MI + MI + CI: Could *MI Theory*, Multidisciplinary Instruction, and A Community of Inquiry, Sum Up to Math Engagement?

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Abstract

This theoretical piece entertains the notion of increasing math class engagement through a combination of nontraditional frameworks. Research shows low student motivation and achievement in mathematics and the inability to transfer math concepts into real-life situations. Research also shows that that these deficits result from using traditional teaching methods. In this paper I propose a pedagogical blend of three existing and progressively popular frameworks: The process of teaching to Howard Gardner's multiple intelligences, as a means of maximizing student learning in mathematics, is a way for students to make meaningful connections and relationships. The process of relating and linking two or more disciplines to mathematics is a way to help students make meaningful connections to real-life situations. Thirdly, the process of enabling a cooperative learning environment, whereby group discourse is supported in a community of inquiry setting, is a way to help students build sociocultural and interpersonal relationships, as well as increase their engagement in the learning process.

The letter in the word team stands for
together everyone achieves more—John Lounsbury

The purpose of this thought piece is to offer a theoretical argument that supports the relevance of incorporating an interdisciplinary approach to teaching. By virtue of its integrated and comparative format, interdisciplinarity presents the potential foundation for developing our eight intelligences, and the *MI Theory* provides an effective instructional framework for structuring interdisciplinary lessons. Another type of contemporary methodology that supports this marriage of the intelligences and interdisciplinary education in its effort to develop critical thought is cooperative learning.

The variable expression in the title of this paper represents a blend of these conceptual frameworks and their potential for facilitating math engagement in adolescents. My discussion focuses on the following conceptual frameworks: Gardner's *Multiple Intelligences Theory* (1983, 1991, 1993b, 1993c, 1997) as it relates to the multidisciplinary model of teaching, and the Community of Inquiry model (Splitter &

Sharp, 1995) as it relates to cooperative learning and Vygotsky's *Zone of Proximal Development (ZPD)* in small group settings (1988).

As a seasoned secondary mathematics teacher in an urban high school, I have become increasingly interested in teaching to the individual intelligences (or individual strengths) of my math students via interdisciplinary lesson formats and special student-designed projects. From my personal observation over the last 23 years, I have found that adolescents became more engaged with the mathematical subject matter when it was related (or connected) to other disciplines or areas of individual student interest. Moreover, their learning appeared to become more meaningful to them when they were able to discuss problem-solving connections and relationships in a social environment (or small group setting). This observation has prompted me to research the theory behind the practice and entertain a potential formula for strengthening math engagement. From this perspective I elected to share some theoretical insight with the education community as well as to the field of math educators.

Math Engagement

Often secondary math teachers are faced with the frustration of reaching students who choose *not* to engage or to only *passively* engage in math class activities and discussion. For the purposes of this theoretical piece, *active* engagement will refer to the student having *to do something* to contribute to the lesson other than listening and taking notes. *Passive* engagement will refer to the act of following directions, note taking, and listening, without *doing* or initiating any extra task (Greenwood, Delquadri, & Hall, 1984). In this sense, I hope to provide some pedagogical context whereby educators can enable situations for students to reinvent the learning process. Students can relate disciplines relevant to their own subject matter interests, and discuss these connections in small groups. In this context students can become actively engaged in the process, as they choose to relate topics of individual interest to mathematical concepts, in communal discourse with their peers.

Three Conceptual Models

MI Theory

Gardner's theory of multiple intelligences, an idea that originally appeared in his seminal piece, *Frames of Mind* in 1983, was inspired by his work with brain-damaged veterans at Boston's Veteran Medical Center and with developing minds of children through his work at Project Zero at Harvard's Graduate School of Education. As his doctoral education was drawing to a close, he "first encountered the neurological research of Norman Gerschwind," and was "fascinated by Gerschwind's discussion of what happens to once normal or gifted individuals who have had the misfortune of suffering from a stroke or some other form of brain damage." He pointed out that "often the symptoms run counter to intuition: for example, a patient who is alexia but not graphic loses the ability to read words but can still read numbers, name objects, and write normally (Gardner, 2003)." Since these intelligences work together, developing one may affect another. Since his studies in 1993, he added an eighth intelligence (the existentialist), and most recently a ninth intelligence, known as and naturalist intelligences, described as the ability to recognize and classify plants, mineral, and animals including rocks, grass, and all variety of flora and fauna (Checkley, 1997). See Figure 1.1 for a complete list and brief description all of Gardner's Multiple Intelligences.

