education, an instructional model based on the premise that all learning is accompanied by an affective as well as a cognitive component (Brown, 1990; Shiflet & Brown, 1972). Confluent education makes explicit the role of affect in learning, and in so doing, assumes that meaningful learning integrates the affective and cognitive domains. Having survived the onslaught of antithetical pedagogy (Shapiro, 1983), Confluent education offers more than 20 years of experience to bear on the problems of explicitly integrating the cognitive and affective domains in instructional and research design. Given this history, it was a likely model to use with these student teachers.

Confluent interventions are designed to engage learners in activities that are relevant and meaningful. Primarily based on Gestalt awareness training, an important confluent instructional principle is the active position of the learner in present time experiences. Like early childhood constructivist curriculum and instruction, Confluent Education assumes and supports the autonomy of the learner. The purpose of a confluent intervention in this case is to access the powerful, prior constructed, affective inhibitors to present mathematical performance. Once brought to awareness, these inhibitors, often internalized messages and detailed past experiences, may be defused as anxiety producers, allowing students to take control of and refocus their energy toward a more positive approach to mathematics.

In this case, the intervention known as the Mathe Teakst Buk[3] was used to simulate a typical classroom mathematics lesson and test.

Problem:

In a key position to influence the desired changes in the way mathematics is taught and learned, the instructors of mathematics methods courses are challenged to ensure that student teachers acquire a "positive disposition" towards mathematical thinking as they acquire the necessary cognitive processes that constitute content knowledge and instructional design. Because prior experiences have impacted some student teachers negatively, resulting in serious inhibitions towards mathematics, instructors must help these students deconstruct their prior learning and reconstruct a new understanding of mathematical processes. It is evident that the situation requires attention to both cognitive and affective processes. Using a Confluent Education intervention described later in this paper, this case study explored the types of influence interventions such as the Confluent Education model may have on changing disposition towards mathematics instruction.

Participants:

Seventy student teachers participating in this study were enrolled in a fifth year multiple subject teaching credential program at the University of California, Santa Barbara. These students ranged in age from 23 to 58 at the beginning of the study. Of the initial cohort group of 70, fewer than 10% were male. Fewer than 15% of these students were of minority backgrounds. By the end of the year, 3 student teachers had withdrawn from the program.

Data Collection:

Data was collected in three stages during the year of pre-service preparation:

First, students were surveyed to determine their initial feelings towards math, and their levels of confidence to teach mathematics at various grade levels. These initial surveys were given during the first Mathematics procedures class in August 1991. The survey data served as a baseline for descriptions of student's disposition towards mathematics and sense of self efficacy towards mathematical instruction at the elementary school level.

Second, journal entries were collected after an intervention known as *The Mathe Teakst Buk* (Center of Innovation in Education, 1991), that involved the students in a simulation followed by affective processing. A complete description of the intervention is included in the Appendix.

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[3] The simulation activity incorporates an adapted form of the Ctaite Mathe Teakst Buk, developed by the Center for Innovation in Education.

Third, a final survey was taken at the end of the student teaching year. This survey was included in the packet of evaluations given to students upon completion of their coursework and student teaching take-over in June 1992.

Intervention:

A complete script of the Mathe Teakst Buk simulation is included in the Appendix of this paper. The simulation was expected to raise questions and comments ranging from the power of affect in supporting or blocking learning, to appropriate teaching strategies that support student performance.

Following the simulation, the students engaged in "processing," an adaptation of a contact/withdrawal technique borrowed from Gestalt therapy (Brown, 1990).[4] Student teachers were asked to get in touch with their feelings and to write about what emerged for them as a result of the experience. This provided the first level of processing. Meta processing[5] in this intervention occurred when participants examined their affective response to what they had written. Quick write responses to the question Did this activity remind you of a prior experience? were collected for later analysis.

Process questions for discussion included:

1. What did you learn?
2. How did this activity make you feel?
3. What strategies did you use to get the work done?
4. What did the teacher do to help? hinder?
5. Were you concerned about getting it done or getting it right?
6. Can you make any comparisons between how you feel and how your second language learners feel?
7. Did you feel a sense of pride for doing it fast?

