



MATHEMATICS IMPROVEMENT PROGRAM (MIP)

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Overview

The Math Improvement Program (MIP) is an in-service mathematics approach to teacher professional development that actively engages teachers in a deep understanding of the learning conditions in their classroom as they work towards providing equitable mathematics teaching practices.

The program was developed through practice with actual St. Maarten elementary teachers based on a strong understanding of the Foundation Based Education (FBE) mathematics curriculum as well as the current best practices in mathematics teaching. MIP was developed, implemented, and tested in three elementary schools in St. Maarten. This grounded approach to effective contextual educational practice development started in 2019 and has shown remarkable results even with the challenges that were experienced by all schools during the COVID 19 pandemic. The results of the 2021 Mathematics FBE Exit exam revealed that the schools that were actively part of the program outperformed all the other schools under their school board (See the MIP Results section of this document). In addition, MIP schools all performed above the national average and the school with the highest average performance in the 2021 FBE mathematics exam was an MIP school.

Introduction

A proper foundation in mathematics is essential for all students' educational development and their social mobility since mathematics plays a key role in the high school admission process. Since students absorb and retain information at different rates, it is very common to find students who are left struggling as the curriculum objectives keep moving on. Teachers have traditionally had difficulty addressing this phenomenon as data has shown that the most effective mathematics programs encourage student interaction over teacher centered instruction (Slavin, 2010). If properly utilized, student interaction within well designed mathematical learning environments can be used to ensure that any gaps in learning are adequately addressed.

The MIP is an effective, efficient, and practical method for improving students' appreciation and love for mathematics while building the capacity of teachers to quickly identify and remedy individual students' weaknesses. In this program an expert mathematics coach with a deep understanding of the contextual nature of St. Maarten's mathematics education and curriculum works with teachers to build their capacity in providing quality equitable mathematics education that will greatly increase overall mathematics performance.

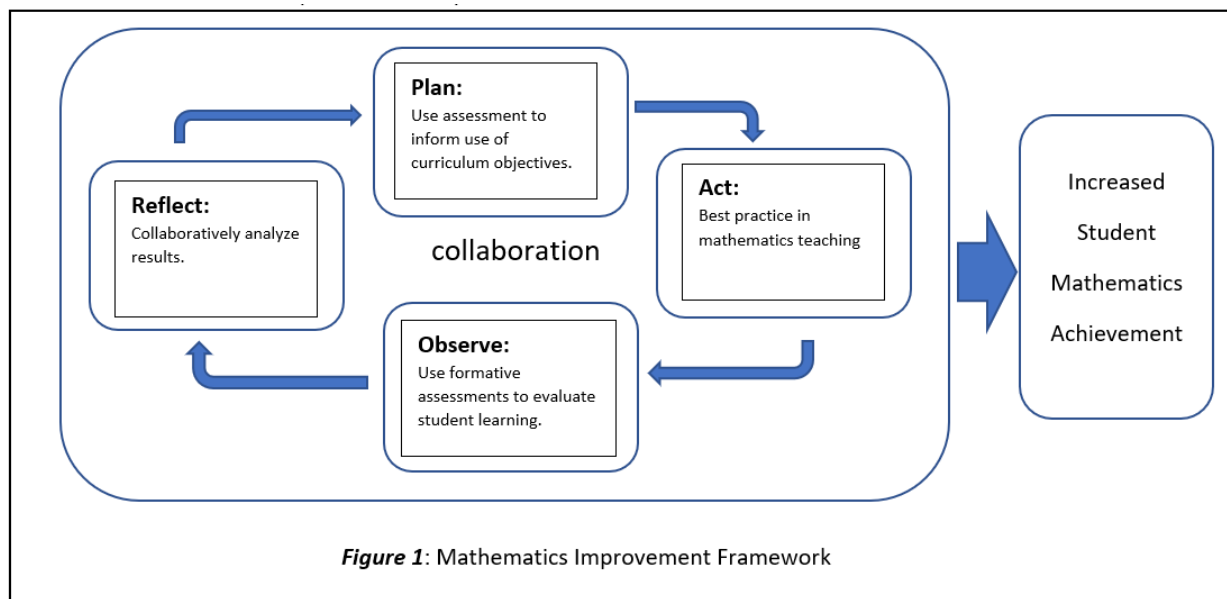
Goals

1. To increase teacher capacity in providing equitable, quality mathematics education that meets the needs of the 21st century student.
2. To stimulate student's appreciation for mathematics and problem solving
3. To build confidence in math learners

