An Extended Literature Review:

The Effect of Multiple Intelligences on Elementary Student Performance

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Abstract

Multiple Intelligences (MI) curriculum has demonstrated increased student achievement including improved engagement and performance on standardized tests. MI-based instruction also improves student achievement in science. Many educators focus solely on delivering content standards instead of infusing their curriculum with pedagogy that engages students and deepens their understanding of complex concepts. The purpose of this literature review is to explore the effect of MI based curriculum on student achievement in core curriculum at the elementary school level.

The literature reveals several trends such as schools that have implemented MI have successfully increased student achievement in all areas of the core curriculum. The review of the literature addresses the following: (1) Increase in Student Achievement; (2) Multiple Intelligences and Science Education; and (3) MI as a Pedagogical Organizer and Framework for Structuring Curriculum.

The literature review is limited to elementary education. The literature discusses MI-based curriculum in Kindergarten through sixth grade classes with an emphasis on science. Future research should focus on investigating the relationship between MI-based curriculum and student achievement as well as providing specific examples of MI-based lessons. These lessons will help teachers implement MI into a variety of education environments. In conclusion, teachers should be educated in ways to infuse their curriculum with an MI framework to help create authentic learning experiences that will ultimately increase student performance and achievement.

Introduction

> ...good elementary science education can do much to provide a sound foundation for later learning, as well as helping students become comfortable with using science and scientific thinking in their daily lives, whether in a career or as consumers and citizens (Aschbacher & Pine, 2006, p. 308).

As an educator for National Audubon Society (NAS), whose science programs consist largely of inquiry-based learning, I discovered how to help children experience scientific concepts through their senses and become active participants in learning. During this time I implemented science curriculum that "sprang to life" through multi-facetted, hands-on learning activities filled with experiments, exploration, art, music, literature, movement, and dance among others. For example, instead of just lecturing about a frog's life cycle, children physically emulated the cycle with their bodies. Imagine children balled up on the floor representing a frog egg, lying on their bellies and wiggling their legs like a tadpole, and eventually hopping around the class as mature frogs. Children learned about a Maple tree by touching and feeling the bark, 'tasting' maple syrup, and scavenging around for enormous leaves. Second grade students learned about migration by mimicking bird behaviors. They 'collected' food and experienced some of the challenges birds endure (i.e. weather, predators, diminishing habitats, pollution, etc.). For two years I watched children, parents, and educators metamorphose into scientists and become enthralled with the natural world as they were able to discover and learn in new and exciting ways. Years later as I reflect on my teaching experiences

at National Audubon Society (NAS), I realize why our curriculum was so effective in generating excitement and enthusiasm: it was rooted in innovative education philosophies and pedagogy.

As an educator for NAS I recognized innovative teaching practices, but I did not have enough formal training in education to associate our curriculum with specific theories. However, once I began my credential program I started to connect practice and theory. I realized the curriculum we used at NAS was infused with well respected philosophies, practices, and pedagogy, including Inquiry learning, Constructivism, Differentiation, Scaffolding, Bloom's Taxonomy, Piaget's Cognitive profiles, Vygotsky's Zone of Proximal Development, and Howard Gardner's theory of Multiple Intelligences (MI) among others. I continued to make theoretical connections to my previous teaching experiences as I progressed through my graduate studies, but I found myself especially intrigued by Gardner's theory of MI and his work with Project Zero.

Statement of the Problem

The demands and challenges of delivering 'good science' education can be overwhelming. Since core elementary curriculum, including language arts, math, history, and science are content standards based, many educators focus solely on delivering state mandated content and fulfilling frameworks of standards instead of infusing their curriculum with pedagogy that engages students and deepens their understanding of complex concepts. "Efforts to cover too much material doom the achievement of understanding. We are most likely to enhance understanding if we probe deeply in a small number of topics" (Gardner, 2003, p.10).

Purpose

The purpose of this extended literature review is to identify the connection between MI based curriculum and student achievement. The literature addresses core curriculum in elementary grades Kindergarten through sixth grade with an emphasis on science.

Research Question

The literature review addresses the following questions: How does MI-based curriculum and instruction affect elementary student performance? How does MI-based instruction affect elementary student performance in science? Can MI serve as a framework for helping educators organize curriculum?