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[4] Processing is an integral component of Confluent Education. It was used regularly during the math procedures course to encourage student teachers to examine their attitudes and understandings of mathematics through systematic reflection on their feelings as well as the content of the learning situation (Brown, 1990; Shiflett & Brown, 1972). While the inclusion of "processing" in lesson design is now more widely used in both science and mathematics methods classes, it is usually used as a means of reviewing the content covered and learning strategies used rather than as a means of helping the learner become aware of his/her feelings. In situations where trust has been established, processing is used to make explicit the diverse meanings attributed to a given situation by different participants.

[5] Confluent processing also includes "meta processing" which is distinguished from processing by a change in the learner's focus from one level of awareness to another. For example, awareness of the physical manifestation of affect may reveal personal meaning. At another level, the learner may become aware of the diversity of meaning attributed to the same event by others.

Processing corresponds to the psychological interchange between the individual and the environment identified by Piaget. In contrast, meta processing is a form of reflective thinking that disengages the participants from active involvement with a particular task in order to reflect on the simultaneous dynamic interaction of the multiple aspects of what is known. By becoming aware of a second level of experience, i.e.. to observe the self observing, meta processing is designed to reveal patterns of meaning brought to a given content or feeling.

Data Analysis:

Responses to initial survey were counted and sorted according to emergent categories (Strauss and Corbin, 1990). The same strategy for analysis was used for the journal responses to the simulation activity. Categories of affective responses were generated inductively from the data. Final surveys were analyzed in the same manner as initial surveys.

Initial Responses to survey questions:

Of a sample of 70, 12 student teachers indicated that they felt somewhat insecure or insecure in relation to their confidence in mathematical thinking. In answer to another question, 10 of the 12 student teachers confirmed their characterization of themselves as somewhat insecure or insecure as a math student. Given the opportunity to describe their affective response to math in the last question "When I think about math I feel...", these 12 students were joined by 13 others whose responses indicated negative affect towards mathematics.

These responses justify the original purpose of the study. While certainly not the majority, when given the opportunity, 25 of 70 student teachers expressed their personal fear, anxiety, and sense of inadequacy in relation to mathematics. Some made specific references to prior negative experiences linked to their present feeling; some describe a physical manifestation of an affective state. Samples of the responses are presented below:

Physical manifestation of affective state linked to prior experience:

"I feel anxious because I have not had good experiences with math growing up." "I feel angry with my elementary school teachers, I feel anxiety and think of the math teacher going too fast." "I feel a bit uneasy as new concepts do not often come easily for me." "I get a little nervous because I don't understand a lot of it." "I feel fine except when they are word problems." "I feel like I want to do well in it and not be afraid of it, but I know I don't think that way, I'm an artist."

Realization of past experience on present sense of efficacy:

"I realize that my past math education has been a real hindrance to the mathematician lurking inside of me."

Anxiety linked to inadequacy:

"I feel very anxious and inadequate..." "I feel less than adequate, although I test average." "I wish I had more knowledge and confidence." "I feel very nervous and insecure."

Fear: "When I think about math I am initially scared off." "Panic when it entails being tested." "I feel confused and scared inside.

Physical manifestation: "I feel tense and slightly numb." "I sometimes get a headache." "I feel nauseated."

Coping strategy: "I usually try to think of the easiest way to get around it."

Other negative descriptors: "I cringe with anxiety." "I am bored." "I get horrified."

The initial survey revealed that more than 1/3 of the student teachers in the multiple subject credential program held negative dispositions towards mathematics in some degree. These responses included: physical manifestations of affective state linked to prior experience; realization of past experience on present sense of efficacy; anxiety linked to inadequacy; fear; negative physical manifestation and coping strategies.

While the majority of student teachers replied with statements indicating positive disposition towards mathematics, only one student teacher responded with a statement describing a conceptualization of mathematics. She wrote: "I think that it is a language which can shape the way we perceive relationships in daily life situations, a tool for conceptual, spacial and symbolic understanding." For the purpose of this study, the students for whom math was associated with positive or neutral affect were assumed to be more likely to transfer their enthusiasm to their students. Their responses were not analyzed further.

