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MATH REMEDIATION FOR HIGH SCHOOL FRESHMEN

by

KAMBIZ BORHON  
M.A. University of Central Florida, 2011

A dissertation in practice submitted in partial fulfillment of the requirements  
for the degree of Doctor of Education  
in the College of Education and Human Performance  
at the University of Central Florida  
Orlando, Florida

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2015

Major Professor: David N. Boote

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## ABSTRACT

This study is an attempt to address the problem associated with a high percentage of freshman students, at a private Christian high school in Florida, who either fail Algebra 1 or pass with a low percentage rate. As a result, these students either retake Algebra 1 or continue on—being inadequately prepared to successfully pass Geometry and Algebra 2. This study concentrates on the student background knowledge of mathematics, which is among the causes associated with this problem, and proposes remediation. As such, a mathematics remediation course is designed and implemented for a select number of incoming freshmen. This study includes a correlational examination to determine a possible correlation between students' background knowledge of the middle school mathematics and predicts a possible failure or successful completion of Algebra I in high school. In addition, it purposes a two-stage evolution plan in order to determine the effectiveness of the design of the remedial course as well as its effectiveness. Undertaking the design evaluation, this study uses a mixed-modes design consisting of a qualitative (interview and observation) of a number of participants and a quantitative examination (survey) of a larger sample. The correlational study indicates that there is a positive and moderately strong correlation between students' background knowledge in (middle school) mathematics and their grades in Algebra 1. The evaluation concludes that students find the design of the MIP program helpful and aesthetically appealing; however, its usability did not meet the evaluation criteria. Furthermore, the MIP Program Manager and teacher are fully satisfied with its design, content, and components.

In memory of my beloved father

## ACKNOWLEDGMENTS

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## LIST OF ACRONYMS

ELL	English Language Learner
ESE	Exceptional Student Education
ESOL	English for Speakers of Other Languages
IEP	Individualized Education Program
LEP	Limited English Proficiency
MIP	Mathematics Intervention Program
SLD	Specific Learning Disabilities

## CHAPTER ONE: INTRODUCTION

### Problem Statement

For the past few years, Remnant High School—a private Christian high school in Florida—has been experiencing that a high percentage of freshman students either fail or pass Algebra 1 at a low percentage rate.

### Introduction

#### **Background**

This study is an attempt to address the problem associated with a high percentage of freshman students at Remnant High School (RHS) who either fail Algebra 1 or pass it at a low percentage rate. As a result, these students either retake Algebra 1 or continue on—being inadequately prepared to successfully pass Geometry and Algebra 2. The impact of such unpreparedness in mathematics is strongly manifested when students take Algebra 1, which is a fundamental course in high school mathematics and beyond. A successful completion of Algebra 1 is essential for undertaking Geometry and Algebra 2, among others. Among the causes associated with this problem, this study concentrates on the student background knowledge of mathematics as a major contributing factor to this problem. In order to address this problem and maximize the incoming freshman students' preparedness for Algebra 1, this study proposes a remediation solution by designing and implementing a remediation course—Mathematics Intervention Program (MIP)—for a select number of incoming freshmen.

Designing and implementing the MIP program, this study undertakes a two-part evaluation process: 1) conducting an evaluation of the program design, and 2) proposing an evaluation of the overall program implementation and its effectiveness. Such processes include a pre- and post-test design (the mathematics portion of the ACT Aspire standardized test) to determine the effectiveness of the MIP program. An anonymous survey will also be used to collect quantitative data from students who are placed in the MIP program at RHS. In addition, the quantitative data with respect to prior freshman students' Algebra 1 grades and related standardized test scores (ACT Explore) for the past three years will also be examined to determine the correlation between the incoming freshman students' prior Explore scores and their Algebra 1 grades. The related data corresponds to students' grades/scores prior to the implementation of the MIP program in Fall 2014. This study will also include a qualitative examination of selected faculty and administrators.

### **Organizational Context**

As a senior academy, Remnant High School was established in Florida in 1918. Its mission is declared as to modeling love and service for God, having respect for self and others, developing intellectual growth, and modeling a Christ-like character. The organizational structure of RHS is composed of a total of 35 faculty and staff members, among which there are 15 full- and three part-time teachers. There are about 345 students (grades 9-12) in RHS. The demographic characteristics of the student body consist of approximately 35 percent white, 30 percent Hispanic, 30 percent black, and

five percent Asian and Native American. Moreover, there are about 15 English learners, and the student population is by far Christian.

The Seventh-day Adventist (hereafter referred as Adventist) educational system is a denominationally-based school system which was established in the early 1870s, and is currently the second largest Christian school system in the world. The Adventist education is a worldwide Christ-centered system with a holistic approach in education. The global Adventist educational system includes 7, 804 educational institutions, 84, 997 teachers, and over 1.6 million students (ADOE, 2011). The Adventist education adopted the philosophy that education should be redemptive in nature and that “mental, physical, social, and spiritual health, intellectual growth, and service to humanity” form its core values (Circle, 2011, para. 2). As the highest world-wide authority for the Seventh-day Adventist Church, the General Conference also establishes and maintains Adventist education policies and oversees its corresponding Pre K-12 and post-secondary schools. The General Conference is divided into 13 worldwide Divisions which are subdivided into Unions. Each Union is composed of several Conferences. One of its major divisions is the North American Division (NAD) which includes the United States and Canada (NAD, 2013). This study concentrates on one of the schools (RHS) in the Florida Conference of the Seventh-day Adventist (hereafter referred as the Conference) which is a member of the Southern Union in NAD. The Office of Education (OE) in the Conference maintains the educational policies of NAD in Florida, and oversees 23 elementary schools (grades 1-8), five junior academies (grades 1-9), and two senior academies (grades 9-12) in Florida (Conference, 2013). The Conference declares its fundamental mission as “Creating Christian leaders grounded in their love



for Jesus and His church” (Conference, 2013). To formalize its curricula and unify Adventist education, North American Division developed its own standards in the early 2000s. The NAD standards have been compared with state standards and national organizations for each discipline. Such comparison, in Florida, indicated that NAD standards are comparable to both Sunshine States Standards as well as the Common Core.