Essential components of the MIP

The MIP is designed to encourage continuous improvement in student learning. As such, the core of this approach as shown in Figure 1 is built around the following core questions:

1. What do we want our students to know?
2. What are the best practices in getting them to know what we want them to know?
3. How will we know if they have learned?
4. How will we respond to what they do not learn?



On a macrolevel, the first question deals with a proper alignment of the curriculum objectives across the grade levels based on the connectionist approach to mathematics education (See below). The aim will be to provide a smooth and less stressful flow of mathematical skills as students move through the grade levels. Based on the model, the curriculum alignment is continuously being reviewed for areas of weakness as the context of the school environment changes. The first question forms the basis for planning and instruction and fundamentally relies on teachers engaging students from conceptual understanding of mathematics to a more abstract understanding.

As teachers implement their plans, they are constantly challenged to identify key environmental signals in their classrooms that may promote or restrict learning. They are engaged in collaborative discussions led by the math coach that exposes them to research based best practices in mathematics teaching.

The effectiveness of teaching methods is evaluated with periodic formative assessments that are administered every 6 to 8 weeks. This timeframe allows for adequate time for proper instruction while not moving the learning objectives too far along that remediation of areas of concern cannot occur. The mathematics coach uses the results of the interim assessments to guide the teachers through deep reflection that allows for adjustments in planning and instruction.

The MIP's Theoretical Base

The MIP is based on a solid theoretical base that utilizes a deep understanding of mathematics education, school improvement and educational change which will be briefly discussed here. Improving student achievement ultimately involves changes in teaching practices and improving instruction. Yet “teachers need assistance to change and develop” (Hall & Hord, 1987, p. 4). Teachers’ beliefs about the nature, teaching and learning of mathematics have been shown to influence how they use the curriculum (Remillard, 2005). In turn, teachers’ beliefs are strongly affected by their own experiences as students – before they begin their careers as teachers (Schoen & LaVenja, 2019). These ideas suggest that for proper implementation of best practices in mathematics teaching to occur, teachers must change their beliefs. Moreover, it suggests that change in beliefs occurs through experiences.

Askew et al. (1997) characterizes teachers’ orientation to the teaching of mathematics as falling into three categories: transmission, connectionist, and discovery. These orientations fit into the traditional concepts of teacher-centered vs student-centered teaching and therefore, provide a valuable conceptualization for proper mathematics teaching and learning in any modern mathematics setting, including FBE.

The transmission orientation is based on the belief that mathematics consists of a series of facts that must be transferred to the students (Swan, 2006). Teachers who use this orientation believe that teachers show the students how to solve the problems and follow this up with a set of practice problems which are solved using the method that the teacher prescribes (Schoen & LaVenja, 2019). These teachers adopt teacher-centered methods and believe that problem-solving can only occur after students have learned the calculation procedures. Lam (2007) notes that the Caribbean mathematics teacher rarely acts as a facilitator and prefers teacher centered approaches. This is the dominant orientation among our teachers mainly because this was the method that they were taught, and this method is largely supported by teacher evaluation procedures. This orientation, however, hampers students’ problem-solving abilities as can be seen by students’ continued underperformance in the problem-solving aspects of FBE.

A teacher can also adopt a connectionist orientation to their teaching of mathematics. Connectionist teachers recognize that the mathematics curriculum functions as a whole and actively link different areas of the curriculum (Askew et al., 1997). These teachers have a strong inclination towards a belief in the social construction of knowledge and therefore work collaboratively with their students to develop the mathematical ideas. The students of these teachers are aware of different methods of solving problems and can select the most appropriate method. The teacher develops this skill by challenging students to actively solve realistic problems through collaboration (Swan, 2006). Askew et al. (1997) found that teachers who adopted a connectionist orientation in their teaching of numeracy produced the greatest gains in student achievement.