Figure 1.1 Gardner's Multiple Intelligences *(Checkley, 1997)*

Linguistic	The capacity to use language, and determine meanings, sounds and rhythms
Logical-Mathematical	The capacity to understand cause and effect, and manipulating numbers, quantities and operations.
Spatial	The capacity to represent the spatial world internally in one's mind.
Bodily-Kinesthetic	The capacity to control one's whole body or parts of the body well.
Musical	The capacity to produce and appreciate rhythm, pitch, and timbre; and appreciation of the forms of musical expressiveness.
Interpersonal	The capacity to work well with others
Intrapersonal	The capacity to understand oneself and one's own feelings
Existential	The capacity to understand in philosophical and theoretical terms
Naturalistic	The capacity to discriminate among plants, animals, rocks and the world around us.

Some secondary teachers have capitalized on their school's multiple intelligence directed programs by coordinating statewide interdisciplinary units. Gardner warns that although interdisciplinary education is a popular avenue for change, he reminds educators that they must first consider to continue instilling the knowledge of the disciplines, which he views as the more sophisticated knowledge, before thinking in interdisciplinary terms. Teachers are planning projects, lessons, assessments, and interdisciplinary curriculums around the multiple intelligences theory. Like intelligence, the adaptations exhibit variety (Campbell, 1997).

Figure 1.2 refers to a description of each of Gardner's original six intelligences and the symbols used to denote them. (The following representational chart of Gardner's original six intelligences (1983) have since become more sophisticated in their descriptions of what constitutes each intelligence). More research is needed to demonstrate the extent to which the transfer from one to another occurs.

Figure 1.2 The Original Seven Multiple Intelligence Symbols (Fogarty & Stoehr, 1995)

VISUAL/SPATIAL	Show Me!	Give me the big picture. Show me an overview. Let me see the idea.
LOGICAL/MATHEMATICAL	Why Bother!	What's the rationale? Why does this make sense? Why is this such a good idea?
VERBAL/LINGUISTIC	Who Says?	Who are the leading voices? What does the research say? Who are the proponents of this idea?
MUSICAL/RHYTHMIC	I Hear	I hear the input. I am internalizing the music, rhythm, beat of this idea. Its melody is in my head.
BODILY/KINESTHETIC	Just Do It!	How do I use it? How is it useful to me? Let's dig in and do it.
INTERPERSONAL/SOCIAL	Can We Talk?	Can we discuss the idea? What are the pros and cons? How can we evaluate this critically and fairly?
INTERPERSONAL/ INTROSPECTIVE	What's in it for Me?	How does this affect me? What is my connection to this idea? What will I get from this?

Gardner used what he learned to formulate a theory advocating seven ways of viewing the world. Rounding out the accepted and established verbal and mathematical intelligences Gardner hypothesized that human potential encompasses spatial, musical, and kinesthetic, as well as interpersonal and intrapersonal intelligences. His comprehensive view of intelligence further suggested that while seven intelligences are independent of one another, they *do work together* (Gardner, 1993a). Since these intelligences work together, developing one may affect another. That is to say, the spatial, musical, kinesthetic, and interpersonal intelligences, that become apparent in music-related, performance-related, and other extracurricular clubs involving peer relations may *work together* with the verbal and mathematical intelligences.

Literature pertaining to studies on *MI Theory*, (e.g. Bednar, Coughlin, Evans, & Sievers, 2002), revealed that students who have been taught in a manner which enabled them to demonstrate distinctive strengths and their individual intelligences, by incorporating various artistic, spatial, musical, linguistic, naturalistic, and other skills into their learning, found mathematical problem solving more interesting and meaningful. Teaching to the multiple intelligences showed an increase in motivation and achievement in mathematics.