### **History and Conceptualization**

The problem associated with mathematics achievement is, indeed, a national concern for an increasing number of students requiring interventions of some sort to address their achievement gaps. Virtually in every state, students struggle to stay in grade level and are screened for potential difficulties in reading and mathematics (Jordan, Kaplan, Locuniak, & Ramineni, 2007). As Balfanz and Byrnes (2006) noted, the mathematics achievement levels of US students have fallen far behind the desired levels of achievement and that “many students end middle school ill-prepared to succeed in a rigorous sequence of college-preparatory mathematics courses in high school” (p. 144). Particularly, there is a strong indication that mathematics achievement of American students between fourth and eighth grade fall even more rapidly compared with the elementary grades (Balfanz & Byrnes, 2006). According to the 2007 Trends in International Mathematics and Science Study, as Meyen and Greer (2009) emphasize, “eight countries outperformed the United States in mathematics achievement at the fourth-grade level, and five countries outperformed the United States at the eighth-grade level” (p. 1). With respect to mathematics, Geary (as cited in Jordan et al., 2007)

notes that students' weakness in mathematics are often related to "selective cognitive deficits, inadequate instruction, or a combination of factors" (p. 36). As Carr (2012) claims, students who develop a "solid conceptual mathematics foundation at the elementary level" will later succeed in higher-level mathematics courses (p. 269). Given the situation, many schools implement strategies that are unsupported by research or data, unrelated to the actual problem, or ineffective—at times, may even adversely affect the achievement gap.

The problem associated with remediation is initiated at the elementary level, nurtured in the middle school institutions, and solidified in our secondary school system. Continue to grow exponentially, this problem has been penetrating in our post-secondary educational system—generating serious educational, social, and economical problems in the U.S. especially during the recent decades. The high college remediation rates, as Howell (2011) observes, may signify a "disconnect between K–12 curricula and the expectations and requirements of postsecondary study" (p. 296). To manage these discrepancies, "many states have implemented or are considering K–16 initiatives"—which signifies "aligning secondary and postsecondary curriculum as well as the curriculum within the elementary and secondary system itself" (Howell, 2011, p. 296). Higher education institutions are finding that ever increasing number of entering freshman students are unprepared for college-level coursework, particularly in mathematics (Fine, Duggan, & Braddy, 2009). Perin (2006) asserts that more than half of community college students need remediation among which up to 80 percent enroll in at least one remedial course. Furthermore, 75 percent of postsecondary institutions in the United States, according to the U.S. Department of Education, "offer remedial

courses in mathematics and English catering to the 28% of first-time college freshmen at both two- and four-year postsecondary institutions who lack the skills necessary to perform college-level work (Parsad & Lewis, as cited in Howell, 2011, p. 296). Most of these students will be required to successfully complete the so-called remedial courses prior to taking the corresponding college-level coursework. Fine et al. (2009) observe that “remediation of incoming college freshman students is a national concern because remediated students are at higher risk of failing to complete their degrees” (p. 433). Bahr (2008) estimates “the national direct cost of public postsecondary remedial programs at 1–2 billion dollars annually, and the total direct and indirect public and private costs at nearly 17 billion dollars annually” (p. 421). This is a staggering number that reveals the magnitude of the remediation which I believe is a real burden on our educational system. Astin, as cited in Handel and Williams (2011), concludes that remedial education is “the most important educational problem in America today” (p. 29).

Waycaster (2001) insists that the “alternatives to remediation can range from unemployment and low-wage jobs to welfare participation and incarceration—all of which are more expensive for [the] society, [and that] a good remediation program can serve as a cost-effective investment” (p. 404). Given that most of these students are among the minorities, less affluent families, and those whom English is a second language (Attewell, Lavin, Domina, & Levey, 2006), remediation would provide opportunities to rectify race and class disparities to “develop the minimum skills deemed necessary...to acquire the prerequisite competencies that are crucial for negotiating college-level coursework” (Bahr, 2008, p. 420). In addition, Waycaster (2001) stresses

that “Well over half of minority students who ultimately graduated initially failed academic skills tests” (p. 890), and that the impact of eliminating remedial courses would be catastrophic on minority students. All indications point that although remediation is costly and redundant, it seems necessary.

### Literature Review

A number of researchers have focused on the effectiveness of remedial mathematics courses and their impact on student achievement. Traditionally, most research with respect to remediation and its effectiveness is concentrated on higher education—the majority of which have studied (community) college students. Nonetheless their findings are helpful and to various degrees relevant to remediation at the secondary level as well.

Bettinger and Long (2009) studied many aspects of college remediation from its economics to its effectiveness. They explored the impact of remediation on student interest, “persistence, transfer behavior, and degree completion for similar students placed in and out of remediation” (p. 752). This study focused specifically on 18- to 20-year old college undergraduates. The researchers investigated the impact of remediation on college students’ performance and persistence by using data comprising over 28,000 students provided by the Ohio Board of Regents (OBR). In addition, they explored the lack of colleges’ uniform testing policies and remedial placement procedures. They also examined the possible social and psychological impact of grouping lower-ability students in remedial courses. With this comprehensive approach to the study of remediation, the researchers were able to explore the impact of remedial

courses from a variety of perspectives, including economical, psychological, emotional and other factors. They tracked these students for six years, using longitudinal information provided by colleges, and students' standardized test results and surveys, limiting their sample to full-time students who took American College Testing (ACT) and intended to complete four-year degrees.

Emphasizing the positive impact of remediation on educational outcomes, Bettinger and Long (2009) concluded that students who take remedial courses “have better educational outcomes in comparison to students with similar backgrounds and preparation who were not required to take the courses” (p. 760). Moreover, they observed that mathematics and English remediation increases the possibility of degree completion within four to six years. The researchers suggested that students who are required to take remedial courses “are more likely to persist in college in comparison to students with similar backgrounds” (Bettinger & Long, 2009, p. 736) compared with those who are not required to do so. In this study, the researchers identified a variety of perspectives with respect to the impact of remediation on students which are very important to the design of the MIP program.

Illich et al. (2004) focused on the college's common practice of allowing students to concurrently enroll in remedial and college-level courses. They specifically analyzed the possible differences among students “who successfully complete their remedial courses, students who do not successfully complete their remedial courses, and students who are not required to take remedial courses” (p. 438). The researchers utilized a set of data which were collected over three semesters (Fall 1999, 2000, and 2001), and obtained from the college's Office of Institutional Effectiveness and Planning.

The population in this study was composed of 12,375 students who enrolled at McLennan Community College located in Waco, Texas. In addition, the researchers explored a possible negative impact of instructors “who teach college-level courses...[but] may have little or no awareness that some of their students may be concurrently enrolled in remedial courses” (Illich et al., 2004, p. 450). Moreover, they examined the sufficiency of relying primarily on a “single placement test to determine a student’s academic preparedness” (p. 452). The researchers concluded that “Students who successfully complete their remedial courses perform as well as non-developmental students enrolled in college-level courses [however, those who do not] under-perform in their college-level courses” (p. 452). In addition, they suggested that exclusive reliance on a single test in determining students’ academic preparedness is inadequate. Exploring the impact of these somewhat unique variables on remediation is helpful to my study, for the majority of MIP students will also enroll in Algebra 1, and the MIP placement and successful remediation will be determined by relying on a single standardized test result.

