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Effect of Multiple Intelligences on Achievement in Mathematics: A Meta-Analysis

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Abstract

Mathematics is considered the queen of science, the development of other sciences and other subjects is based on the development of Mathematics concepts. Therefore, a student needs to master and/or need to be smart in Mathematics so that it is easier to develop his ideas in other fields, especially in the field of science and education. The application of the Multiple Intelligence (MI) theory in teaching Mathematics provides the teacher with the ability to apply new skills and MI theory provides the students to improve group learning and achievement. The approach of using MI theory acknowledges individual differences while enabling students to meet the demands of the lessons under consideration. Students are thus able to accomplish their school work and engage well in teaching-learning activities. A meta-analysis of the studies related to the effect of Multiple Intelligences on Achievement in Mathematics and other associated factors is conducted. The studies in Mathematics (from 2000 to 2021) are analyzed and all the studies revealed that using the Multiple Intelligence theory in the teaching-learning process of Mathematics is having a significant and positive effect on achievement compared with other methods of teaching. This paper highlights the results of the Meta-Analysis undertaken by the authors for wider consumption of teaching and research community in Mathematics Education.

Keywords: Multiple intelligence theory, mathematics achievement, meta-analysis

Introduction

Mathematics is a fundamental part of human thought and logic, and integral to attempts at understanding the world and ourselves. Mathematics provides an effective way of building mental discipline and encourages logical reasoning and mental rigor. The word Mathematics has different meanings to different people. People perceive Mathematics according to their own experiences and these experiences differ from person to person In addition, Mathematics knowledge plays a crucial role in understanding the contents of other school subjects such as science, social studies, and even music and art.. Mathematics is considered the queen of science, the development of other sciences and other subjects is based on the development of Mathematics concepts. Therefore, a student needs to master and/or need to be smart in Mathematics so that it is easier to develop his ideas in other fields, especially in the field of science and education.

As per Courant and Robbins, Mathematics is an expression of the human mind that reflects the active will, contemplative reason, and the desire for aesthetic perfection. Its basic elements are logic and intuition, analysis and construction, and generality and individuality. The following conclusions can be made related to the meaning of Mathematics: It is a science of numbers and space, has its language in terms of signs, symbols, terms, operations, etc. It Uses/Requires intuition, logic, reasoning, analysis, construction, generality, and individuality. It helps in drawing conclusions and interpreting various ideas and themes. It is suited for dealing with abstract concepts of any kind, has an aesthetic value and helps to admire the beauty of nature, and Helps to solve problems of daily life.

Mathematics should be treated as an important subject in the overall curriculum, as

- Mathematics has a transversal nature. If we reflect on the history of curriculum in general, then Mathematics (geometry and algebra) were two of the seven liberal arts in Greek as well as in medieval times. This historical role supports the notion that Mathematics has provided the mental discipline required for other disciplines.
- Mathematics literacy is a crucial attribute of individuals living more effective lives as constructive, concerned, and reflective citizens. Mathematics literacy is taken to include basic computational skills, quantitative reasoning, spatial ability, etc.
- Mathematics is applied in various fields and disciplines, i.e., Mathematics concepts and procedures are used to solve problems in science, engineering, and economics.