Many voices from the field, including authors, strategists, and consultants, support the theories of Gardner (1983), (e.g. Armstrong, 1993; Bellanca, 1992a, 1992b; Chapman, 1993; O'Connor & Young, 1994; B. Campbell, 1994; L. Campbell, 1992; Lazear, 1991, 1994). The variety of ways in which students receive information and express themselves naturally lead to the concept of integrating curricula (Willis, 1991).

The Multidisciplinary Model

According to Smith and Karr-Kidwell (2000), the three most common forms of integration of subject matter are known as *multidisciplinary*, *transdisciplinary*, and *interdisciplinary*. An *interdisciplinary* method of teaching is a holistic approach that links all of the learned disciplines by emphasizing all its relationships and connections in order to construct a project. The *multidisciplinary* approach more specifically connects two or more disciplines, such as math and art or math, science, and history in a specify project. In the *transdisciplinary* approach, the content and the theme are the same, and there is no division between disciplines (e.g. How can knowledge of biology help us analyze the grave social problems in the area of "race" relations in the United States? Or how can knowledge in math help to balance the federal budget?). The *interdisciplinary* approach starts with the disciplines and connects them with each other, the overall theme, or the issues (e.g. What type of knowledge would be useful before building your own home in a new neighborhood? The necessary skills span many disciplines). Each of the integrated approaches uses issues, problems, or themes to organize content (Smith & Karr-Kidwell, 2000). The NCTM standards specifically suggest incorporating interdisciplinary lessons into the math curriculum. The standards specifically suggest that as "students' knowledge of mathematics...increase[s], the connections they make with other academic disciplines, ... give them greater mathematical power" (NCTM, 2000, p. 354). Instructional programs through grade 12 "should enable all students to: recognize and use connections among mathematical ideas; understand how mathematical ideas interconnect and build on one another to produce a coherent whole; and recognize and apply mathematics in contexts outside of mathematics (NCTM, 2000, p. 354)." Is it conceivable to think that the success rate of motivating our

students would be far greater when widening the scope of mathematics, than by narrowing the field of interest?

As the multidisciplinary model of teaching focuses on relating common themes through tasks indicative of other subject matter disciplines, (such as sketching is indicative of art class, or writing is indicative of English class); Gardner emphasizes allowing students to ponder a given theme through other windows, or points of entry (Gardner, 1993). By integrating unrelated subjects, like math and art, math and literature, math and music, or math and history, we are in effect tapping into multiple interests, and allowing expression of different intelligences (Bednar et al., 2002; Wicklem & Schell, 1995). It can be argued that educators can motivate more students by giving them the opportunity to express themselves in different ways (Gardner, 1983, 1993, 1999). Research has indicated that an interdisciplinary approach to teaching and learning is conducive to the development of critical thinking skills (Astin, 1993; Dressel & Mayhew, 1954; Tsui, 1999; Terenzini, Springer & Pascarella, 1995; and Winter, McClelland, & Stewart, 1981).

The New Jersey Department of Education developed statewide recommendations for educators, called *core content goals*, to help students make connections, and thereby become more interested and more engaged in classroom activity. Such contemporary initiatives specifically reflect goals that are geared toward ways of unobtrusively infusing and relating subjects throughout the curriculum. This effort was designed with the intention of capturing student interest and deepening their understanding of content relevance and application to life (NJDE, 2001). This theoretical construct for developing deeper learning focuses on the concepts of *variety and integration* of subject matter, as a basis for enriching the mathematical learning process. It can be argued that deeper and more reflective thinking and assimilation requires active engagement through interdisciplinary exposure. Miller (2001), in his comparative study of the genius minds of Einstein and Picasso eloquently stated,

> We wonder about the moment when everything comes together to produce incredible insights. How does this happen? How do thoughts emerge that go beyond the information at hand? Answering these questions demands a multidisciplinary mode of thinking and analysis that is becoming progressively more important as lines between disciplines become blurred (Miller, 2001, p. 8).

Current literature demonstrates this integrative process can be achieved through other unassuming methods in the educational spectrum. A recent quantitative case study by Schreiber (2002) concerned institutional factors influencing mathematical achievement and supported the theoretical concept that crossing disciplines had a positive influence on math outcomes. Goodlad, Grossman, and Wineburg (2000) reported on a qualitative case study conducted by a group of leading educators who examined the merit of the interdisciplinary curriculum movement that has gained widespread popularity in recent years. They posited that incorporating interdisciplinary curricula is a worthy concept needed to challenge the supremacy of separate subjects as a means of organizing the curriculum.