In his longitudinal study, Bahr (2008) examined the relative success or failure of mathematics remediation by “comparing the long-term academic outcomes...of students who remediate successfully in mathematics...with those of students who achieve college-level mathematics skill without the need for remedial assistance” (p. 421). In this research, he analyzed a set of data which addressed 85,894 first-time college freshmen enrolled in 107 community colleges in California in Fall 1996, and he tracked their mathematics progress for 6 years. To address the effectiveness of mathematics remediation, using two complex modeling systems, the researcher

presented a “hierarchical multinomial logistic regression” model to measure the long-term student attainment and a “more complex 10-category nominal” model to measure the status of students’ “college-level math skill attainment” (Bahr, 2008, p. 442). The researcher concluded that students who “remediate successfully...exhibit long-term academic attainment...that is comparable to that of students who achieve college-level math skill without the need” (p. 446) for remediation. In this regard, he found mathematics remediation to be highly effective only for those students who remediate successfully. Bahr’s important study and findings—specifically with respect to the positive long-term academic outcomes for students who remediate successfully in mathematics—is particularly helpful for justifying the implementation of the MIP program at RHS.

A few studies have been conducted with respect to Adventist education, in general, and non specific to mathematics achievement. Combining “published and unpublished research to assess the extent to which Adventist schools have accomplished their goals,” Thayer (2008) asserts that the “Results of more recent studies should be given more weight in applying results to the current situation” (pp. 3, 6). The most recent and by far comprehensive study on Adventist education was completed in 2007, the CognitiveGenesis Research Study—components of which have been used continuously by NAD in its advertising materials. Prior to the CognitiveGenesis Research Study, few studies have been conducted from mid-1970s to 2006 (Thayer, 2008)—most of which concentrate on few individual Unions as well as select Adventist schools in NAD. A good portion of these studies measure elements such as the impact of Adventist education on students’ spiritual outcomes; academic

achievements of Adventist youth in public schools; and academic achievement with respect to number of years of Adventist schooling, school size, and class size among others (Thayer, 2008).

In an attempt to assess the academic achievement at the elementary and secondary levels in the Adventist educational system, a comprehensive four-year study, entitled the CognitiveGenesis Research Study, was conducted starting Fall 2006 to Spring 2010 at the Center for Research on Adventist Education at La Sierra University—a post-secondary Adventist educational institution in NAD (CognitiveGenesis, 2013). The primary focus of this study is to measure achievement in Adventist schools and how it compares with that of the national norm (CognitiveGenesis, 2013). To accomplish this task, the researchers assessed various factors associated with academic performance of elementary and secondary students in U.S. Adventist schools. To assess students' achievement—measuring students' actual knowledge and skills—the researchers selected the following standardized test instruments: the Iowa Tests of Basic Skills (ITBS) for elementary and middle school students and the Iowa Tests for Educational Development (ITED) for high school students (CognitiveGenesis, 2013). To assess students' ability, the Cognitive Abilities Test (CogAT) was used. The ITBS, ITED, and CogAT tests were conducted starting 2006-2007 and ending in the 2009-2010 schoolyear (four years). Furthermore, surveys from four groups—students, parents, teachers, and school administrators—were conducted to measure how variables from different groups relate to achievement and ability (CognitiveGenesis, 2013). The surveys were conducted starting 2006-2007 and ending in the 2008-2009 schoolyear (three years). Subsequently, the collected data



were cleaned, and the final dataset included 51,706 records which were used for statistical analysis (CognitiveGenesis, 2013). The researchers identified the following among their findings: 1) The longer students remain in an Adventist school, the higher their academic achievement will be; 2) Students' achievements in small Adventist schools are comparable to students in larger schools; and 3) Median composite *achievement* was at the 60<sup>th</sup> percentile and median composite *ability* at 55<sup>th</sup> percentile over the four years for grades 3-8 (both above the national norm—i.e., above the 50<sup>th</sup> percentile of the norm group), and median composite *achievement* was at the 65<sup>th</sup> percentile and median composite *ability* at 62<sup>nd</sup> percentile over the four years for grades 9 and 11 (both above the national norm—i.e., above the 50<sup>th</sup> percentile of the norm group). Furthermore, in all grade levels, the mean achievement was about a third of a grade level higher than the predicted value based on ability (CognitiveGenesis, 2013).

This study was conducted in the Adventist schools only in Unites States. Given that Canada's Adventist schools were not included, the findings of this study may not be generalized to NAD or the global Adventist school system in general. (Adventist schools, education, or school systems—unless specified—are usually defined and considered as a global term.) Moreover, given that La Sierra University itself is among the NAD educational institutions and in charge of conducting this research, the findings of this study might have been more reliable if the data and related findings had also been analyzed and validated by an independent institution as well.

## Definitions

**Remediation** (also known as the preparatory education or developmental coursework) refers to programs providing reading, writing, and mathematics courses for students with (related) competencies measured at below their grade levels, or students who are inadequately prepared entering higher education.

**Remedial mathematics** (also known as developmental mathematics) refers to mathematics courses required for freshman college students who are not prepared for college-level mathematics courses, typically College Algebra. In this study, mathematics remediation refers to middle school mathematics (including Pre-Algebra) required for freshmen high school students who are unprepared for Algebra 1.

## Causes and Factors

In addition to internal factors, all organizations, with varying degrees, are impacted by external changes and influences—the identifications and especially diagnoses of which are usually very complex. As such, identifying internal and external contributing factors to problems with respect to educational institutions is a colossal task. In this study, I attempt to identify both internal and external contributing factors with respect to the existing problem at RHS.

## External Factors

Like other secondary institutions, RHS admits freshman students from a variety of middle schools. Although the majority of these students come from within the Adventist schools system, RHS also accepts students from public schools and other Christian denominations' school systems, among others. And so, students with varying

degree of competencies with respect to their grade levels are admitted who subsequently attend Algebra 1 as a high school entry level mathematics. RHS has been experiencing that about 25 percent of these students have difficulties in mathematics, and thus struggle in Algebra 1. Naturally, RHS does not have control over the possible educational-related inadequacies in other schools. As explained before, the problem associated with student unpreparedness, especially in reading and mathematics, is a national issue which seems to have its roots established early during students' elementary school-years. Given the complexity and enormity of the issue and its root causes, most studies have concentrated on remediation as a solution and its effectiveness.