Theoretical Rationale

Gardner conceived the theory of MI in 1983, described in his work, *Frames of Mind*. Gardner's theory encourages a shift from the more traditional understanding of intelligence to a more holistic perspective that validates and fosters each and every part of a person's mind. Gardner (1983) suggests that people possess eight different intelligences: linguistic intelligence, musical intelligence, logical-mathematical intelligence, spatial intelligence, bodily-kinesthetic intelligence, interpersonal intelligence, intrapersonal intelligence, and naturalist intelligence. The table below provides a few examples of activities that correlate with each of Gardner's intelligences.

Smart	**Examples**
Linguistic	Reading, writing, foreign languages, storytelling, puns, rhymes, tongue twisters
Musical	Singing, humming, rapping, listening to music, playing an instrument
Logical-Mathematical	Estimating, remembering statistics, science, logic puzzles, strategy games
Spatial	Drawing, building, watching movies, playing video games, reading maps
Bodily-Kinesthetic	Playing sports, acting in skits/plays, building crafts or models, dancing
Intrapersonal	Watching people, making friends, helping others, conversing, volunteering
Interpersonal	Thinking deeply, setting goals, working on your own, understanding feelings
Naturalist	Gardening, caring for animals, camping, hiking, recycling, cooking

(Examples adapted from materials created by Armstrong 2000-2003).

Gardner (1983) suggests people are intelligent in many different ways and that society must recognize, validate, and nurture the varied human intelligence profile. MI is a powerful lens that completely transforms the traditional perspective of intelligence by

recognizing every person's talents and contributions and celebrating *all* the individuals who enrich our society: artists, architects, musicians, naturalists, designers, dancers, therapists, and entrepreneurs, among others (Armstrong, 2000).

Gardner never anticipated educators would become the primary audience of MI, nor did he realize the implications MI would have in the classroom (2004). Applied within the realm of education, MI is especially influential because it expands the "horizons of available teaching and learning tools beyond the conventional linguistic and logical methods used in most schools" (Whitaker, 2002, p. 13). MI provides a model that confirms every person's strengths and recognizes the talent and abilities of each learner. Gardner believes educators adopt MI to develop poised, informed, creative, dynamic, industrious students. He says:

> [Educators] use MI so that youngsters can become literate, master the ways of thinking of important disciplines, express themselves in various artistic symbol systems, understand the community and the broader world in which they live, and achieve a better understanding of themselves and an enhanced capacity to deal with others in civil and productive ways (Kornhaber, Fierros, & Veenema, 2004, Foreword xii).

Gardner's statement reflects a pertinent and powerful philosophy of education that encourages teachers to impart knowledge in a multifaceted manner and help children become insightful and constructive participants of society. Furthermore, Shore (2004) suggests, MI has united educators who need to provide educational experiences that are relevant to diverse learners. MI helps educators support every learner by celebrating the

kids who draw well, run fast, sing loud, socialize a lot, have a keen sense of self awareness, as well as those kids who just like collecting bugs (Whitaker, 2002).

Almost twenty years later, teachers continue to discuss MI and apply it in a variety of educational environments. Gardner is pleased with the sustainability of MI and is "flattered" that educators continue to apply and discuss MI (Gardner, 2004, p. 212). Educators across the world not only continue to discuss Gardner's theory, but have built entire learning communities using MI as the core philosophy.

MI in Action

In an educational environment, MI encourages instructors to create multi-facetted curriculum and engaging learning experiences. The following section provides a quick glimpse into two examples of MI-based science curriculum. These examples will connect the more abstract theoretical idea of MI with 'practical' classroom applications.

In an elementary unit on rain forests, MI-based instruction was delivered through a variety of learning experiences. Students at Westmark School in Encino California learned about rainforests by transforming their classroom into a rainforest. Students used wall decorations, music, sound effects, flora, and humidifiers to create a realistic setting where they could learn about the rainforest experientially (Wagmeister & Shifrin, 2000). Students were involved in other MI-based activities like searching through magazines for photos, navigating internet sites for information about rain forests, learning about rain forest bugs, insects, and arachnids from a visiting entomologist, learning about rain forest animals by meeting and touching a giant iguana and a Capuchin monkey, and participating in units taught by a high school student. The MI-based curriculum helped the students truly experience a rainforest by incorporating an array of intelligences,

educational mediums, and engaging activities. The students were immersed interesting and exciting activities guided by an entomologist and exposed to elements of real life including insects and animals. The MI-based rainforest unit was infused with real-world connections that literally made the information 'come-alive'.

