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Multiple Intelligences Represented in Fourth Grade Curriculum*

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Abstract

In this study, the 4th grade Texas Everyday Mathematics teacher guide (2a) curriculum was focused on to investigate how many multiple intelligences were represented in the 4th grade curriculum. Six intelligence were the focus: visual-spatial intelligence, bodily-kinesthetic intelligence, musical intelligence, interpersonal intelligence, intrapersonal intelligence, and naturalist intelligence. Verbal-linguistic, mathematics-logical, and existential intelligences were not the focus. To investigate the 4th grade teacher's guide Texas Everyday Mathematics curriculum Multiple Intelligences Theory checklist (created by the researcher) and Multiple Intelligences Theory chart (created by the researcher based on literature) were used. The researcher read the entire lesson, sentence by sentence, and coded any occurrence of multiple intelligences within each section heading. For each sentence, the researcher considered whether multiple intelligences were present, and, if present, the researcher used the curriculum Multiple Intelligences Theory reference chart to identify the type of multiple intelligences. To check the reliability of this study, two experts, - other than the researcher, assessed the presence and category of multiple intelligences in the curriculum. All coding questions were discussed between researcher and raters until reaching consensus. According to the findings, visual-spatial, bodily-kinesthetic, interpersonal and intrapersonal intelligences were represented in the Texas Everyday Mathematics fractions unit which is a good example of represented Multiple Intelligences Theory activities.

Keywords

Multiple Intelligences, fourth grade, curriculum, elementary education, fractions, textbooks

Mathematics is one of the main content areas from elementary to higher education in many countries (Isik & Tarim, 2009; Yildirim, 2006). Goals of mathematics education for students include thinking logically, becoming mathematical problem solvers, communicating mathematically, using logical reasoning to make their lives meaningful,

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and understanding spatial relationships (Texas Education Agency-TEA, 2008). According to the National Council of Teachers of Mathematics (NCTM) (2000), if students do not have problem-solving skills, they can not apply mathematics to real-life situations. Consequently, “the aim of mathematics must be solving to learn, not learning to solve” (Koroglu & Yesildere, 2004, p. 26). This means that students should have problem solving-skills and students must be problem solvers and thinkers. Unfortunately, mathematics can be problematic for students, and many students fail in mathematics (Isik & Tarim, 2009).

There are many reasons why children do not succeed in maths. One of the most important reasons is that students do not understand the nature of mathematics (Koroglu & Yesildere, 2004). If students cannot discover the nature and beauty of mathematics and stimulate students’ curiosity about it, mathematics education may not be realized. Koroglu and Yesildere (2004) also suggest that to create a joyful classroom environment for students, teachers should make students a part of mathematics.

Researchers point out that learning of fractions is problematic for 4th grade students because they do not understand fractions well (Cramer, Post, & delMas, 2002) and, teaching fractions could be difficult for teachers (Cramer, Post, & delMas, 2002; Watanabe, 2001). Research highlights some reasons why students have problems learning about fractions (Cramer & Wyberg, 2009). Cramer, Post and delMas (2002) states that teaching practices which stress rules and meanings of fractions is one of the areas students have difficulties with. Also the other issue is that “traditionally mathematics instruction in grade 4 devotes little time to developing an understanding of the meaning of fractions beyond simple part-whole shading tasks” (Cramer, Post, & delMas, 2002, p. 112). Generally, students do not have enough time to apply their solutions and answers to the questions, and they have limited time to compare different models for learning fractions (Cramer, Post, & delMas, 2002). Another issue is that students do not have any experiences applying mathematics to the workplace. The NCTM (2009) suggests that students should apply mathematicial concepts in real life, as well as in other disciplines. The other problem is the use of traditional methods to teach mathematics. Traditional methods of teaching focus on memorization. Memorizing rules, teaching by telling, and rote memorization must be reduced because they may not be an effective approach to teaching mathematics concepts (Steen, 1989). Memorizing lessens some students’ interest in mathematics, so their attitudes reflect poor achievement in the subject (Bednar, Coughlin, Evans, & Sievers, 2002). The traditional teaching approaches should be modified and enhanced (Isik & Tarim, 2009).