<u>Sample of responses to Simulation and Affective processing of the Mathe Teakst Buk experience</u>:

The first set are statements of *affectively loaded memories sometimes associated with tests*:

"The feeling of material not being adequately covered and having no recourse scares me into rebellion." "My memories are very vague but the anxiety is very real." "I felt dumb, and I felt frustrated and very little. Like I was nobody and that I didn't matter."

"Whenever I would take tests, I would feel stress and feel very uncomfortable and nervous and actually forget material that I knew in my brain."

"It brought back all the fear and anxiety of tests. The feeling of competing against the clock and with my fellow students... You want to cheat and talk but you fear the teacher and possible punishment. The time limit, the anxiety of not knowing can make me very stressed even if I knew the answer, sometimes these outside forces can make me feel distracted."

The following two students' responses *connect a sense of powerlessness with a coping strategy*:

"This activity brought back memories of being a very young elementary student when the teacher is all powerful and holds all the cards. I felt small and powerless. I wanted to please my teacher and was getting frustrated because I wasn't keeping up. Eventually I was so overwhelmed I just gave up. There is some face saving in not even trying. It helped me remember how much power and control a teacher wields over students."

"It made me want to give up. I was so confused and lost I didn't even know what kinds of questions to ask. So I accepted my C's and D's and tried not to care."

The following responses include not only *the feelings attached to the memory*, but *a specific incident or teacher whose influence is coupled to the negative affective response*. A surprising proportion of these couplings recall teachers in the fourth grade!

"This simulation reminded me of all the time I feared getting the answer wrong. I felt so stupid I couldn't get the answer. It reminded me of when I was in the fourth grade and couldn't figure something out and had to go to the teachers desk twice. She told me she didn't have time to help me. She got mad when I didn't understand because I was supposed to be smart."

"This reminded me of one third grade teacher I had that was totally unreasonable and she seemed to me to gain pleasure out of yelling at people for their mistakes. She would announce it to the whole class and make us feel totally embarrassed and stupid."

"It reminded me of fourth grade, doing long division and how much I hated it."

"This reminded me of a day when I was in the fourth grade. The teacher thought that I was making noises, so she made me come up in front of the class and make them 20 times. I didn't realize I was making them so this seemed like some horrible punishment, totally unexpected and unreasonable, striking me blindly. Coming from someone I had previously trusted. I went home and cried and cried by myself. I don't remember telling my mom. I had always liked school but I sure didn't want to go back the next day."

"This brought back to my memory my fourth grade teacher , Sister Brona who hit the children with a ruler. Even though I was a good student, she liked me and I never got in trouble, I still felt like crawling in a hole whenever she was beating someone. I used to get sick to my stomach and feel super nervous even though I wasn't even in trouble."

"Mr. Wolf's algebra class: This was a classic example of board fright. Mr. Wolf would call us up to the black board, no volunteers or backing out and we would stand there until we got the right answer. We were intimidated by the teacher and probably actually physically scared of him. He was known to give very hard "noogies" to people who were talking in class."

When personal stories are told with intensity it is a clue that the student might benefit from "working" his/her material. These students engaged in another Confluent exercise known as the "working chair." The story is relived in the present, intact with the emotion of the past experience. During the story telling, the facilitator may prompt the student to imagine that characters in the story are sitting in the chair and encourages the student to talk to them. As an example, in one case when a particular memory emerged, the instructor asked the person who was sharing, "If you had an opportunity to tell that teacher something right now, what would you say to her? Pretend I am that teacher." The facilitator might also prompt the student to become that teacher and respond to the statements. By telling the story in the present tense, emotions stored in memory are re experienced in the safe context of the present. The student is often able to consciously decouple the baggage of emotion from the math content material. It is this experience that allows the participant to begin to reconstruct their affective response to math by reframing it in the context of the present rather than the past.