At New City School in St. Louis, Missouri, first grade students engaged in a MI-based study of plants. Student were exposed to a variety of literature about plants including fiction books like *Miss Rumphius* and reference books about flowers, trees, and plants (Wallach & Callahan, 1994). Students wrote poetry and stories about plants, created flower patterns in math, utilized the scientific method, conducted experiments with plants, and gained "firsthand experience with germination, plant growth, pollination, and seed formation" (p. 32). The students visited a Botanical garden, met a local landscape architect, and created an incredible plant museum where visitors could learn about plants through a variety of intelligences.

Like the rainforest unit, the plant unit engaged students through interesting, practical, and useful learning activities and helped the students internalize information to help them understand pertinent science content and the real world. These two examples demonstrate how MI can be used to create powerful, engaging curriculum and educational experiences. Additionally, MI helps educators teach 'holistically' by presenting content through a variety of activities and modalities.

Assumptions

Initially I was attracted to MI because it clearly complimented other education philosophies. As a new teacher I new MI would help me organize curriculum in a clear and concise manner that would engage students' unique interests and abilities. MI-based

curriculum paralleled much of my previous teaching experiences and supported many of the 'tricks and trades' I used as an educator for National Audubon Society to make learning exhilarating and engaging. Furthermore, I recognized that MI reinforced good teaching strategies like thematic-units, project based curriculum, centers, inquiry-based and hands-on learning, as well as other progressive philosophies. As I continued to research MI, I was astounded by its practical application to the classroom and the positive outcomes it yielded such as a marked increase in student achievement.

Background and Need

The natural application of MI to the field of education has entirely revolutionized learning in many schools. MI removes the focus from the more traditional emphasis on linguistic and mathematical intelligences, and encourages teachers and students to nurture and develop each of the eight intelligences (Gardner, 1999). Research suggests that MI fosters "marked changes in curriculum, assessment and pedagogy" (Kornhaber, Fierros, & Veenema, 2004, p. 70). In an attempt to investigate these 'marked changes' and explore the benefits of using MI, Project Zero conducted a research investigation.

Project Zero is Howard Gardner's research group out of Harvard's Graduate School of Education. In an investigation that aimed to "identify, document, and disseminate practices that are employed in schools that link MI with benefits for students", the **S**chools **U**sing **M**ultiple **I**ntelligence **T**heory (SUMIT) was created by Project Zero investigators and funded by the Schwab Foundation for Learning and the Geraldine R. Dodge Foundation (Kornhaber, Fierros, & Veenema, 2004, p. 11). SUMIT conducted a three-and-a-half year study during which time they collected data from 41 diverse schools from 18 different states. 61 percent of the schools were elementary

schools and all of the schools had been using MI for three or more years. Research data was collected through telephone interviews, school visits, classroom observations, in-depth conversations with teachers and administrators, and student interviews. Student and teacher work was also gathered and analyzed.

Once analyzed, the project data was organized according to four different outcomes: (1) test scores, (2) schooling of students with learning disabilities, (3) student discipline, and (4) parent participation. The data revealed the following improvements:

- Almost 80 percent of the schools reported improvements in standardized test scores.
- Almost 80 percent of school reported improvements for students with learning disabilities that included improved learning, motivation, and effort or social adjustment.
- More than 80 percent of the school reported improvements in student discipline.
- 80 percent of the schools reported improvement in parent participation.

(Kornhaber, Fierros, & Veenema, 2004, p. 12-16).

One teacher associated improved student achievement with variety in learning. She said: "I think children have more opportunities to achieve...because they have different modalities and different ways to express themselves" (p. 72). In the classroom MI provided diverse learning experiences. As a result, learners connected to content through a variety of activities and developed new knowledge through many intelligences. Other positive changes were reported including a new joy and excitement for learning as well as "classrooms of student who were eagerly and actively engaged" (p. 73).

The next phase of the research investigation involved the dissemination of MI practices employed by the participating schools. *Multiple Intelligences: Best Ideas from Research and Practice* was developed and written by Project Zero investigators and published in 2004. The book targets K-8 educators and is the only publication that outlines clear and concise examples of MI-based instruction. Furthermore, the book "…presents a powerful, research-driven description of effective practices involving MI" (Foreword xiv). The research-driven descriptions and persuasive data documenting marked increase in student achievement are powerful examples of effective MI-based curriculum.

