

New Consciousness and Sustainable Practices for the Hermetic Transformative Leadership of Mathematics Education

Presented by: Samuel James DeVries Ph.D. NCC; Associate Dean Mathematics, Adjunct Professor, Cuyahoga Community College, Depth Psychological OD Consultant, Cleveland, OH; and Elizabeth James Thompson Ph.D.; Depth Psychotherapist and Educator; Cleveland, OH

Introduction

Math teaching and learning success is at an unsustainable level given that 60% of students entering two-year institutions require remediation and only 5% of the entering students achieve college level credit after one year of instruction. Math learning spaces are often psychologically unsafe and hostile to individual learning differences. This paper provides a new depth perspective and consciousness from which to lead relational, psychologically safe mathematics learning spaces that inspire creative, transformative learning experiences. Sustainable mathematics learning success depends upon the establishment of Eros-informed transformative relationships in a psychologically safe learning space that encompasses both the experience of self-development and instrumental math. Research has shown the value and positive impact of Eros-informed relationships and the new knowledge and personal self-development that can result from them (Thompson, 2011). Successful learning occurs from a positive relationship with the subject matter of math—marked by engaging inquiry, wonder, mulling, creativity, discovery, conjecture, argument creation, creative problem solving, persistence and pattern identification—as well as through positive, engaging, relational experiences both intrapersonally and collaboratively with others.

This paper incorporates information from multiple fields—including depth psychology, neurobiology, education, mathematics, leadership and organizational behavior—in the pursuit of an integrative, multi-perspectival inquiry intended to encompass as much information concerning math learning phenomena as possible. Each discipline contributes its theoretical bases to the premises of the present conversation.

The Research Approach

Three studies are used as the basis of this paper—one qualitative, one correlational, and one experimental—involving 388 students and 55 higher education faculty using standardized psychometric instruments, specifically: Kolb Learning Style Inventory (Kolb, 2005a), Psychological Type Indicator (Myers, 1998; Jung, 1977), Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia, & McKeachie, 1993), Mathematics Anxiety Scale (Betz, 1978), Psychological Safety Scale (Edmondson, 1999), and the Transformational Leadership Behavior Scales (Podsakoff, MacKenzie, & Bommer, 1996). The quantitative data were analyzed using appropriate ANOVA, correlations, and regressions to determine the relationships between variables. The qualitative data, some of which are provided, give a richness, texture, and subjective experiential feel to the research. The problems discovered and the solutions implemented that address the learning issues are discussed.

Definitions of Terms and Concepts

Archetype: A psychological archetype is a primal pattern or principal form of psychological structure. The concept of psychological archetypes was advanced by the Swiss psychiatrist Carl Jung (1919). In Jung's psychological framework, archetypes are innate, universal prototypes for ideas and may be used to interpret or amplify meaningful experience or observations. A group of memories, feelings, ideas and interpretations associated with an archetype can become a complex. A case in point is the archetypal idea of inferiority associated by some students with mathematics.

Archetypes as such (Jung, 1968) are not experienced, but archetypal patterns in the learning space are experienced as meaningful, salient patterns for individuals and groups. They are the totality of an experience, which is greater than its individual elements. A learning space experienced as safe and generative is different from the pattern in a space that is experienced as hostile and isolating. One may refer to the gestalt of an experience, or the feel of an experience, or the vibe of an experience; these can be related to the archetypal patterns associated with an experience.

The archetypal patterns associated with an experience or the psychological field (Conforti, 1999) of the learning space is critical to the learning that takes place in the space. This is because all learning is based on experience and the psychological experience of learning math is a large and critical aspect successful remediation when a psychological complex is being constellated in the psychological field of the learning space.

Complex: An emotionally charged psychological structure or cluster of character traits or associations that together can act as an autonomous “splinter” personality with an emotionally infused pattern of ideas at its core (e.g., the villainous math teacher or the victimized student). Jung, (1934) took the term from Pierre Janet, who regarded the complex as the “via regia [highway] to the unconscious” (Young-Eisendrath & Dawson, 2004).

Analytical psychology introduced the notion of complexes, or feeling-toned ideas (Jung, 1934). A psychological complex is a combination of functions in the mind, including cognition and emotions, which fuse together and form a whole. A complex is a structured, patterned and dynamic psychological system of thoughts and feelings that cluster—revolve—around an archetypal theme. The attitude of a complex in a subject matter domain can affect what a student learns or does not, how the student pays attention, the student’s motivation, strategies, and persistence for learning, what the student remembers, and the student’s sense of self-efficacy. Complexes and their attitude can influence a learner’s preference for one learning activity over another and are known to hinder and even block learning.