### Internal Factors

Internal factors—such as structural changes, budget, and new administration, among others—usually have direct impact on an educational institution. Although the major contributing factors associated with this problem at RHS are external in nature, there are internal factors which have amplified the problem. To better understand and diagnose the internal factors associated with this problem at RHS, the Bolman and Deal's organizational theory—the four-frame model: human resource as well as structural, political, and symbolic frames—is used (Bolman & Deal, 2008).

**Human Resource Cause:** Lack of a dedicated program in the Mathematics Department

Several administrators and leaders at RHS have been aware of this problem for many years; however, they did not address the issue effectively. It is important to note

that during the last eight years, RHS has been managed by two entirely different administration teams, and was subject to complete structural changes less than three years ago. Undoubtedly, such major changes especially during a short span of time would also have a major impact on the problem in this study. Nonetheless, the Mathematics Department at RHS has not truly investigated the problem internally—concentrating on the external causes associated with the problem. Given the situation, although all four members of the Mathematics Department had been aware of the problem, they mainly discussed its related impacts.

**Structural Cause:** Lack of a clear admission policy and procedure with regard to unprepared incoming freshman students

As far as admissions are concerned, RHS has a relatively relaxed policy with regard to admitting students. As such, it has continuously been admitting freshman students (approximately a quarter of whom) require remediation in mathematics.

**Political Cause:** Lack of a comprehensive plan at the Conference level

Given that the majority of its incoming freshmen come from within the Adventist system, a good percentage of these unprepared students come from the middle schools under the jurisdiction of the Conference. The administration at RHS has not discussed the issue in the Conference. Having done so, they would have critically looked into the educational processes within many elementary and middle schools under the jurisdiction of the Conference which is not a “politically correct” move. The other option for the RHS administration would have been to simply refuse admission to the unprepared incoming freshmen. This option would have also introduced very negative political consequences.

### **Symbolic Cause:** Undetermined

Given the organization's mission and culture, RHS has always stressed its intellectual and academic growth as a symbol for an institution of choice which has also been a source pride for RHS faculty and staff. The problem associated with the unprepared freshman students was an important issue to consider, discuss, and investigate by the faculty and administration. However, it is not entirely clear as to why such issue has been overlooked at the school level.

### Proposed Solution

The new RHS administration became determined to resolve the continuous problems associated with the unprepared incoming freshmen; however, they highly desired to avoid a possible tension with other Adventist schools and the Conference.

The school administration finally decided to look into this problem more closely and provide a data-driven solution using which RHS would be able to control and gradually resolve this problem "internally"—a possible solution to the *political cause* with respect to the problem in this study. The Admission Department at RHS has always been collecting incoming freshman students' ACT Explore test, Florida Comprehensive Assessment Test (FACT 2.0), and/or Iowa Test of Basic Skills (ITBS) scores as part of its admission requirements. Therefore, the RHS administration has been aware of students with low scores in mathematics, but the lack of a clear admission policy prevented them from taking the necessary action. With respect to a comprehensive admission policy including unprepared incoming freshman students, the new school administration evaluated two options: 1) Rejecting admissions to these students; and 2)

Admitting these students with a precondition—requiring them to take the related remediation course offered by RHS. The administration selected the latter option temporarily without changing the current admission policy officially until a proposed solution is determined, implemented, and evaluated—a possible solution to the *structural cause* with respect to the problem in this study.

To study the problem and remedy a solution, the academic dean at school designated me, one of the teachers at RHS with the necessary experience and credentials in research and design, to investigate the problem and propose a solution. Furthermore, under the supervision of the academic dean, I would be fully supported by the Mathematics Department. In addition, it was decided that after the initial implementation and evaluation of the desired solution, the Mathematics Department would be fully in charge of the remediation course. A preliminary study, conducted in 2014, indicated that about 25 percent of incoming freshman students struggle in mathematics—a high percentage of whom pass Algebra 1 with a grade of “C” (a score about 75 percent). In this study, students’ ACT Explore scores for grade 8 (the math portion only) were compared with their semester and final Algebra 1 grades. These students continue struggling through Geometry and especially Algebra 2 as it has also been observed by the Mathematics Department at RHS. In such situations, as research clearly indicates, remediation is a natural solution. Thus, concentrating on the lack of an adequate student background knowledge of mathematics as a major contributing (external) factor to this problem, this study proposed a remediation solution by designing and implementing a remediation course—Mathematics Intervention Program

(MIP)—for a select number of incoming freshmen — a possible solution to the *human resource cause* with respect to the problem in this study.

### Mathematics Remediation

According to the National Assessment of Educational Progress report that identifies the improvement in mathematics for students at all achievement levels, as Bottge, Grant, Stephens, & Rueda (2010) point out, “26% of students without disabilities and 67% of students with disabilities in Grade 8 still scored below the *Basic* level in math” (p. 81). Research indicates that traditionally mathematics remediation has been less successful and that the need for a more comprehensive study on the effectiveness of mathematics remediation has become necessary. Among those who are in need of remediation, more students require remediation in mathematics, as Bahr (2007) observes, yet their low rate of successful remediation is troubling for “three out of four underprepared students who start down the path toward college-level math never arrive at that destination” (p. 697). Furthermore, students do often “associate mathematics with anxiety and failure, which can negatively influence engagement,” motivation, and self-efficacy—components of which are essential especially in remedial mathematics courses (Wenner, Burn, & Baer, 2011). With respect to the secondary mathematics, research indicates that students who lack the necessary knowledge of middle school mathematics will struggle and most likely fail Algebra 1. As such, remediation in mathematics is vital in improving the mathematical foundations of the freshman students who lack the necessary knowledge of middle school mathematics (especially the grade 8 mathematics and Pre-Algebra). The impact of this unpreparedness is

strongly manifested when students take Algebra 1, which is a fundamental course in high school mathematics and beyond. A successful completion of Algebra 1 is, indeed, essential for undertaking Geometry and Algebra 2 among others.



## CHAPTER TWO: DESIGN

### Mathematics Intervention Program

#### Overview

The MIP program is a remedial course in mathematics concentrated on mathematics grades 6-8 and Pre-Algebra which is designed to “help students make the transition from basic elementary mathematics to Algebra 1 and Geometry and provides a foundation for understanding a broad spectrum of mathematical topics” (NAD, 2003, p. 51).

#### Objectives

Upon the completion of this course, students will:

1. Know the real number system, and be able to add, subtract, multiply and divide rational numbers.
2. Solve problems involving integer exponents, roots, and radicals.
3. Understand ratio, analyze proportional relationships, and use their applications.
4. Understand variables and evaluate expressions.
5. Solve one-variable equations and Inequalities.
6. Understand and evaluate functions.
7. Distinguish geometric shapes and figures.
8. Solve problems involving measuring and computing angle, perimeter, area, surface area and volume.
9. Understand the concept of probability and perform statistical data analysis.