Review of the Literature

A large body of research has been published on MI in the last twenty years. When I searched well-known databases like ERIC and WilsonSelect, I was bombarded with thousands upon thousands of published works. Therefore I narrowed the scope of my research to elementary education, which included Kindergarten through sixth grade. Within this narrowed search domain, I discovered a manageable collection of literature that revealed many positive implications between MI and elementary student achievement. The literature is divided into several sub-categories:

(1) Practical Education Consequences - Increase in Student Achievement

(2) Increase of On-Task Behavior

(3) Challenges in Teaching Elementary Science

(4) Multiple Intelligences & Science - Useful Applications and Positive Results

(5) MI as a Pedagogical Organizer and Framework for Structuring Curriculum

The following pages document and discuss the literature at is pertains to these five sub-categories.

Practical Education Consequences - Increase in Student Achievement

In the context of education and student achievement, MI is especially powerful because it helps parents and teachers understand education holistically. Gardner (1994) says MI persuades parents and teachers to examine their own ideas and assumptions about achievement and consider various teaching approaches. This suggestion provides a powerful lens to analyze MI in the context of elementary student performance.

Several studies (Campbell & Campbell, 1999; Kornhaber, Fierros, & Veenema, 2004), suggest MI-based instruction increases student achievement. The following research indicates a number of positive outcomes including increased student confidence, intrinsic motivation, engagement, and performance on standardized tests.

Greenhawk (1997) discusses the implementation of MI at White Marsh Elementary School in Maryland. The application of MI increased student performance on standardized tests and produced a "school-wide culture of achievement" (p. 62). Over a period of five years, Greenhawk and her colleagues collected data that revealed MI-based curriculum helped students understand their abilities as learners, build confidence, take educational risks, and retain more knowledge. MI helped educators initiate 'unforgettable learning' experiences and assess student knowledge more accurately. Greenhawk postulates that MI transformed her school's learning community and helped the teachers and students strive toward excellence by valuing "excellence, diversity and achievement" (p. 64).

Hickey (2004) reports increased student achievement in history, geography, literature and music. MI-based units were developed and implemented in various classrooms by teachers enrolled in a multiple intelligences graduate course. The five case studies revealed an increase in student engagement and participation among others. In a music unit, students were more actively engaged, remembered information for longer periods of time, and utilized higher level thinking skills to make connections between different musical eras and artists. The teacher said the increased student learning and achievement was impressive. Another teacher reported that MI-based history curriculum encouraged students to remain on task, while another teacher said the history curriculum

motivated students to "take ownership of their learning" and produce better quality work (p. 85). The five case studies provide clear examples of student success attributed to MI-based instruction.

When students are offered a variety of learning experiences they become actively engaged and invested in their individual learning process. Furthermore, students will participate more frequently and retain more knowledge because they understand the material in a more complex way (Emig, 1997). Teele (1996) parallels this idea saying: "intrinsic motivation, positive self-image, and a sense of responsibility develop when student become stakeholders in the educational process and accept responsibility for their own actions" (p. 72). When students understand and apply their personal intelligences, they become more connected to their learning and invested in their educational experiences.

Increase of On-Task Behavior

MI-based instructional planning addresses the needs of a variety of learners. When the unique intellectual profile of each student is incorporated and validated in the educational environment, student engagement increases. Increased student engagement leads to improved student participation and less discipline problems. Kornhaber (2004) suggests that student discipline is directly linked to student engagement. If students are interested in learning, actively participate "academically and socially" then "fewer students will get into trouble" (p. 72). Highland, McNally, and Peart (1999) document a study examining MI and improved student behavior and participation. Students in pre-kindergarten, Kindergarten, and first grade, who exhibited misbehaviors such as talking out, distracting others, and not participating, were involved in an intervention that

involved sixteen MI-based lessons. Research data included three-months of classroom observations, anecdotal records, progress reports, and report cards. The data revealed that 77 percent of the students showed an improvement in their behavior including taking turns talking, keeping hands to themselves, staying on task, not daydreaming and wandering around the class, sharing, helping others, being respectful to peers, and an increased interest and participation in classroom activities.