According to the international exams such as Trends in International Mathematics and Science Study (TIMSS) in 2007, students’ scores in the United States are not satisfying; indicating that in general, U.S. students’ achievement is behind the average of some other countries (Wahl, 2009). Fourth grade American students’ scores are ranked 8th out of 36 countries in 2007 (Wahl, 2009) and 14th out of 57 countries in 2015. Moreover, another international study, The Programme for International Student Assessment (PISA), indicates that U.S. students’ maths scores are 40th out of 72 participating countries and economies (2015). According to the National Center for Education Statistics (2018), 4th grade students achievement scores for the public school in Texas are 244 out of 500 in 2015 and 241 out of 500 in 2017. The average of states scores is 239 in 2017 and 240 in 2015 in the United State which means Texas is barely above average.

Some elementary teachers follow the prepared curricula in mathematics, and curricula tell them what to do, how to do, and when to do in the classroom, and these prepared curricula include everything for teachers to assist teachers with their instructional organization curriculum (Russell, 2007). According to NCTM (2009), a curriculum is not a just collection of activities. In addition to the fact that the importance of mathematics should be focused on, a curriculum must be complementary and organized well across the grades. Mathematics is the important key to finding jobs and preparing students for college in the twenty-first century as these jobs require understanding new ideas and overcoming unusual problems (Steen, 1989). This example shows why the mathematics curriculum is important. The aim of any curriculum should be to encourage students to become problem solvers and thinkers. Moreover, students do not know how to find information or how to become problem solvers instead of just memorizing (Buher, n.d.). Koroglu and Yesildere (2004) identified that the aim of mathematics should not be knowledge to solve, but instead solving to learn. The quality of a mathematics curriculum is one key factor in increasing student learning and achievement (Sood & Jitendra, 2007), and curriculum should focus on students' interests and abilities.

Each child has different learning capacities or styles. Mathematics is learned in a myriad of ways. While some people learn best by seeing, some remember best from words, and others learn best by doing with their hands (Munro, 1994). Sarmusk (2010) points out that learning must be individualized, much like fingerprints. Every student has different intelligences and different learning styles that need to be capitalized on by instructors. Also, teachers should give students the opportunity to discover and reach their full potential. Isik and Tarim (2009) identifies that the traditional teaching approach is the reason why students fail in mathematics. Currently, most teachers use traditional teacher oriented methods to teach mathematics, which makes students bored during lectures (Isik & Tarim, 2009). To improve both students' and teachers' knowledge about mathematics has become a significant component in the general education curriculum.

Multiple Intelligences Theory (MIT) is one theory for teaching. Teaching to all nine intelligences makes instruction and learning more meaningful to individual students (Bednar, Coughlin, Evans, & Sievers, 2002). The learning environment should be arranged based on MIT, and that "will provide the opportunity for the students to discover themselves and their potential" (Isik & Tarim, 2009, p. 466). MIT is not just a theory, but a philosophy of education that shows teachers how to teach while showing students how to learn (Temur, 2007). In two recent studies, researchers found that after MIT in mathematics classrooms, students improve their problem-solving skills and are eager to learn mathematics (Koroglu & Yesildere, 2004; Temur, 2007). They easily remember what they were taught and apply mathematics to real life (Temur, 2007). Therefore, learning mathematics becomes more important to the students.

Literature Review

Generally, intelligence can be explained as the abilities of "reasoning, decision making and self-criticism" (Temur, 2007, p. 86). Intelligence is also defined as the capacity to respond completely in terms of reality or phenomena (Temur, 2007). More narrowly, Gardner (1999) identifies intelligence as a kind of characteristic and individual difference. Gardner (1983) suggests that students have different learning styles and intelligences. Intelligence can further be identified by Gardner as "the ability to solve problems that one encounters in real life, the ability to generate new problems to solve, [and] the ability to make something or offer a service that is valued within one`s culture" (as cited in Dickinson, Campbell, & Campbell, 1996, p. xv). Not all students have the same intelligences, ability, and interests (Campbell, Campbell, & Dickinson, 1996). The basic knowledge such as "language arts, mathematics, history, and science" is not taught in the same way for children and all students must learn this basic knowledge (Campbell et al., 1996; p. xxi).

MIT is developed by Gardner (1983). Gardner conceives nine different intelligences: verbal-linguistic, logical-mathematics, visual-spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, naturalist, and existential. Traditional teaching methods focus on verbal-linguistic and mathematical-logical intelligences (Gardner, 1999). Gardner theory suggests that we should attend to all intelligences. The MIT suggests that teachers should be trained to use music, cooperative learning, art activities, role play, and field trips.