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The complexity of those problems often requires relatively sophisticated Mathematics concepts and procedures when compared to Mathematics literacy aforementioned.
Mathematics is a part of our human cultural heritage and we have the responsibility to develop that heritage.
Secondly, since Mathematics provides foundational knowledge and skills for other school subjects, such as sciences, art, economy, etc., the issue of how Mathematics is intertwined with other school subjects deserved to be addressed. In some curricula, Mathematics is offered independently to support the study of other school subjects as an 'instrumental subject', and in other curricula, integrated courses that combine Mathematics and other fields are offered.
Thirdly, we may wish to reflect on the number of hours (proportion of hours) and/or courses allocated to Mathematics when compared to the other school subject in the curriculum of each country. In addition to this quantitative analysis, information about the qualitative description of school Mathematics with other subjects also needs to be gathered. Although this comparison won't show us the whole picture of why different countries attach the importance that they do to Mathematics, the comparison may nonetheless provoke further discussion. School Mathematics education, then should aim to support increasing participation in the human endeavor of Mathematics in an authentic relationship with the discipline.
Many approaches can be used when teaching Mathematics to young children and many theories and philosophies of learning address empowering children to learn Mathematics. Whatever method is chosen, however, children's varied learning styles, strengths, experiences, and perspectives must be considered. To achieve that goal, it is important to recognize that not all children learn in the same way and that children have multiple means of learning.
Each child may use a variety of this intelligence to learn Mathematics concepts and skills, not just the logical-Mathematics. Therefore, it is not necessary to attempt to categorize children by intelligence, but only to provide them with a multitude of learning opportunities. Teaching an extremely heterogeneous group of students presents this challenge. Children might have strength in one or more intelligence, which serve as mechanisms for learning and leads to cognitive ability. It becomes clear that multiple intelligence theory, developed by Howard Gardner, provided a definitive, yet broad framework for developing curricula that could be used to better serve this group of students. Therefore, the goal of helping a diverse group of students reach their maximum learning potential presents two major challenges to the instructor. First, it is imperative to identify one's dominant intelligence areas and to realize that not all students in a class possess those same strengths. The second challenge is to develop classroom presentations that use a variety of techniques that are compatible with the student's intellectual competencies. This is critical for optimal learning.

Multiple Intelligences

Howard Gardner's multiple intelligence theory (1983) [27] states that children employ a variety of intelligence in learning situations. According to this MI theory, individuals possess a set of eight intellectual competencies by which they learn, as opposed to one general intelligence. Gardner's notions of multiple intelligences appeal in that this intelligence corresponds to talent areas in the school setting (Gardner, 1983; Armstrong, 1994) [27, 31]. Essentially, Gardner (1983, 1993 & 1999) [27, 28, 30] redefined intelligence and proposed an initial set of seven bits of intelligence that can characterize gifted individuals, suggesting that each gifted individual may excel in one or more intelligence. In a classroom, the areas of strengths are different for each student. In any given individual some of these intelligences may be stronger than others.
The intelligence given by Gardner's Multiple Intelligence theory and their description is;

1. **Linguistics (Words Language):** the ability to use words correctly and comfortably, either orally or in writing, to express meaning
2. **Logical (Mathematics):** the ability to use numbers correctly and effectively; to think inductively or deductively; to categorize, classify and generalize numbers and relations.
3. **Spatial (Visual):** the ability to understand, interpret, and model the visual world; ability to visualize objects and create mental images; to represent spatial information effectively
4. **Bodily-Kinesthetic (Body/Physical):** the ability to use physical means to represent ideas, feelings, and the knowledge of the body and how it functions.
5. **Musical (Music):** the ability to understand and use musical concepts in a perceptive or technical sense; recognize tonal patterns, rhythm, and beat; develop an appreciation for music
6. **Interpersonal (People/Relationships):** the ability to relate to and understand people; to possess good social and leadership skills; person-to-person relationships.
7. **Intrapersonal (Self):** the ability to use self-understanding and self-knowledge; to monitor themselves and to be self-disciplined. (Armstrong, 1994) [31].

Subsequently, Gardner (1993, 1999) [27, 30] considered other possible candidates and added naturalist intelligence as an eighth intelligence, that is, related to observing patterns in nature, identifying and classifying objects, and understanding natural and human-made systems.
While these intelligences are conceptually distinct, they may also be conceptualized as being associated with broad categories (Campbell *et al*., 1999) [32]. Specifically, intelligence that is centered on the person (intrapersonal and interpersonal intelligence) is personal or person-related, intelligence that is dependent on interacting with objects in the environment (visual-spatial and bodily-kinesthetic intelligence) is object-related, and intelligence that is not so dependent (verbal-linguistic and musical intelligence) are object-free intelligence. However, the empirical basis for such classification needs to be further investigated. By paying attention to children's varying abilities, interests, and intelligence, we will be able to enhance the quality of Mathematics curriculum and instruction. Teachers may want to consider the different ways in which a Mathematics concept, skill, or procedure might be approached in light of the different multiple intelligences, while also acknowledging that many of these approaches and multiple intelligences overlap.