The following are two examples of an adaptation of the "working chair."

P: "This reminds me of Mrs. Floodman in eighth grade when the class was clearly not ready for the test but even though we protested she gave it anyway. We were confused and tried to communicate between us but she kept yelling for quiet. Gretchen and I were trying to help each other when she caught us and intimidated us up in front of the whole class saying we cheated. We had to go to the Principal."

F: If you had the chance, what would you like to tell Mrs. Floodman?

P: You made us take a test when you knew we didn't know the material. That was a waste of our time and it only made us feel stupid. When we tried to succeed the only way we could we got in trouble. You made us fail.

Another participant's story:

P: What it brought up for me was my fear of getting in trouble of doing it wrong and wanting the teacher to like me and also not really caring because I knew he was being unreasonable.

F: If I were the teacher what would you say to me?

P: I feel withdrawn, invisible, quiet and rebellious. Very aware of myself and past decisions. I am also feeling appreciative of my ability to adapt and not listen to what you have to say, knowing that *I am not dumb*. What I appreciate is my recognition that I am not dumb. I learned to adapt, and count on my fingers, hiding it in my hair.

These results poignantly confirm the positions of the learners as received, subjective or procedural knowers. Far from the confidence and active mental engagement of constructive knowers, as children, these student teachers were fearful, embarrassed, and inhibited. They assumed that their teachers had knowledge and that they didn't. They internalized powerlessness and inadequacy. In some cases, they developed coping strategies as defense systems against further degradation of voice but for the most part, mathematical autonomy was lost to them.

Responses to final survey questions:

Of the initial sample of 70, three students withdrew from the program. Of the remaining 67, only 39 students returned the final surveys. While it is acknowledged that the return rate is poor, it is the types of qualitative responses that are important to uncovering the possible influence of confluent interventions. No attempt is made here to establish a causal relationship between the specific Mathe Teakst Buk intervention and determination of its effectiveness as in a pre and post test design. The findings are reported with the acknowledgment that without the qualitative responses, there would be little to learn from this study.

Of the 39 returned surveys, one student did not respond to the question of confidence in math thinking, one student teacher indicated that she continued to feel insecure. The 37 other responses indicated a level of confidence in mathematical thinking at the adequate to very confident levels. When asked how they characterize themselves as math students, all 39 responses indicated adequate to very confident.

The last question on the survey yielded information that helps to explain the types of shifts in confidence that may have occurred. Given the opportunity to describe their affective response to math in the last question When I think about math I feel..., responses tended to fit four types: 26 responses indicated an enthusiasm for teaching the subject in a hands-on way to help their students understand the concepts. The following is a typical response of this type: "I think about unifix cubes, tangrams, attribute blocks, base ten blocks, geo boards, pentaminos and I get excited about teaching." Four responses indicated a change in feeling for math, but a lingering doubt at the higher grade levels. For example, "I feel like there are fun ways to teach it, but I'm still a little nervous about upper grade math." Seven responses indicated a change in feeling toward mathematics. These statements ranged from, "I feel OK, a little insecure but not terrified or, think about how I used to be frightened of it but I'm not any more" to "I no longer want to puke, which was my initial reaction many months ago. Now, when I think about math I feel challenged in a motivating way." Of the last 2 responses, 1 indicated that math was a challenge and 1 response while indicating a sense of adequacy also indicated a continued feeling of nausea when thinking about the subject.

Discussion:

The findings of this study indicate that there are indeed powerful prior experiences which influence affective disposition, mathematical competency, and self-efficacy of new teachers to teach mathematics. Responses of participant student teachers indicate that those who have a negative disposition to mathematics have not achieved the autonomy of constructive knowers at least in the field of mathematics. These students seem to function similarly to the received, subjective or procedural knowers defined in *Women's Ways of Knowing*. Their mathematical "voice" is dominated by fear, insecurity, and anxiety.