Gardner (1983) creates an original list of seven intelligences in his book, Frames of Mind. Logical-mathematical and verbal-linguistic intelligences are very common in schools; musical, visual-spatial, and bodily-kinesthetic intelligences are usually related with the arts; and interpersonal and intrapersonal intelligences are called personal intelligences (Gardner 1999). These seven intelligences are the original set of intelligences. Sarmusak (2010) gives information about the 8th naturalist intelligence which was added to the list by Gardner in Intelligence Reframe in 1999. Sarmusak (2010) points out existential intelligence, which is a possibility ninth intelligence, and Gardner is still researching on this intelligence. Existential intelligence is that “capacity has been valued in every known human culture” (Gardner, 1999, p. 61). Existential intelligence is the capacity for understanding human being and existence. People who have this intelligence explore the meaning of death, the meaning of life, or how people existed in the past. The more generally accepted eight intelligences are described as:

Verbal-Linguistic (Word Smart) is about language skills such as speaking, writing, and listening. This intelligence is concerned with the capacity to learn languages and the ability to use language to achieve certain goals (Smith, 2002, 2008).

Logical-mathematical intelligence involves logical thinking, problem-solving, deductive and inductive reasoning, and awareness patterns relationship. People who have logical-mathematical intelligence are good at reason and logic. Gardner suggests that mathematics, science, and logic are incorporated by this intelligence. Using mental abilities to organize bodily activities is utilizing Bodily-Kinesthetic (Body Smart).

Visual-spatial intelligence is the capacity to bring a spatial world into a person`s mind (Baum, Viens, & Slatin, 2005). Furthermore, spatial intelligence is the ability to recognize visual patterns (Gardner, 1983). There are people who think in three-dimensional ways.

Bodily-kinesthetic intelligence is using mental abilities to organize bodily activitie. Gardner (1983) indicates that physical and mental activities are related to each other. Bodily-kinesthetic learners are good at physical skills.

Musical intelligence is the ability to understand in music. There are people who possess sensitivity to pitch, rhythm, and tone (Douglas, Burton, & Reese-Durham, 2008).

Interpersonal intelligence is the ability to maintain relationships, communicate with others, understand them, and assume roles within groups (Campbell, Campbell, & Dickinson, 1996).

Intrapersonal intelligence is the capacity to understand yourself (Baum, Viens, & Slatin, 2005). The learner is a self-reflective and self-directed learner. Intrapersonal intelligence refers to recognizing who you are, what you can do, and what you want.

Naturalist intelligence is a person's ability to recognize oneself as a member of a species. This intelligence is added later in Gardner's research process.

Whichever instruction method is chosen or skills that students have, instructors should recognize that all students have multiple dominant intelligences, and that children do not learn in the same way (Adams, 2000, 2001). According to McGraw Hill-Wright Group (n.d) good teaching is very similar to differentiated instruction. For individual students varying needs, experienced teachers use different teaching styles (McGraw Hill-Wright Group, n.d).

Before using MIT in the classroom, teachers must be trained on it because teachers should arrange classroom environments and lessons for students who have different intelligences and interests (Koroglu & Yesildere, 2004; Ulgen, 1997). According to Armstrong (2009), it is not possible that teaching strategies will fit all of the students at the same time. Some strategies should work with some students, and they should be less successfully for other students. Because of these differences, teachers should use different strategies in the classroom. For verbal-linguistic intelligence example activities include storytelling, brainstorming, tape recording, journal writing, textbook, lectures, and so on are examples of teaching strategies. Classifications, categorizations, calculations, quantifications, are some examples of teaching strategies for logical-mathematical intelligence. Visual-spatial intelligence activities include picture metaphors, color cues, and idea sketching (Armstrong, 2009). Bodily answers, classroom theater, and hands on thinking are some examples of teaching strategies for bodily-kinesthetic intelligence. Musical concepts, supermemory music, and discographies are examples of musical intelligence strategies. For interpersonal intelligence, some example activities are peer sharing, cooperative groups, and board games. Nature walks and pet in the classroom are some example activities of naturalistic intelligence. In addition, feeling toned moments and goal setting sessions are some example activities of intrapersonal intelligence.

If we arrange an effective learning environment for students, all of them can easily learn (Bednar, Coughlin, Evans, & Sievers, 2002). The classroom environment is as important as recognizing intelligences (Campbell et al., 1996). Recognizing students' intelligences is not only important to teach mathematics, but also creating classroom environment in which to learn for teaching is significant (Campbell et al., 1996).