Meta-Analysis

Meta-analysis is defined as the grouping of apparently similar studies conducted on a particular topic according to specific criteria and combining the quantitative findings of these studies (Dincer, 2014, p.4; Hunter, Jackson & Schmidt, 1982, cit. Erkus, 2013, p.109) [33, 34]. Cohen, Manion, and Morrison

describe meta-analysis in simple terms as the 'analysis of analyses'. Glass (1976) [35] and Petitti (2003, p.13) [36] explain meta–analysis as the observation of the extent or size of the effects of a phenomenon that has already been reported in research articles (cit. Chambers, 2004) [37]. Through this method, an advanced perspective of the research on the topic to which the meta-analysis is applied can be gained, which allows opportunities for the formation of new models and theories (Erkus, 2013, p.109). There is an overwhelming agreement in academic circles that meta–analysis research synthesis is one of the most widespread methods for the aim of this study (Lipsey & Wilson, 2001; Schulze, 2007, p.87) [38, 39]. This method unifies the results obtained from small–scale studies conducted by individuals at different times and places to present a variety of facts on the topic. By widening the number of samples, the quantitative results derived from various studies are emphasized. This process ensures that the researcher obtains more precise information.

The Aim and Significance of the Study

This study aims to bring together and contrast independent studies on the effect of multiple intelligences on Achievement in Mathematics and to analyze their results. Some recent studies on the topic have been conducted independently and have arrived at results and suggestions. Several recent studies on Multiple Intelligences that have been conducted separately have arrived at very influencing results. Throughout the twenty-year period in which the Multiple Intelligences approach has been applied, there have been studies that have researched the effect on student achievements. In such situations, there exists a pressing need to look at all previous studies so that new studies approach subjects from a more developed and advanced perspective and arrive at more scientifically reliable results. For this reason, there is a critical need for a more comprehensive and detailed approach to the subject under research to interpret, contrast, and provide better access for researchers concerning the studies already conducted on this topic. Meta–analysis has been accepted as a method that helps in this aim. In our analysis of the existing academic literature, we encountered only one meta–analysis study that examined the effect of 'Multiple Intelligences on Academic Achievement.

Several studies are showing that schools' widespread use of Multiple Intelligences such as the Relationship between Multiple Intelligences and process standards, Using Multiple Intelligences to improve skills in Mathematics learning, and Multiple Intelligence in assessing giftedness among students. Multiple Intelligences as a component of Instructional Design in teaching Mathematics, and the Correlation of Multiple Intelligences and Achievement in Mathematics produced successful results. When the literature review of these studies (Adams, T L 2000, Willis, J. K. 2001, Yildirim, K., Tarim, K., & İflazoğlu, A. 2006, Douglas, Kimberly Smith Burton and Nancy Reese-Durham 2008, Yıldırım, K., & Tarım, K. 2008, Bakı, A., Gürbüz, R., Ünal, S., & Atasoy, E. 2009, Onika Tabuk, M., & Özdemir, A. Ş. 2009, Savitz, R. M., & Savitz, F. R. 2010, Sreeraj, K G 2015, Tarannum Tahira 2016, Arsalan Wares 2020, Ndia, L., Solihatin, E., & Syahrial, Z. 2020, Rizqona Maharani, Marsigit Marsigit & Ariyadi Wijaya 2020, Stephanie Buono & amp; Eunice Eunhee Jang 2021) [1, 2, 5, 7, 8, 12, 11, 15, 22, 23, 25] is analysed and the research results are examined, it can be seen that MI presents a wide range of scope under the categories; Relationship between Multiple Intelligences and process standards, Using Multiple Intelligences to improve skills in Mathematics learning, Multiple Intelligence in assessing giftedness among students, Multiple Intelligences as a component of Instructional design in teaching Mathematics and Achievement in Mathematics and all the studies revealed that, using Multiple Intelligence theory in teaching learning process of Mathematics is having significant and positive effect on achievement compared with other methods of teaching and helps teachers reach more students in their class by providing a variety of methods. It can be argued that the rich teaching materials used in teaching processes will be reasonably effective in revealing the different personal interests, needs, and abilities of the students, and in giving them the basis of the learning-teaching process in the class to a most efficient and high degree.