## Standards

Standard-based education has become a common approach in teaching and learning for several decades. It has also become a venue by which schools and teachers (even students) are held accountable for learning achievements. As a set of guiding principles, standards refer to “how well the student must perform, at what kinds of tasks, based on what content, to be considered proficient and effective” (Wiggins & McTighe, 2006, p. 350). The MIP standards are developed in comparison with the NAD standards and the ACT Explore/Aspire standardized test contents to ensure compatibility. Although indirectly (somewhat) relevant, Sunshine State Standards are also considered and compared during the development process. The MIP standards are divided into four domains and four sub-domains: 1) Numbers, Properties, and Operations (including two sub-domains: Numbers and Operations as well as Ratio and Proportions); 2) Algebra (including two sub-domains: Variables, Equations, and Inequalities as well as Functions); 3) Geometry; and 4) Probability, Statistics, and Analysis. More information regarding these domains in comparison with the NAD, ACT Explore and Sunshine State standards are provided in Table 1. To maximize efficiency and expand simplicity, four modules of the MIP program carry the names of their corresponding domains. Furthermore, each domain is identified using specific codes to facilitate referencing, among others. These codes start with the M.I.P. prefix (for MIP) followed by “M” (for Mathematics, the first domain), “A” (for Algebra, the second domain), “G” (for Geometry, the third domain), or “D” (for Data, the fourth domain), then followed by a number. Table 2 provides detail information on MIP standards.

**Table 1 — MIP Standards Overview and Comparison**

Standard	Domain/Content								
<b>MIP</b>	• Numbers, Properties and Operations			• Algebra		• Geometry		• Probability, Statistics and Data Analysis	
	Numbers and Operations	Ratio and Proportion		Variables, Equations and Inequalities	Functions				
<b>NAD</b>	• Number and Operations			• Algebra		• Geometry	• Measurement	• Data Analysis and Probability	
	Computation	Ratio and Proportion	Designs and Patterns	Variables and Equations	Functions				
<b>ACT Explore</b>	• Numbers: Concepts and Properties	• Basic Operations and Applications		• Expressions, Equations and Inequality	• Graphical Representations	• Properties of plane figures	• Measurement	• Probability, Statistics and Data Analysis	
<b>Sunshine State</b>	• The Number System	• Ratios and Proportional Relationships		• Expressions and Equations	• Functions	• Geometry		• Statistics and Probability	

Sources: ACT-Explore (2013); FLDOE (2014); NAD (2003)

**Table 2 — MIP Standards**

<b>MIP Standards</b>					
<b>MODULE I: NUMBERS, PROPERTIES AND OPERATIONS</b>		<b>MODULE II: ALGEBRA</b>		<b>MODULE III: GEOMETRY</b>	<b>MODULE IV: PROBABABILITY, STATISTICS AND DATA ANALYSIS</b>
Numbers and Operations	Ratio and Proportion	Variables, Equations and Inequalities	Functions	Geometry	Probability, Statistics and Data Analysis
<b>upon the completion of each standard, the student will be able to:</b>					
<ul style="list-style-type: none"> <li>• <b>M.I.P.M.1:</b> Know the real number system, and be able to add, subtract, multiply, and divide rational numbers.</li> <li>• <b>M.I.P.M.2:</b> Solve multi-step arithmetic problems using rational numbers.</li> <li>• <b>M.I.P.M.3:</b> Solve problems involving integer exponents, roots, and radicals.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>M.I.P.M.7:</b> Understand ratio and use its applications.</li> <li>• <b>M.I.P.M.8:</b> Analyze proportional relationships and use their applications.</li> <li>• <b>M.I.P.M.9:</b> Solve problems that involve percentage and interest.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>M.I.P.A.1:</b> Understand variables, and simplify and evaluate expressions.</li> <li>• <b>M.I.P.A.2:</b> Solve first-degree equations with one variable.</li> <li>• <b>M.I.P.A.3:</b> Perform word-</li> </ul>	<ul style="list-style-type: none"> <li>• <b>M.I.P.A.6:</b> Understand and evaluate linear functions.</li> <li>• <b>M.I.P.A.7:</b> Understand coordinate system and ordered pairs.</li> <li>• <b>M.I.P.A.8:</b> Locate points in the</li> </ul>	<ul style="list-style-type: none"> <li>• <b>M.I.P.G.1:</b> Understand points, lines and rays.</li> <li>• <b>M.I.P.G.2:</b> Understand and solve problems involve angles and transversal.</li> <li>• <b>M.I.P.G.3:</b> Understand geometric shapes and</li> </ul>	<ul style="list-style-type: none"> <li>• <b>M.I.P.D.1:</b> Understand the concept of probability.</li> <li>• <b>M.I.P.D.2:</b> Determine the probability of an event.</li> <li>• <b>M.I.P.D.3:</b> Compute measures of central tendency.</li> </ul>

<ul style="list-style-type: none"> <li>• <b>M.I.P.M.4:</b> Understand estimating and rounding, absolute value, primes and greatest common factor.</li> <li>• <b>M.I.P.M.5:</b> Understand the scientific notation.</li> <li>• <b>M.I.P.M.6:</b> Solve problems that involve converting units of measurement.</li> </ul>		<p>to-symbol translations.</p> <ul style="list-style-type: none"> <li>• <b>M.I.P.A.4:</b> Understand and solve inequalities with one variable.</li> <li>• <b>M.I.P.A.5:</b> Solve real-world problems involving simple equation.</li> </ul>	<p>coordinate plane.</p> <ul style="list-style-type: none"> <li>• <b>M.I.P.A.9:</b> Perform graphing tables.</li> <li>• <b>M.I.P.A.10:</b> Perform graphing linear equations.</li> <li>• <b>M.I.P.A.11:</b> Understand and solve problems involve slope and intercepts.</li> <li>• <b>M.I.P.A.12:</b> Constructing linear equations.</li> </ul>	<p>figures.</p> <ul style="list-style-type: none"> <li>• <b>M.I.P.G.4:</b> Solve problems involve computing perimeter and area of geometric figures.</li> <li>• <b>M.I.P.G.5:</b> Solve problems involve computing surface area and volume of geometric solid figures.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>M.I.P.D.4:</b> Create and use frequency tables.</li> <li>• <b>M.I.P.D.5:</b> Create and interpret graphs.</li> <li>• <b>M.I.P.D.6:</b> Read, understand and manipulate data from tables and graphs.</li> <li>• <b>M.I.P.D.7:</b> Perform statistical data analysis.</li> </ul>
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Sources: Authors' developed standards based on information from ACT-Explore (2013); FLDOE (2014); NAD (2003)

## Contents

The following is a short list of MIP contents.