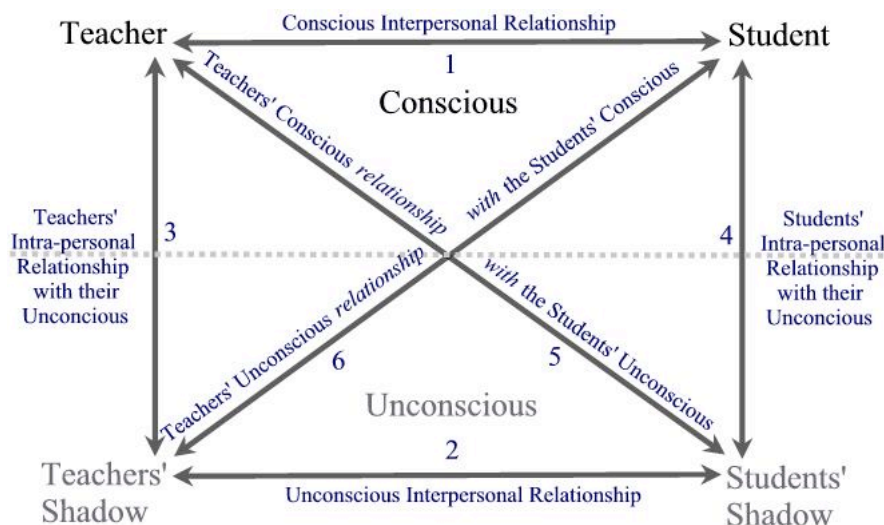
Complex Depotentiation: As a potentate is a ruler or sovereign, to de-potentiate is to supplant the potentate—to displace or unseat the ruler, thus freeing oneself from under their influence. Pointing to the autonomous nature of a psychological complex, it is experienced as “having us” in its grip or under its influence, not unlike being under the irresistible yet invisible field of influence generated by a vortex. To de-potentiate a complex is to bring it from the unconscious to the conscious where its capacity for influence is diminished (DeVries 2007).

Conscious / Unconscious processes: Also: preconscious, non-conscious, tacit, implicit (Underwood & Bright, 1996), automatic (Fredrickson, 1984), subliminal processing (Erderlyi,

1974), which refer to and ways of knowing seen in parallel with what goes on at the conscious level of processing and ways of knowing, both of which have major implications for learning. With the impact of non-conscious material on learning—such as the affective predispositions of the learner or motivational control—we enter the realm of the depth psychological concepts of the personal unconscious (Jung, 1973), and the dynamic unconscious psychological field (Conforti, 1999) at work within the learning space (Kolb & Kolb, 2006).

Figure 1.1 The Teacher and Student in the Quaternity of Conscious and Unconscious Relationships

The psychological relationship combinations of the quaternity between teacher or institution and student at both the conscious and unconscious levels



Consciousness Transformation: A process that involves changing the form of deep structures and basic assumptions. Double-loop, critically reflective feedback plays an important role in this process. That which we implicitly accept is brought into explicit awareness and subjected to critical self-reflection when transformative learning takes place.

Eros: Eros is the Greek god of love and relationship. As the god of *relatedness*, he is the god who *connects*. Eros thus serves as a bridge to bring what has been separated or split apart back into connection and relationship. Jung speaks of the “connective quality of Eros” whose function

is relationship (Jung, 1959/1979, p. 14). The experience of Eros in the learning space brings in a form of compassionate caring that is incompatible with fear; furthermore this kind of caring love has physiological effects in that it helps the immune system and reduces cortisol levels caused by stress (Siegel, 1986; Ornish, 1998; Guarneri, 2006). Eros calls to mind the web of life, the “participatory universe” uncovered by quantum physics (Peat, 2002), reminding us of the importance of our interrelatedness, interconnectedness and interdependence. Eros stresses the personal realm (Von Franz in Boa, 1992) revealing the importance of interpersonal relationships and implying emotional involvement at some level. When Eros is present, individuals are safe to share their truth and reality with another in a personal way (Lockhart, 1983). Eros humanizes an archetype (Guggenbuhl-Craig, 2008) and no instructor of mathematics can divorce himself or herself from the archetype of the teacher. Eros is a creator god, and thus associated with the awakening and presence of creativity and discovery. Because—as a fertility god—he is closely connected with the life/death/rebirth cycle of nature, he is associated with the process of transformation, and thus represents transformative love (Downing, 1976). As the god of psychic reality (Hillman, 1972) Eros underscores the importance of depth psychological factors and knowledge from the realm of imagination. He promotes the development of consciousness and is the catalyst for personal development and self-knowledge. Knowledge that comes from connection and relatedness, as well as from creativity, experience, intuition, and the imagination, can be thought of as eros knowledge.

Experiential Learning Space: The interdependence and tension between emotion and reason in the experiential learning space has been regarded as critical since the time of Socrates (Gardiner, et al, 1970). An experiential learning space provides an environment for authentic experiences in relevant contexts and allows for the safe questioning from multiple perspectives (Kolb, 2006). As cited in Kolb (2006) the concept of the experiential learning space builds on Lewin’s (1951) field theory, which viewed the social environment as a dynamic field interacting with human consciousness. For Lewin (1952) individuals were seen to behave differently according to the way in which tensions between perceptions of the self and of the environment were worked through. The theory of experiential learning space as defined by (Kolb 2006) draws on Vygotsky’s (1978) idea of social cognition, Bronfrenbrenner’s (1979) ideas of person, process, and nested contexts, and Nonaka and Konno’s (1998) Japanese concept of “ba” or meaningful

context. Nonaka and Konno indicate that a climate of interpersonal “care, love, trust, and commitment” is necessary for the tacit knowledge in the space to become explicit. In Jung’s (1975) terminology, the container must be safe for the unconscious to become conscious, for knowledge to move from the shadow to the light. Experiential learning spaces must be situated in learning cultural “norms of psychological safety, serious purpose and respect” if learning is to be promoted (Kolb, 2006).