Research Design

This research study employs a meta-analysis method. The studies included in this research were selected under specific criteria. The studies are analyzed under the following categories;

- Relationship between Multiple Intelligences and NCTM process standards
- Using Multiple Intelligences to improve skills in Mathematics Learning
- Multiple Intelligence in assessing giftedness among students.
- Multiple Intelligences as a Component of Instructional Design in Teaching Mathematics
- Correlation of Multiple Intelligences and Achievement in Mathematics

Research Sample

The studies included in the research were taken from the following databases: Mendeley Citations, EBSCO, Google Academic, Shodhganga, and National Thesis Search System of the Higher Education Institution. Twenty research and published articles containing the required information were included in this study. The studies mentioned were all conducted and published between 2000 and 2021.

- **Relationship between Multiple Intelligences and NCTM 2000 Process Standards:** An approach of Multiple Intelligences and NCTM Process Standards to help Children Learn Mathematics, suggested by Adams, T L (2000) [1] from the National Council of Teachers of Mathematics (NCTM) Process Standards for School Mathematics (NCTM, 2000). He has suggested activities relating to Multiple Intelligences and five content-oriented process standards, i.e.,
  i). Problem-Solving,
  ii). Reasoning and Proof,
  iii). Communication,
  iv). Connections, and
  v). Representation.

The ideas were presented for Mathematics lessons and activities are designed to capitalize on children's use of the seven intelligences for learning. The multiple intelligences theory provides a platform from which to build on learners' diverse problem-solving characteristics and strengths. Thus, the following Table provides an example of how the standards and multiple intelligences can be used together to create meaningful and challenging Mathematics experiences for all types of students.

Table 1: Multiple Intelligences and Process Standards as per NCTM 2000

Process Stnds / MI	Problem-Solving	Reasoning & Proof	Communication	Connection	Representation
Linguistic	Write stories as context for word problems. Write about problem-solving.	Express arguments in ways that make series to others. Refute/support a Mathematics idea.	Respond to prompts for writing about Mathematics. Define terms.	Write about relationships between Mathematicsematica1 concepts	Translate word problems to algebraic expressions and vice versa
Logical-Mathematics	Gather, record, and use numerical data to solve problems. Calculate to solve problems.	Generalize Mathematics conclusions. Provide non-examples.	Develop and use categories to classify written and oral Mathematics information.	Categorize and classify numbers. Explore t use of numbers in other disciplines	Use technology to represent and sort data. Represent numbers in various ways.
Spatial	Use drawings and diagrams as problem-solving strategies. Explain a drawn Solution.	Use paper folding and cutting to prove concepts.	Describe characteristics of two-dimensional shapes and three-dimensional objects.	Explore the uses of Mathematics in architecture. Describe the classroom and school.	Use diagrams, charts, pictures, and tables to evolve problems.
Bodily-Kinesthetic	Use dramatization as a strategy for problem-solving	Use parts of the body to reason about concepts (e.g. proportion)	Use body language/characters to convey the message Mathematically	Investigate connections and various restrictions in the world.	Model division by distribution of objects to people.
Musical	Translate problem-solving strategies to musical tunes to help recall strategies	Compare patterns to songs that have patterned rounds that "never end."	Listen to counting songs in other cultures and languages.	Create a Mathematics musical in connection with the music program.	Use objects to model music rhythms. Explore the sound of concrete objects.
Interpersonal	Solve problems through cooperative learning. Lead problem-solving excursion	Collaborate with others to develop arguments and proofs.	Share communicative roles in cooperative groups.	Lead peers in discussions about Mathematics connections.	Debate the applicability of various representations.
Intrapersonal	Set goals for growth in problem-solving. Monitor problem-solving process.	Use personal and previous knowledge to build a basis for a conjecture.	Describe feelings & attitudes about Mathematics. Think aloud.	Consider ways in which Mathematics is used in your own life.	Organize thinking according to various representations. Use different representations.

- **Using Multiple Intelligences to Improve Skills in Mathematics Learning:** In the article 'Multiply with MI: Using Multiple Intelligences to Master Multiplication' by Willis, J. K. (2001) [2] suggested. Multiple intelligence theory as it allows teachers to use eight different possible approaches to Mathematics learning and teaching. This approach, Results in a deeper and richer understanding of Mathematics concepts through multiple representations; Enables all students to learn Mathematics successfully and enjoyably; allows for a variety of entry points into Mathematics content; Focuses on students' unique strengths, encourages a celebration of diversity; and Support creative experimentation with Mathematics ideas. The following table describes learning activities and teaching strategies specific to Multiple Intelligences.