Teachers may use traditional teaching methods, such as lecture and questions (Isik & Tarim, 2009). Furthermore they use just verbal-linguistic and logical-mathematical intelligences in the classroom (Gardner, 1999; Armstrong, 2009). This is one way to organize classroom, but it is not enough. Before organizing classroom environment, teachers may consider different intelligences needs. Nevertheless, MIT teachers may spend less time with lecture. They may apply verbal-linguist and logical-mathematics intelligences, and they should recognize the other intelligences. Teachers may combine verbal-linguistic to musical to visual-spatial to bodily-kinesthetic and so on in the classroom. In MI classroom, videos, pictures are showed, music is played, and pictures are drawn on the blackboard to. Moreover, MI teachers make cooperative groups to make students interactive. Furthermore, hands on activities are commonly used in MIT classroom.

Teaching mathematics through MIT is very effective (Koroglu & Yesildere, 2004). According to Razmjoo (2008) after applying MIT in the classroom, students' learning is improved. Therefore, after changing the classroom environment to address MIT, students become more involved in class due to improved motivation. Applying MIT in class makes classrooms more students centered instead of teacher centered (Isik & Tarim, 2009). Literature and instruction should relate to real life, be personalized, engaging, interdisciplinary, and multiple intelligences based (Bednar, Coughlin, Evans, & Sievers, 2002). If students relate mathematics to real world situations, mathematics can become more meaningful for them (Koroglu & Yesildere, 2004). Also, while learning maths, they can easily learn different approaches from expose to learning activities in the other intelligences.

Research Question

This study investigates Multiple Intelligences Theory (MIT) in the fourth grade mathematics curriculum in the state of Texas. The study will address the following question: To what extent does 4th grade mathematics curriculum, more specifically its "Unit of Fractions and Their Uses; Change and Probability", incorporate MIT?

Methodology

Selection of curriculum

Everyday Mathematics (EM) was selected to explore how Gardner's Multiple Intelligences Approach are represented in fourth grade in the State of Texas. EM is a K-6 mathematics curriculum which is developed by the University of Chicago School Mathematics Project (UCSMP). Classroom teachers, researchers, mathematics educators, and administrators participated in developin EM which is a research-based curriculum (McGraw Hill-Wright Group, n.d). EM is aligned with National Council Teachers of Mathematics (NCTM) standards. Nearly 3 million students in 185,000 classrooms in the U.S. use EM (McGraw-Hill Companies, n.d). EM has been developed since 1980s, and the last edition (3rd edition) was published in 2006. The purpose of EM is to teach mathematics content for elementary students and to make them life-long mathematical thinkers (Bell et al., 2008a).

Table1
List of the lesson titles

Lessons Name in Fractions Unit
7-1 Review of Basic Fraction Concepts
7-2 Fractions of Sets
7-3 Probabilities When Outcomes are Equally Likely
7-4 Pattern- Block Fraction
7-5 Fraction Addition and Subtraction
7-6 Many Names for Fractions
7-7 Equivalent Fraction
7-8 Fraction and Decimals
7-9 Comparing Fraction
7-10 The One for Fraction
7-11 Probability, Fraction, and Spinners
7-12 A Cube-Drop Experiment
7-13 Progress Check 7

Instruments

To explore how Gardner`s MIT are incorporated in 4th grade TEM curriculum, the created MIT checklist was used. The chart was developed by the researcher as a culmination of multiple sources (Family Education Network, n.d.; Campbell et al., 1996; Razmjoo, 2008). Six intelligences were the focus of this study: visual-spatial intelligence, bodily-kinesthetic intelligence, musical intelligence, interpersonal intelligence, intrapersonal intelligence, and naturalist intelligence. Existential intelligence was not the focus because the intelligence is still under development. Furthermore, verbal-linguistic and logical-mathematical intelligences were not specifically coded because these two intelligences are most commonly implemented in schools (Gardner, 1999).

Data collection and analysis

To collect data on the incidence of Multiple Intelligences Theory (MIT) in the Texas Everyday Mathematics (TEM) fractions unit which has 12 sections the researcher read the entire lesson, sentence by sentence, and coded any occurrence of multiple intelligences within each section heading. The data were entered into the checklist (Appendix A). For each sentence, the researcher considered whether multiple intelligences were present, and, if present, the researcher used the MIT reference chart to identify the type of multiple intelligences. In some cases, multiple MIT may have been present. If so, all MIT were indicated on the checklist.