Hermetic: This term is used to describe characteristics ascribed to the Greek god Hermes, and is used here to relate his characteristics to leadership, teaching and consciousness transformation. A Hermetic container is one protected from outside influence much like the container of the learning space created by the hermetic leadership and sage-like guidance provided by a professor in the classroom. Hermetic transformation refers to the powerful discovery of the alchemists. Alchemy, of which Hermes is considered the father, started as an early attempt at inquiry into a way of transforming base metals of the earth into gold. In the process of the early inquiry, those who sought to understand the physical world outside of them came instead to understand their own inner world and the transformation of consciousness.

Hermes is considered to be an experienced and trusted guide and messenger. He had the capacity to be conscious of the archetypal pattern, resonance, and languages used in different cultures and spaces, such as heaven and hell, and was therefore able to speak and interpret from the world of one archetypal pattern to the world of another. Hermes is able to be a guide because he has been there himself and can see in multiple dimensions as well as being able to translate and bring together the opposing parties in a dispute through negotiation. This ambassadorial role between the opposites is symbolized by the caduceus—two snakes entwined around the staff such as that used as the symbol of healing. In order for the reader to understand and differentiate out the type of learning, transformation, leadership and teaching we are seeking to understand with this research, the term hermetic is a useful heuristic metaphor. This study itself bridges between the world of positivist science and the world of soul in human depth psychology.

Hermetic transformative leadership: The Greek god Hermes gave safe passage to travelers from the earth to the underworld. He was a translator of language between places with opposite characteristics, such as the realm of the conscious and the unconscious. Jung described the first steps of *hermetic transformation* as entering into a dialogue with the “other”—in our case the less conscious, opposing mode of learning. This particular kind of leadership introduces the opposites into dialogue and holds them in tension until the transcending function—which values both positions—restores the integrated whole. When the learning cycle is compromised due to complex activation or the bias for one mode of learning—either by an individual or a learning culture such as that of higher education mathematics—balance and wholeness needs to be restored. This reconnection with the whole cycle releases energy back into the learning space, which has been bound up in the polarization. The teachers’ role is to provide such hermetic transformational leadership (DeVries 2009) of the learning space in order that students realize their learning potential in the domain of the subject at hand.

Learning: “Learning is complex, broad, and deep” (Baker, Jensen, & Kolb, 2002). Learning can be defined in terms of being both differentiating (Jung, 1977) and integrative (Kolb, 1984). It can involve transformation or be instrumental (Mezirow, 1991); it can even be liberating (Freire, 1973); conscious or unconscious, occurring individually or collectively. Learning can take place intentionally or unintentionally (Smith, 2002). It involves both concepts and emotions (LeDoux, 1998). Learning is a complex transformational process impacted by individual differences, biological, psychological, social processes and learning cultural norms, which are difficult to bind in one theoretical perspective (Antonacopoulou, 2001). Learning viewed as *paideia* by the ancient Greeks involved cultivating each individual’s unique creative potential through experience in every domain of activity which Zoja (1997), the Jungian theorist cited in Antonacopoulou (2001), viewed as an institutionalized form of the psychological process of individuation (Jung, 1977).

Math Anxiety: A compound concept. Anxiety is a dynamic interplay of affective states, including feelings of fear, apprehension and concern, which has physical expressions such as shortness of breath, muscle tension, increased heart rate, etc. Trichett (1997) demonstrated the negative effects of anxiety on new learning and performance in school. A triggered unconscious

psychological complex of inferiority associated with math can provoke anxiety and can involve cognitive and emotional feeling-toned ideas based on negative previous experience, which then impacts association and memory, thus harming learning.

Freedman (2003) defined math anxiety as “ an emotional reaction to mathematics based on past unpleasant experience which harms future learning”(p.7). Mathematics anxiety is currently defined as “feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations” (Richardson & Suinn, 1972, p. 551).

Psychological Learning Type: A typology based on a grouping of Jung’s (1971) psychological types into four quadrants along two axes in relationship to Kolb’s (2005) learning styles into four quadrants along two axes. Four associations are made: 1) between Kolb’s (1984) concepts of apprehension and Jung’s (1971) concept of perceiving information; 2) between Kolb’s (1984) concept of comprehension and Jung’s (1971) concept of making determinations or judgments about information; 3) between Kolb’s(2005) concept of active experimentation and Jung’s (1971) concept of extroversion; 4) between Kolb’s(2005) concept of reflective observation and Jung’s (1971) concept of introversion. A chi-square analysis of best fit among the typology groupings was used to determine the psychological learning type groupings.

Psychological Safety: Maslow (1954) coined the term “psychological safety” to refer to the need for security and protection from pain, fear, and anxiety. Psychological safety refers to a condition of feeling free or protected from the specific case of harm to the psyche, soul, or mind.

According to Maslow (1954) the need for safety must be met before higher order needs can be pursued. Edmondson (1999) establishes the link between psychological safety and learning. Argyris and Schön (1978) link psychological safety to the ability to challenge ideas in groups. Psychologically unsafe learning spaces can be created by prejudiced against psychological learning types antithetical to the dominant culture of higher education mathematics.

Self-efficacy: A person’s beliefs referring to his/her abilities to successfully perform a given task. According to Bandura (1977 p.71), “self-efficacy is defined as people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that

affect their lives”. “Self-efficacy beliefs determine how people feel, think, motivate themselves and behave in a given context” (Bandura, 1994, p.71).