Table 2: Learning activities and Teaching strategies specific to Multiple Intelligences.

Intelligence	Materials	Learning Activities	Teaching Strategies
Logical-Mathematics	Calculators manipulatives games number lines, Venn diagrams	creating or solving: brain teasers problems logic puzzles equations algorithms justifying thinking	worthwhile tasks connections with previous concepts variety of representations inquiry
Naturalistic	natural objects, model observation notebook magnifying glasses	using nature classifying objects observing patterns	demonstrations outdoor activities naturalistic investigations
Bodily Kinesthetic	manipulatives models individual children or groups	sequencing movements exploring tactile models dramatizing, clapping, tapping, and hopping using concrete materials	gestures dramatizations hands-on examples physical models
Linguistic	children's books textbooks audiotape activity sheets journals	reading word problems writing Mathematics stories, listening to explanations talking about strategies	storytelling book corners humor and jokes question assessment tasks lectures written or oral explanations
Spatial	computers graphs, charts playing cards manipulatives, dominoes, bulletin boards overheads	decorating flash cards drawing diagrams creating pictures or other representations looking at	Mental models, visual cues; ex; color, circles, boxes, arrows.. guided imagery graphic organizers

		illustrations	concept maps, or webs
Interpersonal	games shared manipulatives	working cooperatively participating in simulations interviewing others engaging in role-playing sharing strategies assessing peers' work	Discussions, people-based problems peer tutoring group activities guest speakers
Intrapersonal	self-checking materials diaries or journals	writing in journals addressing values and attitudes reflecting on connections with students' lives conducting self-assessment	private spaces choice time empowerment
Musical	tape recorders CDs instruments	composing, performing, or listening to raps, songs, and chants, using musical notation to create rhythmic patterns	listening corners rhythmical activities background music

According to Gardner's theory, children are intelligent in multiple ways and have unique combinations of intelligence strengths. All these intelligences can be used throughout the Mathematics curriculum. Rather than treat multiplication as memorization of facts or rote computation of irrelevant equations, multiple-intelligence theory enables students to understand it as an exciting relevant way of symbolizing a significant property of the world around them. When teachers encourage the use of diverse intelligence strengths in multiplication, they allow students to increase their capacities to learn facts by heart, conceptualize the meaning of multiplication, develop thinking strategies, solve problems, and engage intensively and creatively in Mathematics. As they do so, students have the opportunity to discover and celebrate their own, and one another's, unique abilities. (Willis, J. K. 2001) [2]

- **Multiple Intelligence in Assessing Giftedness among Students:** The article, 'Assessing Giftedness of Chinese Secondary Students in Hong Kong: a multiple intelligences perspective' by Chan, D. W. (2001) [3] states according to this view, Gardner (1993) [28] strongly supports the use of alternative assessment techniques, especially those involving performance-based assessment, to identify and evaluate student abilities and strengths concerning multiple intelligences (Chen & Gardner, 1997) [29]. Five instruments, the SMIP-Student Multiple Intelligences Profile, the SPM, the WKT-Wallach & Kogan Tests, 1965 on verbal and figural fluency (WKT-V and WKT-F), the RRSL (Roets, 1997 [40] to assess student leadership characteristics) and the HKAT-Hong Kong Achievement Tests were employed in this study the findings contribute a better understanding of the pattern of giftedness as expected in a sample of Chinese secondary students.
- **Multiple Intelligences as a Component of Instructional Design:** Research into Practice: Intervention Models and New Views of Behavior and Motivation (2006), highlights seven distinct studies, the first study provides evidence on the play behaviors of children with and without mental retardation in home and center-based play environments. The second looks at the use of a literacy program that is rooted in a multiple intelligences framework. The third examines the content of individualized family services plans and the needs of families of young children with disabilities. The fourth is a comparison of home-based and center-based Head Start classrooms. The fifth provides a unique glimpse into the relational aggression that may be present among preschool children. The sixth investigates the continuity between kindergarten and 1st-grade classroom environments. The seventh and last study examines the relationship between parenting styles, parent involvement, and motivation in mathematics.