Cooperative Learning in a Community of Inquiry

Since the community of inquiry is a concept that can be shaped and modified to serve various educational purposes, I will describe it in terms of cooperative learning. The essence of the community of inquiry framework as it relates to *MI Theory* and interdisciplinarity lies in the interpersonal,

intrapersonal, and cooperative learning pieces by which it functions. According to Splitter and Sharp (1995),

> The basic components of cooperative learning include an emphasis on small group work in which individuals have clearly defined roles or tasks, and which overall responsibility for progress is shared among all of the members of the group. The benefits of cooperative learning are perceived to be academic, interpersonal, and intrapersonal. (p. 27)

Checkley (1997) defined Gardner's sixth and seventh intelligences as the capacity to work well with others (the interpersonal piece), as well as know and understand one's self and one's feelings (the intrapersonal piece). Both intelligences happen to be necessary components in the behavioral pedagogy for the community of inquiry model (Splitter & Sharp, 1995). I posit that cooperative process of any group discourse requires a degree of both interpersonal and intrapersonal intelligence to function effectively.

Splitter and Sharp (1995) continued to illustrate a linking between the cooperative process and interdisciplinarity when they noted " the community of inquiry constitutes an appropriate framework for teaching and learning across all subject areas and disciplines." (p. 26).

Many interdisciplinary frameworks have been modeled under the heading of curriculum integration, (e.g. Beane, 1993; Fogarty, 1993, Fogarty & Stoehr, 1995; Jacobs, 1990; Kovalik , 1993; Lounsbury, 1992;Vars, 1991). Lounsbury (1992) had intertwined the development of interdisciplinary instruction with teaming, while Fogarty designed ten curriculum integration models that directly corresponded to the seven multiple intelligences as first identified by Gardner (1983). The earlier Vygotskian theories (1988) contributed to the cooperative learning piece-- the key ingredient in the community of inquiry model. According to early Vygotskian thought, as adolescents work in small groups with their peers and the facilitation of an adult, students will reach a higher level of thinking and connection known as their *zone of proximal development* (ZPD). He used this phrase to distinguish between a child's actual intelligence and the level she would attain after appropriate forms of assistance. It is within this zone that students interact to develop deeper problem-solving abilities and sociocultural connections (Vygotsky, 1988).

Fogarty and Stoehr (1995) linked Gardner's multiple intelligences with curriculum integration, while Wahl (1999), a math teacher and math education graduate from the University of Maryland, connected the teaching of mathematics to the multiple intelligences and group learning. Several writers (e.g. Kennedy, 1997; Splitter & Sharp, 1995; Sharp, 1992, Vygotsky, 1988) entertained the idea of group discourse as an integral part of student learning and the development of critical thinkers. I hope to personally conduct empirical research on the combination of teaching math through the multiple intelligences via multidisciplinary projects and collaborative inquiry.

Critical Connections

Ironically in the course of the last year, Howard Gardner, one of the principal investigators for Project Zero, adopted a research project to investigate the nature of interdisciplinary curricula in secondary schools and higher education institutions in the arts and sciences. Project Zero is a research program based at Harvard Graduate School of Education in Cambridge, Massachusetts. Project Zero's

mission "is to understand and enhance learning, thinking, and creativity in the arts, as well as humanistic and scientific disciplines, at an individual and institutional level (http://pzweb.harvard.edu/ p. 2)."

By virtue of the fact that Gardner is well known for the *MI Theory*, it is conceivable that this recent project will investigate how the multiple intelligences are addressed through interdisciplinarity. I am hopeful that this project will provide background data for my own study of the interplay of these conceptual models discussed in this paper.

In an interview with Gardner (1997), he explained that "understanding is..." when "...students can take ideas they learn in school...and apply those [sic] appropriately in new situations (Checkley, 1997, p.17)." He claimed, "The theory of multiple intelligences, in and of itself, is not going to solve anything in our society, but linking the multiple intelligences with a curriculum focused on [this type of] understanding is an extremely powerful intellectual undertaking (Checkley, 1997, p.17)."

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