Self-Regulated Learning: The process of self-reflection and adjustment of personal responses occurring while learning. These responses can be emotional, cognitive, and behavioral. Upon reflection, adjustments are made to enhance individual effectiveness in the learning situation. Corrective action is taken when what is observed during self-reflection differs significantly from what is desired. Self-regulation includes exercise of influence over one's own motivation, thought processes, emotional states and patterns of behavior (Bandura, 1994). Self-regulation of the psyche is a developmental process of dialectic integration of consciousness that results in movement toward a more integrated holistic and spacious personality able to maximize creative learning potential.

Shadow Complex: A psychological structure formed around diatonic aspects of ego at the individual or group level. Any complex (Jung 1969) is by definition unconscious and part of a person's shadow. As a set of feeling-toned ideas revolving around less favorable aspects of oneself (such as the learned helplessness of inferiority associated with an inferior function or mode of learning), it is banished from the illuminated conscious area of the psyche and disavowed. Accepting and integrating shadow aspects of oneself for the purpose of learning is part of the difficult work of development. Conscious development and the integration of the shadow complex may depotentiate math related anxiety for those who disassociate with their capacity for abstract conceptualization and logical judgments.

The Problematic State of Math Learning in Two-year Higher Education Institutions

The funding formulas used for state and federal financial support for post secondary higher education are changing from an emphasis on access to a focus on accountability for learning success and learning outcomes achievement. The greatest coloration and potential barrier to associates degree success and timely degree completion is college level math learning success. Approximately 60% to 80% of the students entering two-year colleges require between 1 and 4 developmental math courses. Each course having an approximate learning success rate of 40% resulting in very few students making it through the sequence successfully or in a timely manner.

Only approximately 5% have achieved college level math after the first year of study. In fact the degree completion rate and time to degree completion at two-year institutions correlates with this tragically low success rate through the developmental math sequence. These facts suggest a pervasive systemic problem, which threatens the future funding sustainability and viability of the community college system as pathway to student success. We must turn around the alarming failure rate of community college students in developmental mathematics or risk the loss of the public trust and funding for sustainability of the important work of two-year post secondary institutions.

"I simply wouldn't have the imagination to come up with the kind of senseless, soul-crushing ideas that constitute contemporary mathematics education."

Mathematician and Teacher Paul Lockhart (2009)

Environmental remediation involves the removal of something negative, toxic or contaminating from the environment. We tend to create new learning environments with the same depth-contaminating elements as the ones we are meant to be improving. This is yielding the same poor learning results for the students sensitive to these contaminants. All learning comes from experience (Kolb, 1984) and all too often the same toxic math learning experiences are repeated for many developmental math students—the same negative experiences they have likely had for at least 12 prior years of formal education.

"Many community college students find themselves struggling painfully and unsuccessfully to complete multiple developmental mathematics courses that mirror and repeat their earlier failed and traumatizing math learning experiences. Students are actively disengaged, avoiding of and viscerally repelled by courses and learning spaces they experience as traumatizing and harmful to their self image self efficacy and esteem. Students find math courses threatening to their college success and their intellectual, social and economic mobility in the community. Our students find our courses to have no connection to their other lived experiences and no relevance to their aspirations or the world they live in."

Samuel DeVries (2007)

"I was made to learn by heart: 'The square of the sum of two numbers is equal to the sum of their squares increased by twice their product.' I had not the vaguest idea what this meant and when I could not remember the words, my tutor threw the book at my head, which did not stimulate my intellect in any way."

Bertrand Russell, as quoted in Lockhart (2009)

Students ideas about math and themselves from precollege level math classes: from reflective journals and conversations prior to psychologically safe math learning experiences in a relational transformative space

“I have no confidence in my ability to do math.”
“I am horrible at math.”
“I am not a math person”
“Nobody in family can do math.”
“I feel like a baby when it comes to math.”
“I ask stupid questions in math class.”
“I just cannot do it no matter how hard I try. I am not made for math.”
“I have no brain for math.”
“I don’t have a head for numbers.”
“I am helpless when it comes to arithmetic”
“Numbers make me dizzy.”
“It’s just too hard for the likes of me.”
“I am a slow math person too slow to take a course successfully.”
“Don’t even ask me about math I don’t do math.”
“Math is like a mountain I was not meant to climb.”
“I am helpless with figures.”
“Nobody can teach me math.”
“It’s like the part of my brain that was supposed to do math is missing altogether.”
“I have the family math curse.”
“I can’t do math and I am in good company.”
“I am a person not a calculator. I don’t do math.”
“I am stupid when it comes to math, I’m ok with everything else. Ask me anything except math.”
“Math is the bane of my existence.”
“If it weren’t for math I would have my college degree.”
“With math, you either have it or you don’t and I don’t.”
“I am clueless, without a clue, when it comes to math.”

Students Images: from reflective journals and conversations prior to psychologically safe math learning experiences in a relational transformative space

“Math makes my skin crawl,”
“I can’t breathe in math class.”
“If it’s a math day it’s an extra deodorant day.”
“Nothing makes me feel worse than math class.”
“It’s so frustrating I go out and scream after tests.”
“I feel sick to my stomach when I try to do math problems.”
“It’s so embarrassing. I shiver to be my age and not able to do simple math.”
“Math scares me to death.”
“I can remember everything except math.”
“Hate. I just feel hate and resentment for having to take math.”
“Math ties me up in such knots that it takes two glasses of scotch to calm me down.”