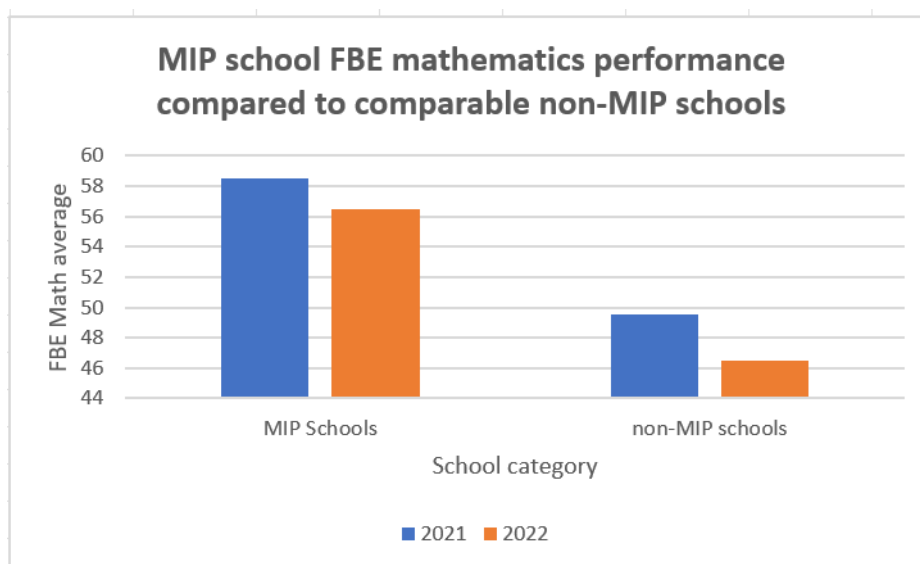
The discovery orientation is like the connectionist orientation. They both are student-centered approaches. However, the discovery orientation is less efficient since it treats all methods of calculations as equally acceptable regardless of their effectiveness or efficiency and uses extensive practical activities (Askew et al., 1997).

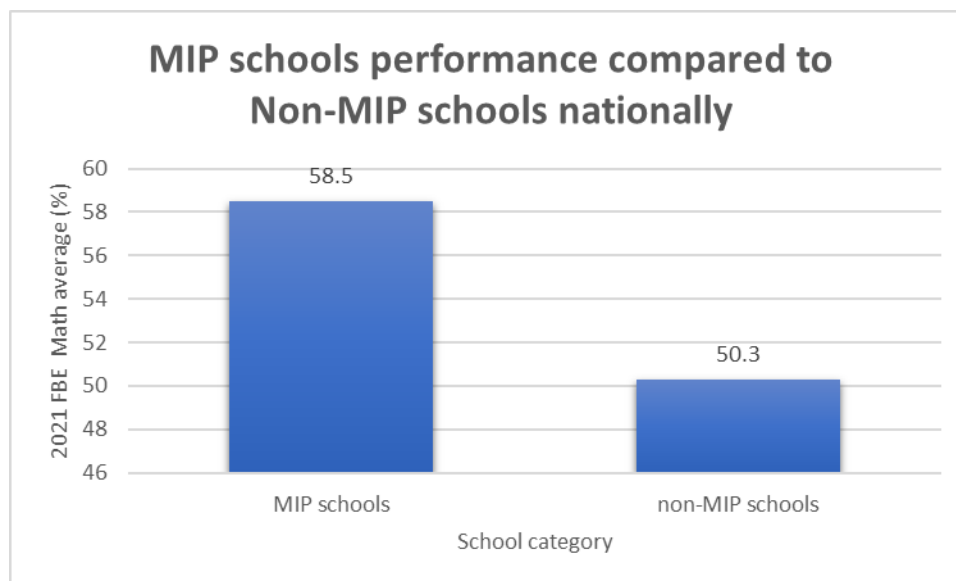
MIP develops a strong connectionist orientation through a participatory process (See Figure 1). This involves an emphasis on essential benchmarks. Planning is based on the information gathered from student assessment. The information derived is used to inform planning and teaching activities. The outcome is that as teachers work together within this process, their collective efficacy increases- providing the base for tackling stubborn areas of student underperformance. Teachers' beliefs in modern mathematics teaching techniques increase as they self-identify their own weaknesses and use ideas from their more successful peers. The value of the interim assessments if facilitating this cannot be overstated. Such assessments are an important part of classroom instruction. They assess students' learning and use that data to inform teachers as they make instructional decisions (Lin, 2006). They allow teachers to make more informed decisions as they measure students' performance against stated criteria (Reys et al., 2014). Instructional decisions in MIP are made based on the following NCTM's (2014) framework:

- Establishing mathematics goals to focus learning.
- Implementation of tasks that promote reasoning and problem solving.
- Using and connecting mathematical representations
- Facilitation of meaningful mathematical discourse
- Posing of purposeful questions
- Building procedural fluency from conceptual understanding
- Supporting productive struggle in learning mathematics
- Eliciting and using evidence of student thinking

MIP Results

The results of the 2021 and 2022 FBE Mathematics Exams showed that the MIP is successful in achieving increased student achievement in these exams. On average students who had been part of the MIP scored higher than their peers who were not part of the program. These results were true when the students were compared to their counterparts within the same school board or when they were compared to other schools nationally.





Furthermore, teachers who participated in the program expressed positive attitudes towards their practice. In relation to the FBE aligned formative assessments that form part of the program, teachers said the following:

"I really liked the use of the MIA [Math Interim Assessment]. These tests gave us the opportunity to really focus on the concepts students had to know for that specific class, that will eventually help them in their future."- Teacher A

"The assessments allow me to reflect on my teaching. I look at the areas that the students did not do too well in and look at what I did and how and what I can do differently."- Teacher B

In relation to changes in their instruction, teachers said the following:

"I start the day with a Math problem. I cater to the different levels in my class when posting the Math problem on the board. My lowest level will get a problem that they can do but will still challenge them. What I have experienced is that this group would still want to try the more challenging problem. The children love this time of the day and are excited to solve the problem. They have grown to love Math."- Teacher C

"Making math fun. Playing online games about the topic we covered excites the students and they are eager to participate."- Teacher D

"I really liked the practice of using manipulatives whether it was digital or in person to help students understand what I was teaching. The students also showed more interest in learning and grasping the concept being taught."- Teacher E

Available Services within the MIP

The MIP functions more effectively as a complete package. However, based on the context of each school, the individual components can be adjusted. The individual components within the program are:

- Teacher coaching through workshops and/ or in-service support
- School and teacher leaders training in developing a deep understanding of the FBE mathematics curriculum and effective mathematics teaching strategies
- Leveled FBE assessments per grade (formative and summative)
- FBE aligned curriculum maps
- FBE benchmark testing and interpretation

About CLIMB

The Creative Leadership and Innovation Management Bureau (CLIMB) is a foundation that has been involved in providing support to organizations towards educational improvements. The foundation helps clients to achieve tangible high impact results in the organization through rigorous research in education, leadership, creativity, and innovation. CLIMB specializes in numeracy, literacy, Response to Intervention (RTI) programs, professional learning community (PLC) development, and educational change management.

About the MIP program facilitator

The MIP program is led by Delroy Pierre who has taught and guided curriculum implementation in Dominica, Sint Maarten, USVI, Panama and the United Arab Emirates (UAE). He is currently a Ph.D. candidate in Creative Leadership Innovation and Change (CLIC) in the Educational Leadership for Change (ELC) track at the University of the Virgin Island conducting research on how teachers make sense of educational changes towards equitable mathematics teaching practices.

Notable Publications:

Pierre, D. (2016). Caribbean 6th grade mathematics exam preparation workbook. Lulu.com.

Pierre, D. (2016). Mathematics: FBE exit exam preparation: Workbook. Lulu.com.

Pierre, D. (in press). FBE mathematics practice assessments.

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