It is not surprising that the anxiety associated with mathematics is often the result of prior miseducative experiences. From the responses of participants, it can be shown that in many cases negative disposition towards math is a defensive response against poor classroom management, outright neglect or abuse of students rather than actual inability with mathematical concepts. Some students develop coping strategies to continue to function. However, unlike the student who hid her fingers in her hair, many students simply give up trying to understand math when they decide they are dumb.

It was found that it is at the meta processing level that specific, deep, previously unconscious memories reemerged in the consciousness of student teachers. When given the opportunity to "process" their feelings of the simulation, many student teachers brought to consciousness the moment they began to believe they were incapable of learning math. It is often a memorable event which from that time forward influenced their sense of competence and self- efficacy. As the student teacher becomes aware of the association of an event or other specific attribution of negative feelings towards mathematics, the reconstructive process can begin.

It is acknowledged that more than half of the student teachers in the original sample had little or no negative affect associated with mathematics. These students were generally successful math students. This study made no attempt to describe subtle changes in students positive disposition towards mathematics or whether these students positive disposition was a result of their status as autonomous mathematical thinkers. Of interest here was the transformation from negative to positive affective response and the association of negative disposition with received, subjective or procedural knowing and lack of autonomous thinking.

This study has described in more explicit terms the influence interventions such as the Confluent Education model may have on changing disposition towards mathematics in multiple subject credential students. This preliminary work suggests that simulations to stimulate the reconstruction of prior experience, when coupled with affective processing, are useful to deconstruct negative dispositions toward mathematics. Three aspects of dispositional change have been described. The first includes awareness of the effects of prior negative experience on disposition towards mathematics. The second entails a de coupling of the negative affect from the content area. The third involves the reconstruction of disposition through activities in mathematics at the concrete level of experience. The active involvement of the learner in concrete experience allows the reconstruction of understanding in the present. Confluent education, which makes explicit the cognitive and affective dimensions of learning offers a model for influencing a change in student teachers disposition toward mathematics.

Confluent interventions should be of particular interest to teacher educators today as they bridge constructivist theory and practice at the intrapersonal and interpersonal level of experience. Instructors of mathematics procedures classes who use confluent interventions may have a better chance to influence the way their student teachers feel about mathematics and ultimately how they teach mathematics to future generations.

Appendix C:

Mathe Teakst Buk Simulation[6]

The intervention begins with a guided imagery experience. The facilitator says," Please close your eyes, relax. (Pause) Let your imagination take you back in time to when you were young, sitting at a desk at school. (Pause) It is math time. When you have an image in your mind, let yourself come back to the present as that youngster. (Pause. Wait for participants to open their eyes.) When all participants are ready, the facilitator continues, "Today we are going to learn to use symbols to represent quantities." (On an overhead projector or chart paper, the facilitator draws one dot and writes the symbol for one.) "This is one. This is how we write one. This is two. This is how we write two." The instructor continues in this pattern until all nine symbols have been introduced. The symbol for zero is also introduced. Participants are given a set of flash cards to help them gain familiarity with the new symbols. (Allow approximately 5-8 minutes.)

Insert figure 1 about here.

After a quick "review" of the symbols which represent the ordinal numbers on a number line, participants are asked to take the role of student in a traditional testing situation. "Please take out something to write with, we are now going to take a test." (Pass out booklets.) "Use your left hand if you are right handed and your right hand if you are left handed. (Authoritatively) Since this is a test to see how well you learned the symbols, you need to do your own work. I don't want to see your eyes on anyone else's paper. Are there any questions? (No pause) Turn to page one. Ready? Begin. (During this portion of the simulation the facilitator should circulate, praising some students, intimidating others. The facilitator must respond as a strict disciplinarian, taking student's papers or isolating students if necessary). While accommodating cultural patterns of behavior, the facilitator must be sensitive to the degree to which the simulation seems real to participants.

Approximately ten seconds before the end of the test taking, the facilitator says, "Finish up the last problem. O.K., pens down."

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[6] The Mathe Teakst Buk simulation is adapted from The Ctaite Mathe Teakst Buk designed by the Center for Innovation in Education, 19225 Vineyard Lane, Saratoga, CA 95070.

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Figure 1

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