A Depth Psychological Perspective of the Problem

From the depth psychological perspective, unconscious dynamics exist and exert an influence. When they go unacknowledged in the classroom, learning can be obstructed. Furthermore, psychological typology (Jung, 1971) can enhance or impede the learning process. Because all learning is based on experience, and the psychology of the space is a large part of the experience, it must be consciously tended to. If not attended to consciously, it will evolve unconsciously in the shadow of the learning space. Unconscious psychological and emotional processes disrupt students' cognitive learning, and negatively "charged" feeling-toned memory associations with previous mathematics learning can derail the current learning process. Math itself can often become associated with a psychological inferiority complex resulting in feelings of shame, not belonging, low motivation and low math self-efficacy (Bandura, 1982), poor self-directed math learning strategies, and feeling unsafe or anxious in math related learning spaces. Transformation of the psychological experience of learning mathematics is critical to successful remediation of the learning space.

... Strictly speaking of course, a deficiency in mathematical ability cannot be regarded as an individual peculiarity. But it does clearly show how a school curriculum may sin against the psychological peculiarity of a pupil. In the same way, certain widely accepted pedagogic principles may prove to be utterly useless, indeed positively harmful, in all cases where psychological peculiarity of the pupil calls for an exclusively individual influence.

Jung, 1954 *CW*, Vol. 17, pp. 149-64

Within the field of higher education, there are certain cultures that arise in the different academic disciplines. These cultures have a professional press that includes an unspoken bias favoring particular ways of being, seeing and knowing, and fostering certain psychological learning types over others. In the culture of mathematics, this professional press is particularly strong.

"The cultural problem is a self-perpetuating monster: students learn about math from their teachers, and teachers learn about it from their teachers, so this lack of understanding and appreciation for mathematics in our culture replicates itself indefinitely. Worse, the perpetuation of this "pseudo-mathematics," this emphasis on the accurate yet mindless manipulation of symbols, creates its own culture and its own set of values" Lockhart (2009).

All people, and thus learners, are not created the same. We have unique ways of taking in, processing, storing, and retrieving information; we have different preferred ways of learning. Beyond that, people with like ontologies, epistemologies, and learning proclivities tend to group together. As human beings, we like to be with others who see the world the way we do. It reinforces our values; it makes us feel good, liked and safe.

In a similar manner, when we are with people who see the world differently than we do we feel out of place less comfortable and less safe to explore, question, discover and learn. It is more difficult to understand and be understood in this type of environment.

The culture of mathematics education is co-created by people who share similar ways of seeing, being and knowing that are based on the principals and characteristics of mathematics itself. It is only natural that people would be drawn unconsciously to people and processes that are close to there own proclivities, talents and preferences. In this study, hundreds of mathematics students tested were and the findings revealed that those who are like their teachers in psychological learning type excel with classic learning pedagogies while those significantly different from the dominant math faculty in learning style and psychological type learn considerably less well in the traditional pedagogies.

When such biases dominate at an unconscious level, developmental math students suffer. This suffering is quite serious and leads to the formation of student's negative views about themselves as learners and adversely impacting their sense of self-efficacy and self-worth at a much broader level. The very social and economic mobility colleges are trying to promote in the outside world for their students is based on these students' view of themselves, which—in the current math culture—is debilitating for many.

The depth psychological perspective calls to attention the fact that it is the students who, by temperament, have a learning style and psychological type not in accord with the dominant math culture who suffer in a particularly insidious way due to the unacknowledged existence of unconscious processes at work in the classroom. Depth psychology's useful heuristic theory explains how an unconscious or “shadow” prejudice that favors culturally preferred learning

styles (Kolb, 2005) and psychological types (Jung, 1971) can cause stress in math learning domains. When such processes are not called into attention, the reasons for math failure in such students is often misunderstood. In turn, this explains why many strategic interventions at the surface level do not resolve the problem. The reason for such poor success lies at a deeper level of consciousness than many of the interventions being used to try and address the issue. In fact, all too often, the same consciousness that created the problem is being used to solve it, the result being superficial changes while deep fundamental assumptions and methodologies remain fixed. As a result the problem persists.

The research here reported, in contrast to other studies, addresses the unconscious processes at work in the math learning space that contribute to the activation of a psychological inferiority complex, which cripples learning success and gives rise to math related anxiety (Baylor, et al, 2004) shown to disrupt and inhibit learning. When such a complex is activated in a student, it effects brain functioning.

Emotions (states of the body) and feelings (states of the mind), are associated with various sites in the brain that trigger these states and the astonishing, almost inconceivable synthesis of the homeostatic process, memory, sensory input, imagination, and foresight that links the unconscious to consciousness and feelings to reasoning.
(Damasio, 2003).

The current understanding of the workings of the brain from Zull (2002) and Ledoux's (1998) neurobiology, Damasio's (2003) neuroscience, and Dehaene's (2003) numerical cognition explain the interaction of the cognitive and emotional systems in the learning process. The concept of the brain's plasticity and capacity for change underlies the process of transforming consciousness through the illumination and integration of psychological complexes, specifically the presence or expulsion of negative feelings associated in the inferiority complex and often combined in association with math learning.