To check the reliability of this study, two trained experts other than the researcher assessed the presence and category of multiple intelligences in TEM fractions unit. The trained experts were familiar with MIT and elementary mathematics education. The experts were asked to analyze TEM fractions unit according to the MIT chart. The researcher gave information about MIT and explanations for each expert. Furthermore, the researcher and experts analyzed at least one lesson of TEM fractions unit together. The experts marked represented intelligences on the MIT checklist heading by heading like the researcher. After investigating all lessons by the experts, the researcher discussed randomly chosen four lessons with each expert. After comparing results, we discussed dissimilar findings and reached a consensus. After discussion, the researcher and experts agreed on the multiple intelligences marked. The percentage of the reliability for the expert 1 is 80% in randomly chosen four lessons. For the expert 2, the percentage of the reliability is 77.14% in randomly chosen four lessons. The reliability assessment told about the reliability of identification of MIT in this study is acceptable. Numbers of total identified multiple intelligences represented by the experts were similar to the researcher's result. However, identified multiple intelligences represented by the experts were sometimes different from the researcher's. For example, the researcher identified "they can model the decimal numbers at their desk" as both visual-spatial and bodily-kinesthetic intelligence; however, the experts identified this as an only bodily-kinesthetic intelligence (Bell et al. 2008b; p.610). The other example is that "Draw a number line from 0 to 1 . . ." was identified by the experts both visual-spatial and bodily-kinesthetic intelligence; however, the researcher identified it only visual-spatial intelligence (Bell et al. 2008b; p.618). Teachers draw a number line, so this is a visual tool for students. If the researcher investigated TEM curriculum based on teacher's activities, it would be both visual-spatial and bodily-kinesthetic intelligence. But the researcher investigated TEM curriculum only based on students' activities.

Results

In this study, 12 lessons of fractions in the 4th grade Texas Everyday Mathematics (TEM) teacher's lesson guide (volume 2a) were investigated through six of the multiple intelligences. This is a mathematics course, so logical-mathematical intelligences and verbal-linguistics intelligences were not assessed because they are commonly used in mathematics curriculum and instruction. The cumulative frequency of occurrence is presented in Table 2.

Table 2
Multiple Intelligences Theory distribution in twelve consecutive lessons

	Visual-Spatial	**Bodily-Kinesthetic**	**Musical**	**Interpersonal**	**Intrapersonal**	**Naturalist**
Lesson 7-1	3	3		1	1	
Lesson 7-2	4	4		3		
Lesson 7-3	2	1		4		
Lesson 7-4	7	3		3	3	
Lesson 7-5	8	5		1		
Lesson 7-6	1	1		3	1	
Lesson 7-7	3			1	1	
Lesson 7-8	6	1		2	1	
Lesson 7-9	7	8		8		
Lesson 7-10	5	2		1		
Lesson 7-11	3	5		10	2	
Lesson 7-12	4	4		3	2	
Total	**53**	**37**	**0**	**40**	**11**	**0**

Table 2 shows that there were a total of 141 identified multiple intelligences represented in fractions unit. Visual-spatial intelligence occurred 53 times (37.59%) and represents the most frequently identified multiple intelligences out of the six MITs. All lessons include visual-spatial activities at least one time. Lesson 7-9, Comparing Fractions, combines seven examples of this intelligence because in this lesson teachers generally use fractions cards to compare fractions. Another example of visual-spatial intelligence is in Lesson 7-4, Pattern–Block Fractions, in which the lesson states on p.588, "use one of the three shapes … and set of pattern blocks" (Bell et al. 2008b). This lesson engages the learners in the visual tool so according to the Family Education Network (n.d.) MI chart, patterning is a tool of visual-spatial intelligence. Furthermore, at Lesson 7-8, Fractions and Decimals, the curriculum guide indicates that learners will, "draw 3 pizzas on the board or on the overhead transparency …" (Bell et al. 2008b; p. 613). This is another example of visual-spatial intelligences because this example includes drawing and which is an example of visual-spatial intelligence. Drawing pictures relating to each term is a visual-spatial activity, and it is an example of visual-spatial intelligence (Bell et al. 2008b; p. 575). A lesson or an activity involving drawing pictures, making visual metaphors or analogies, using charts or so on would have a mark in the visual-spatial column.