**Module 0:** Course Overview (Duration:  $\frac{1}{2}$  Week)

**Module I:** Numbers, Properties, and Operations (Duration:  $4\frac{1}{2}$  Weeks)

**Module II:** Algebra (Duration:  $5\frac{1}{2}$  Weeks)

**Module III:** Geometry (Duration: 4 Weeks)

**Module IV:** Probability, Statistics, and Data Analysis (Duration:  $2\frac{1}{2}$  Weeks)

The following is the list of MIP contents in detail.

### Module 0: COURSE OVERVIEW

1. Orientation and syllabus
2. eBackpack Program for Students

### Module I: NUMBERS, PROPERTIES AND OPERATIONS

1. Computation and Basic Operation
  - 1.1. Real and Rational Numbers
  - 1.2. Estimating and Rounding
  - 1.3. Absolute Value
  - 1.4. Exponents, Roots, and Radicals
  - 1.5. Scientific Notation
  - 1.6. Primes and Greatest Common Factor
  - 1.7. Units of Measure and Conversions
2. Ratio and Proportion
  - 2.1. Ratio and Proportion and Their Applications

2.2. Percent and Interest

## **MODULE II: ALGEBRA**

### **1. Variables and Expressions**

1.1. Variables and Expressions

1.2. Simplifying and Evaluating Expressions

### **2. Properties and Order of Operations**

2.1. Properties

2.2. Order of Operations

### **3. Equations**

3.1. Equations with Variables on One and Both Sides

3.2. Solving Multi-Step Equations

3.3. Performing Word-to-Symbol Translation

### **4. Inequalities**

4.1. Solving Inequalities by Adding or Subtracting

4.2. Solving Inequalities by Multiplying or Dividing

4.3. Solving Multi-Step Inequalities

### **5. Functions**

5.1. Linear Functions

5.2. Coordinate System and Ordered Pairs

5.3. Graphing Tables and Linear Equations

5.4. Slope and Intercept

5.5. Writing Linear Equations

## **MODULE III: GEOMETRY**

### **1. Points, Lines, and Line Segments**

### **2. Angles**

2.1. Acute, Right, and Obtuse Angles

2.2. Vertical, Complementary, and Supplementary Angles

### **3. Transversals**

3.1. Parallel Lines and Adjacent Angles

3.2. Alternate Interior and Exterior Angles

### **4. Triangles**

4.1. Right, Acute, and Obtuse Triangles

4.2. Equilateral, Isosceles, and Scalene Triangles

4.3. Similar Triangles

### **5. Rectangle, Square, and Circle**

### **6. Solid Figures**

### **7. Perimeter, Area, and Volume of a Figure**

## **MODULE IV: PROBABILITY, STATISTICS AND DATA ANALYSIS**

### **1. Probability**

1.1. Calculating Probability

1.2. Tree Diagrams

### **2. Measure of Central Tendency**

2.1. Mean, Median, Mode and Range

2.2. Frequency Table



### **3. Creating and Interpreting Graphs**

- 3.1. Reading and Interpreting Tables and Graphs
- 3.2. Bar, Line, and Circle Graphs
- 3.3. Histograms

### **Storyboards**

Storyboarding is tremendously helpful, if not essential, during the curriculum and instructional design process. It helps all involved to have a clear idea and overview of what content will be presented, how they will be delivered, and how learning will be measured, among others. In the storyboarding of the MIP program, I have concentrated on identifying the contents, learning outcomes, activities, and assessment methods as well as leaning theories that are utilized for each module. The following is the storyboard of the MIP program.

#### **Module 0: Course Overview**

##### **Summary of Content:**

- Familiarization with course requirements, assignments, assessments, and other course policies and procedures
- Familiarization with the eBackpack program