Students cannot learn math without their frontal cortex fully engaged. Hermetic transformative teaching capitalizes on the newest research that shows what works best with our brains. When fear and anxiety are created in biased, toxic learning spaces, energy flows out of students' frontal

cortex down to the reactive limbic brain where no math is learned or recalled. The most rewarding math learning requires the brain's executive functions, the ones that control higher-order neural networks of the frontal cortex to be fully engaged in an integrative way with the other systems of the body, brain and mind. Teachers can help activate those circuits with conscious attention to unconscious processes in the learning space.

Reinforcing the lived experience of the authors, as a teacher/mathematics dean and depth psychologist, this research study reveals how important, and how *real*, the “invisibles” are—those powerful psychological dynamics that can have far-ranging effects in the learning space. When these dynamics are not called into attention and accounted for, students with the non-favored psychological learning type very often end up internalizing a sense of inferiority that slips in “under the radar” because it is an unconscious—and thus unnoted—phenomenon. An unconscious process, such as this type of projection and introjection, has the power to undermine the math learning performance of these students, leading repeatedly to high failure rates in math, extended time in the developmental learning sequence, and poor graduation rates.

Finally, from the depth perspective, the lack of Eros is far too common in the dominant math culture, and the inclusion of Eros is a crucial part of correcting the problem. The current math culture is a climate that not only discourages personal development, transformative learning, and self-knowledge, but fails to see how crucial these are for the successful learning of math. Furthermore, in the culture of math objective and subjective ways of knowing have been split apart; the learning space is impersonal, dehumanized, and centered on abstract facts; fear is often constellated in the students; creativity and imagination are not used for the valuable learning tools they are; and the value of consciousness in bringing to light important psychological dynamics in the classroom is not understood—all to the detriment of learning.

Solutions Discovered and Tested

Consciously differentiated instruction that meets multiple learners’ needs and honors subjective differences. Consciously differentiated instruction places students’ learning at the center where every learner’s needs are taken into account and honored and where the chances for success are exponentially increased for both instructor and student.

The hermetic transformative leadership DeVries (2007) of learning-centered education in safe experiential learning spaces optimizes teacher and student learning success. Providing this type of leadership for mathematics education must begin with our own transformation and authentic integrity (Beebe, 1995). This includes challenging of some of our own tightly held and culturally reified basic assumptions. The Delphic oracle is associated with the phrase “Know Thyself”. As hermetic transformative leaders we must seek to know ourselves and know the learning impact that *who we are* has on others. We need to know how *who we are* as conscious or unconscious leaders translates into the math teaching and learning space. This is our responsibility.

- The hermetic transformative leader asks their students to undergo a transformation of their consciousness. The leader must do the same and model the results of their own neural plasticity and change in order to be taken seriously as safe guides or herms on the transformative journey. The basis of hermetic transformative leadership is ones own lived experience of transformation from which one teaches and leads others (Palmer 2000). If you have never experiences your own left handedness by learning something that is antithetical to your natural proclivities it will be most difficult for you to assist others in doing so.
- The hermetic transformative leader must hold the learning space closed and free of others needs being met through the students this includes being free of the teachers needs and those of other students.
- The relational hermetic transformative teacher acting as a leader present in the learning space understands the challenge of learning subjects that are antithetically opposed to a learners proclivities and psychological learning type and which therefore requires transformative learning and higher degrees of self direction to be achieve.
- The hermetic transformative leader must see hear and accurately reflect back the students experience including the students behaviors and the feelings.
- The hermetic transformative leader shares the vision of the students success and shares their willingness to travel with the students, providing support equal to the challenge each student faces.
- The hermetic transformative leader has experienced what the students they are guiding are going through and shares authentically form their own authentic experience of vulnerability and transformative learning.

- The hermetic transformative leader shepherds internal processes of introspective reflection, consciousness development, self talk and self regulation of learning as openly dialogued and parts of the learning agenda
- The hermetic transformative leader recognizes and differentiates between the transformative learning needed to heal and remediate the impact of negative math learning experiences and the learning needed to develop the art and science of mathematics.

Hermetic transformative experiential learning DeVries (2007) potentially transforms consciousness by involving a “double loop”. This type of double-loop learning experience involves ones mental models in use, habits of mind, and neurologically wired structures of the brain in a second activity of conscious introspection during learning (Argyris & Schön, 1974). Double-loop learning is thus potentially a hermetic, self-transforming, experiential learning process involving a change in consciousness where the learner accepts difficult psychological tasks and uncomfortable challenges of risk-taking while changing old, familiar, cognitive, emotional, and social-behavioral patterns (Illeris, 2004). This type of learning experience requires a learning space that is safe and a relational trusted guide in the form of the teacher. Students with gifts differing from the predominant press of the mathematics discipline need conscious, Eros-infused, connected, supportive, caring and compassionate professional relationships in order to establish psychological safety and experience transformative learning. Our relationship with the students and math must change in order to help the students change their relationship with themselves and math through hermetic transformative experiential learning.

New consciousness and new learning experiences are needed for the creative destruction and transformation of old structures and patterns to take place. It is important to offer more than functional, additive instrumental learning experiences in the math classroom (Mezirow, 1991, 2000; Cranton, 1994; Goleman, 1985; Bateson, 1972). Individual students especially those who's gifts to the world are not in math have developed certain frames of reference over time—associations, feelings and conditioned responses—which then function as “structures of

assumptions through which [they] understand [their] experiences and themselves” (Mezirow, 1997, p. 5). Such assumptions function much like Jung’s feeling-toned ideas or psychological complexes, as they “selectively shape and delimit expectations, perceptions, cognition, and feelings” (Mezirow, 1997, p. 5) of students in the math learning space.