The second most frequent multiple intelligences was interpersonal intelligences which occurred 40 times (28.37%). Moreover, the subsection, Teaching the Lesson, generally has small-group activities, whole-class activities and partner activities. All lessons include at least one instance of interpersonal intelligences. Lesson 7-11-Probability, Fraction, and Spinners- contains 10 interpersonal activities. For example, the curriculum guide directs the teacher to have students “Discuss the answer to Problems 1 and 2, and have students explain their reasoning” (Bell et al. 2008b; p. 633). This was marked in the interpersonal column because this sentence includes discussion, which is part of interpersonal activities. In addition, in Lesson 7-3, Probabilities When Outcomes Are Equally Likely, “Have volunteers share answers” which is an example of interpersonal intelligence (Bell et al. 2008b; p.582).

The third most frequent multiple intelligences was bodily-kinesthetic intelligence which was represented 37 times (26.24%). Bodily-kinesthetic intelligence includes games, drawing, drama, dance, and hands on activities. All lessons, except Lesson 7-7, include bodily-kinesthetic activities at least one time. Lesson 7-9, Comparing Fractions, combines eight examples of this intelligence. In Lesson 7-11, Probability, Fraction, and Spinners, there are five instances of bodily-kinesthetic intelligences. Using a straightedge is an example of bodily-kinesthetic intelligence (Bell et al. 2008b; p. 572). An activity or lesson that includes dramatizing, dancing, or hands on experiences would be marked in the bodily-kinesthetic intelligence column. For example, “… to color the second spinner …” was marked bodily-kinesthetic (Bell et al. 2008b; p. 628).

Finally, intrapersonal intelligence occurred only 11 times (7.80%). In Lesson 7-3, Probabilities When Outcomes Are Equally Likely, “Ask them to explain why they chose a particular phrase and …” which is an example of intrapersonal intelligence (Bell et al. 2008b; p.582).

Two multiple intelligences, namely the musical and naturalistic intelligences were not evident in the TEM fractions unit. Most of the activities had more than one intelligence. For example, if an activity states “students can color the squares using any pattern”, both visual-spatial and bodily-kinesthetic were marked (Bell et al. 2008b; p.633). Moreover, in Lesson 7-11, Probability, Fraction, and Spinners, partners use the first spinner on Math Masters…” is an example of both interpersonal and bodily-kinesthetic intelligences (Bell et al. 2008b; p.628).

Conclusions

The analysis of the TEM curriculum was completed with a created MIT chart based on several sources (Family Education Network, n.d.; Campbell et al., 1996; Razmjoo, 2008). TEM fractions curriculum ended up favoring the visual intelligences among the six intelligences. The result indicates that visual-spatial, bodily-kinesthetic, interpersonal, and intrapersonal intelligences are represented by the TEM fractions unit in 4th grade.

Hands on activities are commonly used in MIT classroom; furthermore, in TEM unit fractions there are a lot of evidence of bodily-kinesthetic intelligence which are based on hands on activities. In MI classroom, teachers make cooperative groups to make students interactive. Furthermore, TEM fractions unit includes cooperative group activities and pair activities which are evidence of interpersonal intelligence. According to Gardner (1983), patterning is an activity of visual-spatial intelligence; furthermore, patterns activities are included in TEM fractions unit.

According to the TEM curriculum developers, the frequent use of visual tools in Everyday Mathematics (EM) lessons provides students with a deep understanding of mathematics concepts (McGraw Hill-Wright Group, n.d). In the classroom, verbal instructions tend to be used, so visual aids can help teachers illustrate verbal instruction (McGraw Hill-Wright Group, n.d). “Lessons also suggest ways to have children demonstrate concepts and skills with gestures or movements” (McGraw Hill-Wright Group, n.d; p.2). A variety of tools including tables, charts, and graphs are provided so that students can organize their thinking. The intended result is that students’ achievement can be enhanced (McGraw Hill-Wright Group, n.d).

Discussion and sharing solutions with other students are recommended by EM lessons. Students have changed their solutions to compare with each other and they can also discuss why it is correct or incorrect (McGraw Hill-Wright Group, n.d). EM curriculum gives students the opportunity to work in the whole class, cooperative groups, and collaborative groups (McGraw Hill-Wright Group, n.d). Children come into contact between everyday life and mathematics concepts with EM (McGraw Hill-Wright Group, n.d).