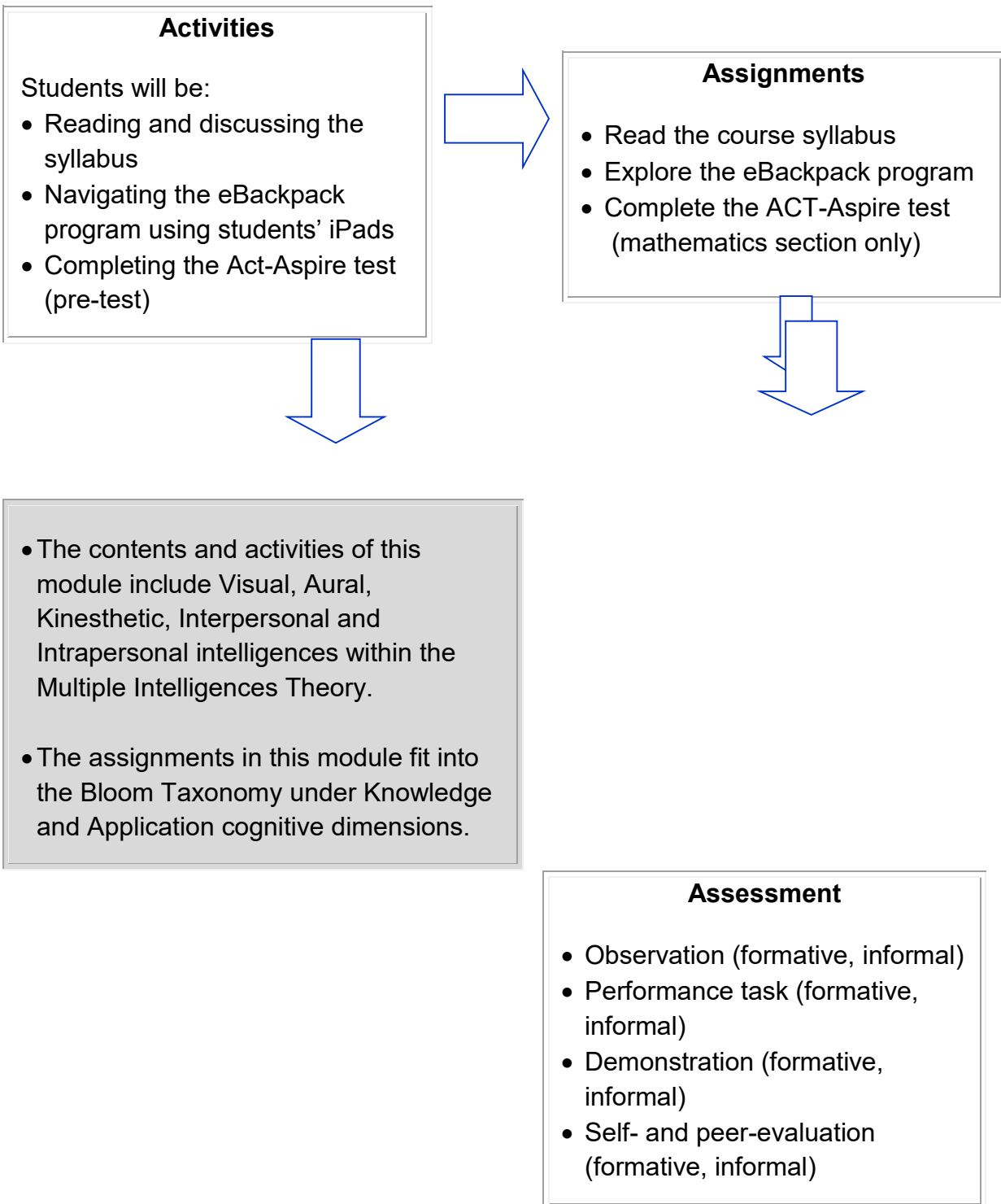
##### **Learning Outcomes:**

Upon the completion of this module, the student will be able to:

- Identify course requirements, policies and procedures.
- Demonstrate navigating the eBackpack program using an iPad.

Figure 1 reflects the storyboard for Module 0.

**Figure 1** — Storyboard for Module 0



**Module I: Numbers, Properties and Operations**

**Summary of Content:**

- Real numbers and operations involving rational numbers
- Improper fraction and mixed numerals
- Problems involving integer exponents, roots, and radicals
- Estimating and rounding, absolute value, primes and greatest common factor
- Scientific notation and conversion of units of measurement
- Ratio and proportional relationships and their applications

**Learning Outcomes:**

Upon the completion of this module, the student will know and be able to:

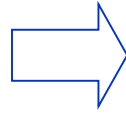
- The real number system and their characteristics and relationship
- Estimating, scientific notation and rounding, absolute value, primes and greatest common factor
- Proportion and use its applications
- Solve simple and multi-step arithmetic problems using rational numbers.
- Solve problems involving integer exponents, roots, and radicals.
- Solve problems involving converting units of measurement.
- Analyze proportional relationships and use their applications.
- Solve problems involving percentage and interest.

Figure 2 reflects the storyboard for Module I.

### Activities

Students will be:

- Reviewing and solving problems related to the previous concepts at home using the module.
- Studying the new concepts (as directed) and solving related problems using physical and virtual recourses.
- Working on the bell-work and participating in the corresponding class discussion.
- Participating in the discussion of the new concepts (and views) presented in class.
- Working on examples and problems related to the presented new concept individually or in groups as well as interacting with the teacher and the in-class tutor.
- Completing the corresponding module tests and quizzes in class.



### Assignments

- Review the assigned concepts in the module using the online links as well as resources provided in the module and workbooks.
- Solve problems provided in the module and workbooks as directed, and check answers in the provided sources.

### Assessment

- Observation (formative, informal)
- Performance task (formative, informal)
- Demonstration (formative, informal)
- Self- and peer-evaluation (formative, informal)
- Quizzes (formative, formal)
- End-of-module Test (summative, formal)

- The contents and activities of this module include Visual, Aural, Kinesthetic, Logical, Interpersonal and Intrapersonal intelligences within the Multiple Intelligences Theory.
- The assignments in this module fit into the Bloom Taxonomy under Knowledge, Comprehension, Application and Analysis cognitive dimensions.

**Figure 2** — Storyboard for Module I

## **Module II: Algebra**

### **Summary of Content:**

- Variables and expressions
- Equations and inequalities
- Linear Functions

### **Learning Outcomes:**

Upon the completion of this module, the student will be able to:

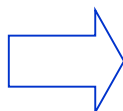
- Simplify and evaluate expressions.
- Understand the laws of operations.
- Apply the order of operations.
- Solve equations and inequalities with one variable.
- Understand and apply linear functions.
- Understand coordinate system and ordered pairs, and locate points in the coordinate plane.
- Construct and graph linear equations and related tables.
- Perform word-to-symbol translation and solve real-world problems.

Figure 3 reflects the storyboard for Module II.

### **Activities**

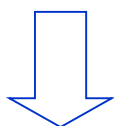
Students will be:

- Reviewing and solving problems related to the previous concepts at home using the module.
- Studying the new concepts (as directed) and solving related problems using physical and virtual recourses.
- Working on the bell-work and participating in the corresponding class discussion.
- Participating in the discussion of the new concepts (and reviews) presented in class.
- Working on examples and problems related to the presented new concept individually or in groups as well as interacting with the teacher and the in-class tutor.
- Completing the corresponding module tests and quizzes in class.



### **Assignments**

- Review the assigned concepts in the module using the online links as well resources provided in the module and workbooks.
- Solve problems provided in the module and workbooks as directed, and check your answers in the provided sources.



- The contents and activities of this module include Visual, Aural, Kinesthetic, Logical, Interpersonal and Intrapersonal intelligences within the Multiple Intelligences Theory.
- The assignments in this module fit into the Bloom Taxonomy under Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation cognitive dimensions.

### **Assessment**

- Observation (formative, informal)
- Performance task (formative, informal)
- Demonstration (formative, informal)
- Self- and peer-evaluation (formative, informal)
- Quizzes (formative, formal)
- End-of-module Test (summative, formal)

**Figure 3** — Storyboard for Module II

## **Module III: Geometry**

### **Summary of Content:**

- Points, lines and rays
- Angles and transversals
- Triangles
- Rectangle, Square, and Circle
- Solid figures

### **Learning Outcomes:**

Upon the completion of this module, the student will be able to:

- Define and distinguish points, lines and rays.
- Understand different types of angles and their properties.
- Understand angles associated with transversals and measure them.
- Understand different types of triangles and their properties.
- Understand rectangle and square and their properties.
- Understand different types of triangles and their properties.
- Compute the perimeter and area of geometric figures.
- Compute the surface area and volume of solid figure.

Figure 4 reflects the storyboard for Module III.