Math learning as a relational appreciative inquiry into pattern form and function needs to be practiced. Learner differentiated, authentic engaging, relevant math learning experiences for all people regardless of psychological learning type DeVries (2007) and proclivities is crucial.

Eros-infused learning spaces

From the depth perspective, more humanistic, eros/love values of compassion and caring are needed in the math classroom. Physics teacher Arthur Zajonc (2006) calls for an epistemology of love in the academies of higher education and learning, emphasizing “a form of inquiry that supports close engagement.” It is derived from his considerable experience as a teacher at Amherst College, where he has witnessed this form of inquiry leading to transformation, insight, broader learning, and expanded consciousness. Zajonc and Parker Palmer (Zajonc, 2006; Palmer, 1993; Palmer & Zajonc, 2010) both stress the fact that objective knowledge is necessary but insufficient to bring about learning, and this would especially apply for developmental students. The Eros quality of humanistic caring springs naturally from an epistemology of love. Furthermore, Eros stresses an ethics of caring (Noddings, 2003) that—due to its emphasis on connection and relationship—serves as a corrective to a separatist, objectivist epistemology.

Conscious attention to the Archetypal Patterns or Psychological field of the learning space: the prevalent patterns and archetypes of the learning space are critical to the learning that takes place in the space as all learning is based on experience and the psychological experience of learning Math is critical to successful remediation.

Archetypal patterns to be aware of in the intentional conscious learning space:

Archetypal pattern of Eros, Hermes, Inquiry, Discovery, Intrigue, Teacher, Student, Exploration, Collaboration, Engagement, Play, Guiding, Shepherding, Journey, Creativity, Acceptance, Caring, Sharing, Mystery

Archetypal patterns to be aware of in the shadow of the math learning space:

Archetypal pattern of the Villain, Victim, Judgment, Good student vs. Bad student, Write vs. Wrong, Duncie, Stupid or Inferior, Outcast, Chosen ones, Scape Goat, Isolation, Force, Power

Learning environments characterized by psychological safety are those where pedagogies recognize and honor individual differences in psychological learning type and the learning space is appropriately differentiated.

New approaches to math teaching and learning using new pedagogues: Recognizing that inquiry, problem-solving, trial and error, curiosity, creativity, play, intuition, discovery and relational interaction are important parts of the math learning experience for many students.

"Mathematics is about problems, and problem solving must be made the focus of a student's mathematical life. Painful and creatively frustrating as it may be, students and their teachers should at all times be engaged in the process—having ideas, not having ideas, discovering patterns, making conjectures, constructing examples and counterexamples, devising arguments, and critiquing each other's work. Specific techniques and methods will arise naturally out of this process, as they did historically: not isolated from, but organically connected to, and as an outgrowth of, their problem-background." Lockhart (2009)

Differentiating learning about oneself as a learner of math—which is subjective and intra-personal, the student being the subject—and the objective instrumental learning of math.

The desired multiple learning outcomes of successful development of self knowledge, improved executive self regulation of learning the instrumental mathematics competence itself is dependent upon our providing students with a different math learning experience. This requires a different consciousness for creation and maintenance than the consciousness we used to create our current math learning options. The student's relationship to himself or herself, to us and to the discipline of mathematics must be transformed. Our relationship to our students is critical in this transformation. In order to change our relationships to students we must first change our conscious relationship to ourselves and to the discipline of Mathematics.

Positive Results from the Experimental study

The developmental students in this study— those who received math instruction in the psychologically safe experiential learning space where unconscious processes were held into

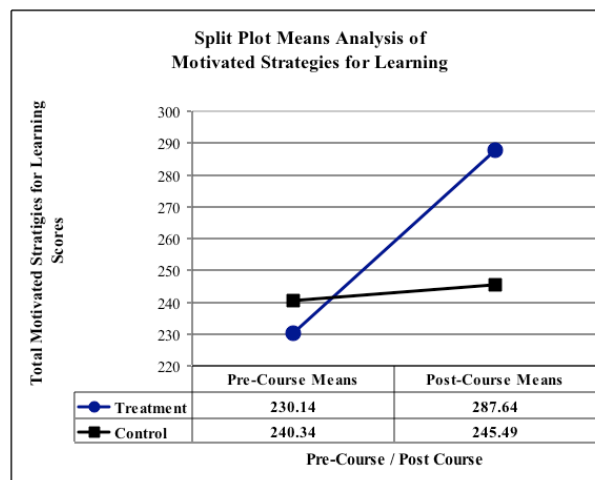
account by the teachers—not only discovered and revealed their otherwise hidden abilities through better math grades, but also showed a heightened sense of self-awareness and appreciation for their own particular ways of learning. Their comments before and after learning in a safe experiential learning space reflect the meaningful interweaving of—and relationship between—self-knowledge and the instrumental knowledge of subject matter.

Data from our recent study shows with statistical significance, that when developmental math students—those who do not possess the culturally favored psychological learning type of the dominant math culture—are provided with an consciously differentiated experiential learning space that is psychologically safe Chang, H., & Lee, A. (2001), inquiry and discovery based and led by relational teachers who show personal care and commitment to individual diversity in learning, they not only outperform their peers (who received math instruction through a traditional model) in the instrumental learning of math, but they also report greater positive change in their View of themselves and in the development of there higher order, frontal cortex located cognitive executive function and self directed learning skills.