Whereas, In the article '*A Spanish intervention program for students with special education needs: effects on intellectual capacity and academic achievement'* Pérez, L. F., & Beltrán, J. A. (2008) [6]. have determined the application of a school intervention program based on the theory of multiple intelligences for improving the academic achievement of students with low intellectual capacity and their level of general intelligence with the assessment design as quasi-experimental, with a non-equivalent control group, and with pre-and post-treatment measurements with 113 students aged between 11 and 16 years. And in the article 'Views of Students and Their Teachers Related to the Instruction Based on the Activities Developed According to the Multiple Intelligences Theory' by Kutluca, T. Et. Al, Çatlioğlu, H., Birgin, O., Aydin, M., & Butakin, V. (2009) [10] described the activities on polygons topic at the 7th-grade level of primary education. Along with this aim, five activities are developed according to the multiple intelligences theory with a case study method sample of the study was 24 seventh-grade students and their mathematics teacher with data collection by survey consisting of open-ended questions for students and a structured interview for the teacher. These studies revealed the project has fully achieved the proposed goals, contributed to scientific knowledge about the development of intelligence, and shown that the teaching of processes is one of the most effective methods to increase academic learning. Significant improvements were observed in learning and intellectual capacity and the case study and survey revealed both teachers and students have positive opinions about activities and instruction based on the multiple intelligences theory.

- **Correlation of Multiple Intelligences and Achievement in Mathematics:** In the article '*The effects of cooperative learning within a multiple intelligence framework on academic achievement and retention in Mathematics'* by Yildirim, K., Tarim, K., & İflazoğlu, A.(2006) [5] with 46 elementary 4th-grade students in an elementary school in the Yüreğir district of Adana with Mathematics achievement test and retention test found that the cooperative learning method supported by multiple intelligence theory is more effective than the whole class teaching on achievement in Mathematics. At the same time, it was found that there are no significant differences in their retention. And in the article 'The Effects of the Multiple Intelligence Teaching Strategy on the Academic Achievement of Eighth Grade Math Students 'by Onika Douglas, Kimberly Smith Burton, and Nancy Reese-Durham (2008) [7] with a quantitative study of 57 samples from public middle schools in North Carolina, with t-test for non-independent samples found that the means of the two groups differed significantly, therefore, compared with the traditional Direct Instructional teaching method. The multiple Intelligence approach garners significant

increases in several areas of importance to a student's academic, social, and emotional well-being, and similarly in the article 'Using Multiple Intelligence Activities and Cooperative Groups to Improve Academic Achievement and Retention' by Yıldırım, K., & Tarım, K. (2008) [8] with a sample of 72 students at public school in the district of Yüreir-Adana with mathematics achievement test and semi-constructed interview form, found that cooperative learning method supported by multiple intelligences has a significant effect on academic achievement and retention. Analysis of interview data revealed that students felt that this instruction is much more beneficial than traditional instruction. And in the article, 'The Effects of Multiple Intelligence Approach in Project Based Learning on Mathematics Achievement' by Tabuk, M., & Özdemir, A. Ş. (2009) [11] with the experimental study conducted at two primary schools in the Fatih district of Istanbul with a sample of 144 students of 6th and with mathematics achievement test and a multiple intelligence quiz found there was no statistically important effect of multiple intelligence approach in project-based learning applied and using two alternative learning approaches together supplies higher success. And in their article 'Experience Matters: Innovative Techniques Add up to Mathematical Achievement' by Savitz, R. M., & Savitz, F. R. (2010) [15] survey implied three findings. First, these undergraduate mathematics students feel that multiple intelligence-based instructions addressed their style of learning better than conventional lecture-based instruction. Second, these students feel that they are more likely to succeed in a multiple intelligence-theory-based mathematics class than in a conventional mathematics class. Finally, these undergraduate mathematics students feel that they learn more in an environment that utilizes multiple intelligence theory, as opposed to a traditional lecture-oriented environment. And further in the article 'The Effect of the Developed Differentiation Approach on the Achievements of the Students' by Altintaş, E., & Özdemir, A. S. (2015) [17], with Convenience and purposeful sampling composed of 57 gifted and 60 non-gifted 5th and 6th-grade students from a public school and a private school in Maltepe and Cekmekoy districts of Istanbul and with 'Mathematics Achievement Test' and 'Multiple-Intelligences Domains Inventory', it showed that activities and curriculum differentiation studies, which are based on elaboration, creative thinking, and multiple intelligences increase students' academic achievements.