New City School students experienced academic and social benefits such as those mentioned above after infusing their curriculum and teaching practices with MI. Hoerr (1994) head of New City School in St. Louis Missouri, experienced a "professional epiphany" that resulted in a "full-scale implementation of multiple intelligences theory" in his school" (Lockwood, 1993, p. 10). Although Hoerr and his faculty always modified curriculum based on their students' needs, MI helped the school alter and change their pedagogy to help more students learn. Hoerr (2004) suggests MI-based curriculum helps students solve practical 'real-life' problems, perform high on standardized tests, and strive toward excellence. New City School graduates enjoy learning, are leaders in their community, and seek extra rigorous coursework. New City School is recognized worldwide as a 'model school' and welcomes 700 visiting educators every year.

MI has the potential to empower students to become motivated, successful learners. There are many positive manifestations of MI-based curriculum including improved behavior, increased student confidence, intrinsic motivation, engagement, and performance on standardized tests. As Barrington (2004) suggests, encouraging students to use their multiple intelligences, helps create "personal meaning" and enhances learning and achievement.

Challenges in Teaching Elementary Science

According to Encyclopedia Britannica (2007), science in general entails a quest of knowledge in regard to "general truths" and "fundamental laws". Children, fueled by their innate curiosity about the world, are natural scientists. They 'quest for knowledge', constantly collect information about reality and 'test' their environment. Lind (1998) suggests children gain essential ideas and beliefs about their environment through active involvement. As children explore their surroundings, they actively create and build their own knowledge and develop an understanding of 'how' the world works. Children constantly modify and adjust their perceptions of the world. Some of the information children collect is correct and some is not. Dalton, Morocco, Tivnan, & Mead, (1997) suggest children formulate ideas about the natural world that are often different from scientific conceptions. As a result, many students enter the classroom with preconceived ideas (Bybee, 2007). Students come to school with both accurate prior knowledge about scientific concepts and certain misconceptions. Therefore, teachers possess a fundamental role in helping children refine and adapt their scientific understanding. Educators "play a critical role in fostering children's alternative conceptions and providing opportunities for them to compare their prior knowledge and beliefs with conflicting evidence and to reconstruct their understanding over time" (Dalton, Morocco, Tivnan, & Mead, 1997, p. 672).

As teachers help students become scientifically literate, they must strive to create an inclusive classroom and make scientific content accessible to *every* learner. Educational equity is an atmosphere where students have plenty of options and can make choices according to their abilities and talents (Hackett, Moyer, Vasquez, Terefi, Zike, & LeRoy,

2007). A survey conducted by the National Science Teachers Association (NSTA), revealed the top two barriers in student achievement in science were: (1) students are not taught enough science at the early grades; and (2) lack of classroom time dedicated to science instruction (science.nsta.org, 2006). Despite these barriers and challenges, educators must find avenues to make science instruction and content accessible to *every* learner. Gardner's (1983) MI is an especially powerful model in helping educators create authentic learning experiences for students as well as increase student achievement, participation, and nurture various learning styles.

Multiple Intelligences & Science - Useful Applications and Positive Results

MI is an innovative and inclusive way to explore scientific content in accordance with State Standards and Frameworks. Multiple Intelligence-based instruction helps educators engage students through their natural curiosity, monopolize on teachable moments, and increase student participation through their own excitement.

Dias-Ward and Dias (2004) summarize a Kindergarten MI-based thematic unit on ladybugs. Aside from allowing the students to explore, investigate, touch, hold, and observe the ladybugs, the cross-curricular learning experience addressed a variety of unique learning preferences. The authors provide a quick 'glimpse' into the ladybug unit and provide pragmatic and simple applications of each intelligence. Dias-Ward and Dias suggest that "designing experiences in which children explore, gather evidence, and formulate explanations is teaching science as inquiry" (p. 44). Ramey-Gassert argues that "hands-on, engaging investigations using simple materials", like the MI-based ladybug unit, is the way "students learn best" (1997, p.433).

Ozdemir, Guneysu, and Tekkaya (2006), summarize a quantitative research project developed to investigate the difference between traditional, that is, direct-instruction facilitated by a teacher, and MI science instruction on fourth grade students' understanding in science. The authors suggest that MI serves as a "framework" that helps teachers "make decisions about ways to structure teaching and learning experiences for students" (p. 74). Ozdemir, Guneysu, and Tekkaya (2006), include a graphic and numerical summary of the project results including significantly greater student achievement and knowledge retention. The authors suggest MI is especially powerful in an educational setting because it helped "a significant number of educators question their work and encourage them to look beyond the narrow confines of the dominant discourses of skilling, curriculum, and testing and assessment" (p. 77).