To illuminate the differences figure 1.2 below displays a means analysis using a simple split plot following the which clearly illuminates the divergence in executive function Motivated Strategies for Learning scores when the treatment group pretest and post course means are compared to the pretest and post course means of the control group.

(figure 1.2) **Split Plot Means Analysis of Total Motivated Strategies for Learning Scores for Pre-Course and Post-Course Treatment and Control Groups**

Analysis of Motivated Strategies for Learning Pre-course and Post-course Based on Treatment and Control Students.



Excerpts from student final essays after a math learning experience in a relational Eros-infused, hermetic transformative, psychologically safe learning space:

“My expectation of this class was totally different than what it turned out to be. One thing my professor did was encouraged me to really look at myself, my attitudes and my destructive self-images about myself and math, my goals and dreams. I did conquer that task of looking inside even when it’s not pretty, and now I do it regularly with great benefit. My professor went through some hard times and she was able to help me through mine.

Pat

“I probably would have continued on the same path, had it not been for the Math class with professor Z. I didn’t realize I was my own worst enemy. I started paying attention to my inner critic and it was very negative and self-defeating. When I remembered, I tried to replace the negative with my teachers positive view of me; it helped. It helps with tests too, I remind myself that I have studied and I know the information. All I need to do is connect with what I have learned and transfer it to paper. I am so grateful about what I have learned about myself and about my ability to do anything I choose to do including math.

Lisa

When a teacher that takes unconscious processes into account makes a learning space safe; students not only learn more, but also feel a greater sense of self-esteem and self-efficacy. Implications extend to leaders in any field who hold a position of authority in any kind of learning space. When teaching includes a more personal relational approach with authentic and even vulnerable sharing concerning our own journeys of transformative learning as well as accountability for the existence of unconscious processes, greater learning and student transformation is made possible.

Students Verbal Comments from the end of the semester

After a math learning experience in a relational transformative space

“I love my math teacher.”

“I can totally learn anything I want to know.”

“This is the best class I have ever taken in any subject and I used to hate math.”

“I want to stay with my teacher through all my math classes. She is awesome.”

“Why didn’t somebody tell me math could be like this?”

“I cannot believe I went through 12 years of hell before somebody helped me with math.”

“I wish I had taken this course years ago.”

“I am not afraid of math any more.”

Additional Experimental Outcomes:

From relational Eros infused hermetic transformative leadership of psychologically safe math learning spaces where inquiry, problem-solving, trial and error, curiosity play, intuition, discovery and relational interaction are the norms

1. **positive** math learning self efficacy
2. **improved** self directed learning skills and executive functioning
3. **increased** curiosity, self esteem and critical thinking, problem solving strategies, creativity and instrumental math learning success with a C or better
4. **persistence** from class to class through completion of the developmental sequence and college degree achievement
5. **social** and economic mobility realized with credential achievement
6. **greater sustainability** of higher education mathematics in the higher education curriculums

Table 1.1 *The % of Students in the Treatment Group who Persisted by Taking Math Courses the following Semester, Compared to the control groups' persistence*

Math Learning Persistence of Treatment group significantly, 23.5% greater than control group

Student Type	# Did Not Enroll Spring 2007	# Did Enroll Spring 2007	Total	% Persisted To Spring 2007
Control Group	53	101	154	65.6%
Treatment Group	7	57	64	89.1%
Total	60	158	218	72.4%
Difference Between Treatment and Control				23.5%

Note. Chi-square = 12.4932137548633, Degrees of freedom: 1,
 p is less than or equal to 0.001. The control and treatment distributions are significantly different.

Before the present study was conducted, there had been no inquiry found in the literature from a depth psychological perspective examining the basic assumptions and working mental models predominant within mathematics higher education learning culture. The findings of the present study suggests a previous prejudice and social injustice may have been an unexamined barrier promulgated against students who do not share the Learning Style and Psychological Learning Types of those in power in the predominant culture. Specifically, the present study located a

preference of the dominant culture for the abstract over concrete learning modes (Kolb) and for Judging or Perceiving Psychological Learning Types (DeVries).

Mathematics higher education cannot continue to abdicate its responsibility to provide for the transformational development of general education students' lives. Over time math education has evolved into more of a mechanical, transactional function, a commodity or product in itself than a process that is educational. The collective consciousness of higher education mathematics teaching has been colonized by the competitive market economy mentality, violently engendering fear, insecurity, and internalized inferiority as an ordinary outcome of a math class experience. This result stands in stark contrast to the philosophy of education that would provide learning experiences for students' individual and collaborative hermetic transformational development. The cultural patterns reified and orchestrated in classrooms by many math faculty serve to narrow and codify students' negative view of themselves and the world rather than providing new learning experiences that would expand, build, and create greater complexity of ideas and greater ease of movement through the learning cycle and more capacity in the students' psychology.

Hermetic, transformational, experiential learning must be facilitated through Eros-infused relational, conversational and collaborative learning experiences. These experiences are created in safe, Eros-infused learning spaces by professional teachers who are involved and engaged, exercising hermetic transformative leadership. Over time the students' relational experience with the teacher—and socially with other students—accurately reflects the students' significance, importance, and potential strengths. In this safe learning space, the reflection and holding of the students' positive projections continues until the students can see and hold the reality of their potential for themselves.

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