And a research study titled, 'Relationship between multiple intelligences and achievement in Mathematics of Students at Secondary Level' by Sreeraj KG (2015) [18] with a survey method for a sample size was 1500 high school students from three districts of Kerala with tools namely test of Linguistic intelligence, the test of Logical-Mathematical Intelligence, the test of Spatial intelligence, the test of Interpersonal intelligence, the test of Intrapersonal intelligence and an Achievement test in mathematics for standard IX, and the findings indicated the relationship between the selected components of Multiple Intelligences and Achievement in Mathematics are significant. And similarly in research study 'Development of Multiple Intelligence Teaching Module in Mathematics for Upper Primary Level' by Tarannum, and Tahira (2016) [19], found that Using student constructed Multiple Intelligence Teaching modules teachers can diagnose students' understanding of topics and can identify the existing and direct implications for teacher education programs. It provides an innovative and superior teaching strategy for teacher educators. The teacher educators need to train the prospective teachers in the construction of the Multiple Intelligence Teaching Module so that in the future they can effectively apply this method in their classrooms.

Furthermore in the study 'The Effect of Learning Models and Multiple Intelligences on Mathematics Achievement' by Ndia, L., Solihatin, E., & Syahrial, Z. (2020) [23]. With a quasi experimental design at SMPN Kendari, Southeast Sulawesi, Indonesia, with mathematics achievement and multiple intelligences inventory and two-way ANOVA found that student mathematics achievement taught with PBL model was higher than those taught with direct learning model, mathematics achievement of students with mathematical logic intelligence was higher than those with spatial intelligence; there was an effect of interaction between learning models and multiple intelligences on student mathematics achievement; mathematics achievement of students with spatial intelligence taught with PBL model was higher than students taught with direct learning model; mathematics achievement of students with mathematical logic intelligence taught by PBL model was higher than those taught with direct learning model; there was no significant difference in mathematics achievement between students with spatial intelligence and mathematical logic intelligence taught by PBL model; mathematics achievement of students with mathematical logic intelligence was higher than those with spatial intelligence taught by direct learning model. And in the study 'Collaborative learning with scientific approach and multiple intelligence: Its impact toward math learning achievement' by Rizqona Maharani, Marsigit Marsigit & Ariyadi Wijaya (2020) [24] with Three Steps Interview (TSI), and Think Pair Share (TPS) with quasi-experimental study with a 3 3 factorial design and participants of this study were grade 8 students of Secondary Schools in Sukoharjo, Central Java, Indonesia, results of the study were; TSI with a scientific approach got better math learning achievement than TPS with a scientific approach and classical with a scientific approach. Besides, TPS with a scientific approach got better learning achievement than classical with a scientific approach Students with logical-mathematical intelligence got better math learning achievement than students with linguistic intelligence, and students with interpersonal intelligence, students with linguistic intelligence got better math learning achievement than students with interpersonal intelligence.

And, in the study 'The Effect of Linguistic Factors on Assessment of English Language Learners' Mathematical Ability: A Differential Item Functioning Analysis, Educational Assessment' by Stephanie Buono & Eunice Eunhee Jang (2021) [25] with the results of this study found several indicators of complex language that disproportionately disadvantage ELL students, such as abstract presentations, unfamiliar vocabulary, and the passive voice. Additionally, all items that contained multiple complex language factors demonstrated DIF, which supports previous research findings demonstrating the cumulative effect of multiple complex language factors on ELL students.

Conclusion

The findings of this meta-analysis demonstrated Multiple Intelligence is an essential component and it is related to every component of the area of sample among all the studies. The experimental studies showed that the effectiveness of the experimental group with Multiple Intelligence instruction is

more than those in the control group who were taught according to other traditional learning methods. Before beginning the meta-analysis for this research study, the subject area and the criteria by which studies would be included in the research were specified. The research was conducted using approximately twenty studies that satisfied the criteria. This Meta-analysis of studies predominately focused on Multiple Intelligences and achievement in Mathematics.

Thus, all the studies revealed using the Multiple Intelligence theory in teaching the learning process of Mathematics is having a significant and positive effect on achievement associated with other methods of teaching. This paper highlights the results of the Meta-Analysis undertaken by the authors for wider consumption of teaching and research community in Mathematics Education.

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