Goodnough (2001b) parallels the idea that MI is useful in structuring science education and believes that MI-based instruction provides "meaningful, personalized, and relevant" curriculum (p. 180). An MI-based action-research project that aimed to present meaningful and engaging science curriculum was conducted. The study also explored the value of MI as a pedagogical framework in the context of science education. Several data collection methods were used including, interviews, observation, group action-research meetings, and journal writing. The data revealed high levels of student engagement and an increased dedication to work. The teacher noted overall that students exhibited higher levels of participation during science and enjoyed the MI-based activities more than past science curriculum. The MI-based curriculum promoted student-centered learning and acknowledged and supported each student's unique cognitive profile. Many positive results manifested as a result of the MI-based curriculum including: an enhanced

conceptual understanding in science, positive attitudes toward science, increased enjoyment and participation, and authentic learning experiences. Furthermore, MI helped students connect to scientific concepts in a broader context. Goodnough states: "if students become engaged in the learning of science and develop positive attitudes toward science, there is a greater probability that they will develop high levels of scientific literacy" (2001b, p. 188).

MI-based science instruction challenges students to develop meaningful understandings of the world around them and create connections between their lives and interests. Furthermore, MI helps educators foster and cater to students' individual learning needs and preferences and links the classroom with the broader community. Most importantly, MI-based instruction is a *holistic* and inclusive instructional model that helps educators create cross-curricular links and integrate different learning styles and abilities.

MI as a Pedagogical Organizer and Framework for Structuring Curriculum

Educators must acknowledge differences in the way students learn to develop their unique capabilities (Eisner, 2004). Recognizing student differences has specific "implications for curriculum" because students should be given opportunities to experience learning that address a variety of intelligences. MI cultivates each student's unique abilities and talents by encouraging educators to respect differences among people and the way they learn (Armstrong, 2000). MI supports educators in this feat by providing a structure for organizing curriculum.

In their research with MI as an instructional organizer, Ucak, Bag, and Usak, (2006) discovered MI provided "educators with a conceptual framework for organizing

and reflecting on curriculum, assessment, and pedagogical practice" (p. 62). Kornhaber (2004) parallels this idea in her extended research with MI, which includes Project Zero and Schools Using Multiple Intelligence Theory (SUMIT). She suggests educators are attracted to MI theory because it compliments existing educational philosophies and provides an organizational framework for curriculum.

Hoerr (1992) and his colleagues at New City School used MI as a catalyst for reflection, discussion, and change. They completely revamped the school curriculum and implemented the MI 'model' in 1990. MI helped the faculty focus on new priorities and reaffirmed their belief that each child has special abilities and talents. Within a few years, MI permeated each and every class at New City School and reinforced the schools' principles of student diversity and affective and experiential learning (Hoerr, 1994). Hoerr believes MI is "a philosophy about education with implications for how kids learn, teachers should teach, and how schools should operate" (p. 29). Hoerr and his colleagues used MI to successfully modify instructional planning, conferences, parent communication, and assessment. Most importantly, they used MI as a foundation to guide educators to "capture all of a child's intelligences" and helped more kids succeed (p. 30).

Like Hoerr, Goodnough (2001a) believes that MI helps educators individualize instruction by incorporating student individuality. Goodnough documented the integration of MI-based instruction into an elementary classroom. MI was used an instructional organizer and provided a framework for curricular adjustments. MI helped the teacher make positive "pedagogical decisions". Furthermore, Goodnough believes MI encourages educators to change their perspective and understand student ability in a

more comprehensive and thorough fashion. This holistic perspective of teaching and learning "provides a lens for guiding teaching decision-making" (p. 232).

MI is a powerful and relevant pedagogical organizer. Goodnough details the integration of MI into an elementary classroom while Hoerr articulates the continued evolution of MI-based instruction and the powerful philosophies behind New City School. Goodnough (2001a) postulates that as a pedagogical organizer, MI helps educators consider and reflect on their curriculum and teaching styles as well as their beliefs about learners. MI also helps educators structure engaging learning experiences that are accessible to every learner. Additionally, MI can promote positive teacher learning that transforms into improved student learning. MI helps teachers reorganize teaching and increase opportunities for to students to participate in learning (Sheppard, 2004).