Furthermore, intrapersonal intelligences activities are implemented less frequently than others. According to Cramer et al.(2002), students have limited time to apply their solutions to the questions, and they do not have enough time to compare different models for learning fractions. The results of this study suggest that naturalist and musical intelligences are not implemented in TEM fractions unit. According to Dannenhoffer and Radin (n.d.), musical intelligence is generally ignored in the classroom. Armstrong (2009) mentions that the importance of music in the classroom is often overlooked by teachers. According to Armstrong (2009) “… most of us have thousands of commercial musical jingles in our long-term memory but relatively few school-related musical pieces (p.85). “…the artists, architects, musicians, naturalists, designers, dancers, therapists, entrepreneurs, and others who enrich the world in which we live” (Armstrong, n.d; p.1). However, many students who have the ability of these skills are overlooked and not encouraged in schools (Armstrong, n.d). Musical and naturalist intelligences are not commonly used and ignored in the classroom.

This study focused on fractions so the expected intelligence in this unit is visual-spatial intelligence. According to Reimer and Moyer (2005), students should increase their success in both conceptual and procedural knowledge using visual tools when they are taught fractions. Suh, Moyer and Beo (2005) agree that visual tools are effective to teach conceptual and procedural knowledge of fractions.

It is not surprising to find visual-spatial, bodily-kinesthetic, interpersonal, and intrapersonal intelligences in the maths curriculum. According to the TEM publisher, this curriculum was written based on students’ individual differences and contains cooperative group activities and pair activities (McGraw Hill-Wright Group, n.d). Furthermore, this curriculum includes visual tools to teach mathematics. In this case, the aim of TEM matches with the aims of MIT and mathematics education. However, this curriculum is good and will be better; because it is research-based curriculum (McGraw Hill-Wright Group, n.d), and it should include musical and naturalist intelligences. Concrete representations are important to teach fractions (Cramer & Wyberg, 2009), and natural activities should play the important role to make fractions concrete for students. Also, the TEM fractions unit should be included musical and naturalist intelligences because fractions are about patterns, shape, and figures; so curriculum writers will add activities or examples from nature. Moreover, curriculum writers should contain music activities about fractions or add music about fractions in the curriculum. The following suggestions are developed:

- Students' differences and different types of intelligence area should be considered by teachers, educators, and curriculum developers.
- The curriculum should be written based on students differences and contains cooperative group activities and also pair activities.
- The curriculum should include more examples, activities and students' works that focus on MIT.
- Textbooks provide more activities to asses the learning of students with different types of intelligence.
- The relevant experts of MIT should be consulted during the preparation of the mathematics textbook.

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Appendix

Multiple Intelligences Chart

Intelligence	Activities	Intelligence	Activities
Verbal-Linguistic	Reading, Writing, Speaking, Listening, Learning with Words, Discussion, Memorizing, Thinking in Words, Debating, Discussion, Journal,	**Logical-Mathematical**	Question, Problem Solving, Patterns in Block, Working with Numbers, Playing Logical Game, Problem Solving, Data Collection, Coding, Critical Thinking, Using Money/Calculator, Working Geometry, Using Manipulatives, Modeling
Visual-Spatial	Using Patterns, Pictures, Drawing, Illustrating, Powerpoint, Visualization, Graphs, Non-Verbal Communication, Visual Puzzle, Analogies, Using the Mind's Eye, Making 3D Projects, Metaphors, Colors Chart, Painting	**Bodily-Kinesthetic**	Acting, Hands on Activity/Experiences, Drama, Body Language, Making Puzzle, Drawing, Dancing, Touching, Physical Game, Going on Field Trip, Using Tools
Musical	Singing, Remembering Melodies, Playing Instruments, Listening Music, Tapping, Rhythms, Humming	**Interpersonal**	Cooperative Learning, Group Works, Sharing Answer/Idea, Group Discussion, Leading, Brainstorming, Cross age Tutoring, Social Awareness, Social Experiences,
Intrapersonal	Personal Response, Individual Project, Individual Study, Understanding Strengths/ Weakness, Self-Reflection, Set Goals, Achieving Goals,	**Naturalistic**	Field Trip, Zoo Trip, An Experience in the Nature World, Reading at Outside, Working at Nature, Watching Animals/Stars/Cloud/Plants,

	Understanding Self		Making Garden, Understand Nature, Identifying Insects/Plants, Cultivation

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