Summary of Major Themes

Knowledge and the practical application of learning are much more valuable than fact recall and knowing a lot of information. MI-based curriculum engages students deeply in their education and increases student achievement because learning is embedded in innovative, practical, flexible, experiences that connect to the real world. MI helps students gain a three-dimensional understanding and familiarity with content that helps them apply their learning in a variety of contexts and situations.

The literature reveals a relationship between MI-based curriculum and increased student achievement in core curriculum including an increase in standardized test scores and increased student participation and engagement. In science education, MI-based curriculum helps students build fundamental understanding of science concepts. MI

helps educators teach in a way that helps students question, explore, reason, collaborate, and communicate their knowledge rather than just follow directions and memorize an existing body of information. MI helps educators make content accessible to every learner and enable students to make connections, build their own theories, and explore content in a variety of ways. This approach is particularly well suited to meet the needs of all learners. Most importantly, MI helps educators move beyond a 'superficial' teaching of science concepts and helps design academic instruction so that each student has the opportunity to master science standards and obtain practical three-dimensional knowledge.

The literature also reveals MI is a useful philosophy and practical framework for structuring curriculum and learning experiences according to each student's needs. Educators worldwide have experienced unmeasured success by infusing their pedagogy with MI. As world populations continue to diversify, MI provides a framework that helps educators offer ways to expand opportunities for students to successfully participate in learning. As educators, our duty is to cultivate differences and variety in learning to create a more diverse world.

Limitations/Gaps in the Literature

Originally my research focused on MI and student performance in science education. As an educator for National Audubon Society (NAS), I immediately identified parallels and connections between inquiry-based science instruction and MI-based curriculum. Naively, I assumed I would discover a large body of research identifying positive implications for student achievement and MI-based science instruction. I was wrong. I did not identify much research on MI and elementary science education in my

review of professional journals and literature. Another limitation in the literature is a lack of curriculum. In my review I was unable to find practical 'day-to-day' lesson plans or detailed instructions of actual MI-based curriculum for the elementary classroom. As educators continue to apply MI in a variety of educational environments, specific examples of effective MI-based curriculum are needed to help guide the integration of the MI-model.

Implications for Future Research

> At present, the notion of schools devoted to multiple intelligences is still in its infancy, and there are as many plausible recipes as there are educational chefs. I hope that in the next twenty years, a number of efforts will be made to craft an education that takes multiple intelligences seriously…(Gardner, 1993, p. 250).

Although previous research investigations provide some insight into the relationship between MI-based curriculum and increased student achievement, there is a need for continued research and application of MI. Additionally, there is limited research on MI-based science instruction and student achievement. Further experimentation and treatments should be conducted in order to expose the benefits of MI-based science education. Gardner (2004) hopes educators and institutions will continue to explore the implications of MI. Finally, educational institutions and teachers preparation courses should offer professional development courses addressing the positive implications between MI-based curriculum and student achievement and how MI-based curriculum can be integrated in elementary education. As Ozdemir, Guneysu, and Tekkaya (2006), suggest:

"teachers need to broaden their instructional and assessment repertoires to include strategies drawing on a wider variety of intelligence types" (p. 77).

Overall Significance of the Literature

The literature indicates that MI-based instruction yields positive implications for student achievement including increased performance on standardized tests, and increased intrinsic motivation, engagement, and confidence. MI is also a powerful pedagogical organizer that helps structure learning according to the needs of students. Educators on a global level should be exposed to literature documenting the incredible affects of MI and inspired to utilize this innovative instruction in their classrooms. Furthermore, teachers should be educated in ways to infuse their curriculum with a multiple intelligence framework to help create more authentic, engaging learning experiences for students.

Reflection

As educators we must honor student differences and acknowledge a variety in excellence. I believe MI provides a powerful framework in helping educators create authentic and innovative learning experiences. MI provides a scope to validate and monopolize on the strengths of each individual student. Although MI is not a step-by-step recipe for success, it provides a powerful and pragmatic structure for designing curriculum. Furthermore, MI enables educators to address the needs of each student on an individual basis and make content and curriculum exciting and accessible to every learner. As our students continue to change and diversify, we must persevere and continue to find new ways to engage and support a variety of learners.

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