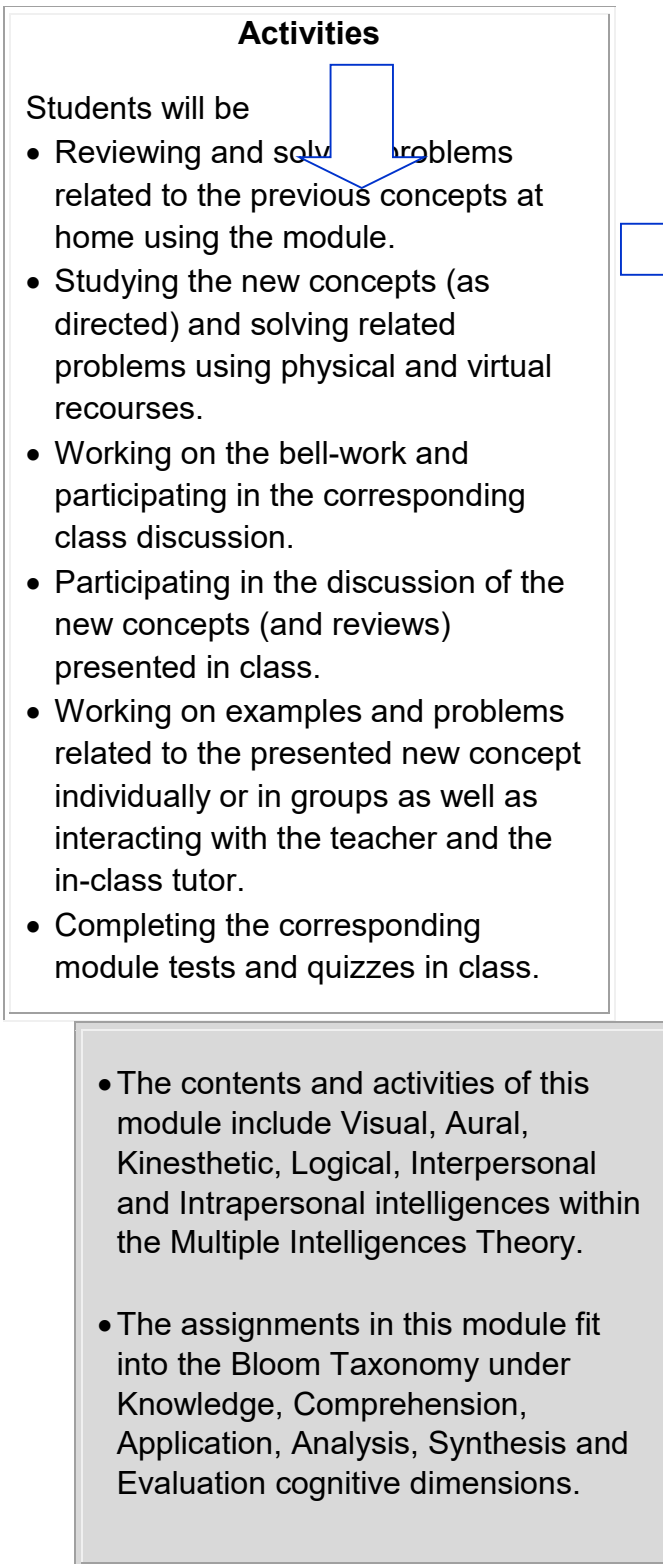


### **Assessment**

- Observation (formative, informal)
- Performance task (formative, informal)
- Demonstration (formative, informal)
- Self- and peer-evaluation (formative, informal)
- Quizzes (formative, formal)
- End-of-module Test (summative, formal)

### **Assignments**

- Review the assigned concepts in the module using the online links as well resources provided in the module and workbooks.
- Solve problems provided in the module and workbooks as directed, and check answers in the provided sources.



**Figure 4** — Storyboard for Module III

## **Module IV: Probability, Statistics and Data Analysis**

### **Summary of Content:**

- Probability of an event
- Measure of central tendency
- Tables and graphs

### **Learning Outcomes:**

Upon the completion of this module, the student will be able to:

- Determine the probability of an event.
- Calculate the average of a list of numbers.
- Determine the median, mode and range of a list of numbers.
- Create and use frequency tables.
- Create and interpret graphs.
- Read, understand and manipulate data from tables and graphs.

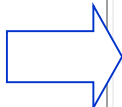
Figure 5 reflects the storyboard for Module IV.

### **Activities**

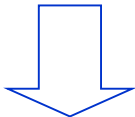
Students will be

- Reviewing and solving problems related to the previous concepts at home using the module.
- Studying the new concepts (as directed) and solving related problems using physical and virtual recourses.
- Working on the bell-work and participating in the corresponding class discussion.
- Participating in the discussion of the new concepts (and reviews) presented in class.
- Working on examples and problems related to the presented new concept individually or in groups as well as interacting with the teacher and the in-class tutor.
- Completing the corresponding module tests and quizzes in class.

### **Assignments**

- 
- Review the assigned concepts in the module using the online links as well resources provided in the module and workbooks.
  - Solve problems provided in the module and workbooks as directed, and check answers in the provided sources.

### **Assessment**

- Observation (formative, informal)
  - Performance task (formative, informal)
  - Demonstration (formative, informal)
  - Self- and peer-evaluation (formative, informal)
  - Quizzes (formative, formal)
  - End-of-module Test (summative, formal)
- 

- The contents and activities of this module include Visual, Aural, Kinesthetic, Logical, Interpersonal and Intrapersonal intelligences within the Multiple Intelligences Theory.
- The assignments in this module fit into the Bloom Taxonomy under Knowledge, Comprehension, Application, Synthesis and Evaluation cognitive dimensions.

**Figure 5** — Storyboard for Module IV

## Textbook

Inclusion of a variety of sources has been important in the design of the MIP program. Textbooks, in general, include too many topics, and promote an overwhelming feeling for both students and teachers. A textbook is truly helpful if it is used as a tool to promote learning, among other resources, and not taking a central role in the process of teaching and learning. As Wiggins and McTighe (2006) observe, at their best, textbooks “organize information and provide many exercises for reinforcing key knowledge and skill” (p. 231). Having this principle in mind, the following criteria are considered for an appropriate textbook for the MIP course: 1) covering the content of the MIP program, 2) providing a balanced approach to the content and related explanations, 3) including several solved examples and a variety of exercises and their answers, 4) being visually pleasing and age appropriate, and 5) being relatively inexpensive since the cost of providing the text was included in the MIP budget. After careful consideration, the following three textbooks are designated for the MIP program which satisfy the above criteria and offer more:

Spectrum (2007). *Spectrum math – grade 8*. Greensboro, NC: Carson-Dellosa.

Spectrum (2011). *Spectrum algebra – grades 6-8*. Greensboro, NC: Carson-Dellosa.

Spectrum (2011). *Spectrum Data Analysis & Probability – Grades 6-8*.

Greensboro, NC: Carson-Dellosa.

## Procedures

Upon a full or partial admission of the incoming freshmen at RHS, students' prior scores on the Explore test, the ITBS test, or FCAT 2.0 were collected and analyzed.

The following is the criteria for MIP placement: student test score on ACT Explore is 18 or less; student test score in FCAT 2.0 is 240 or less; or student normalized standard score on ITBS is 3 or less. The procedures are as follow:

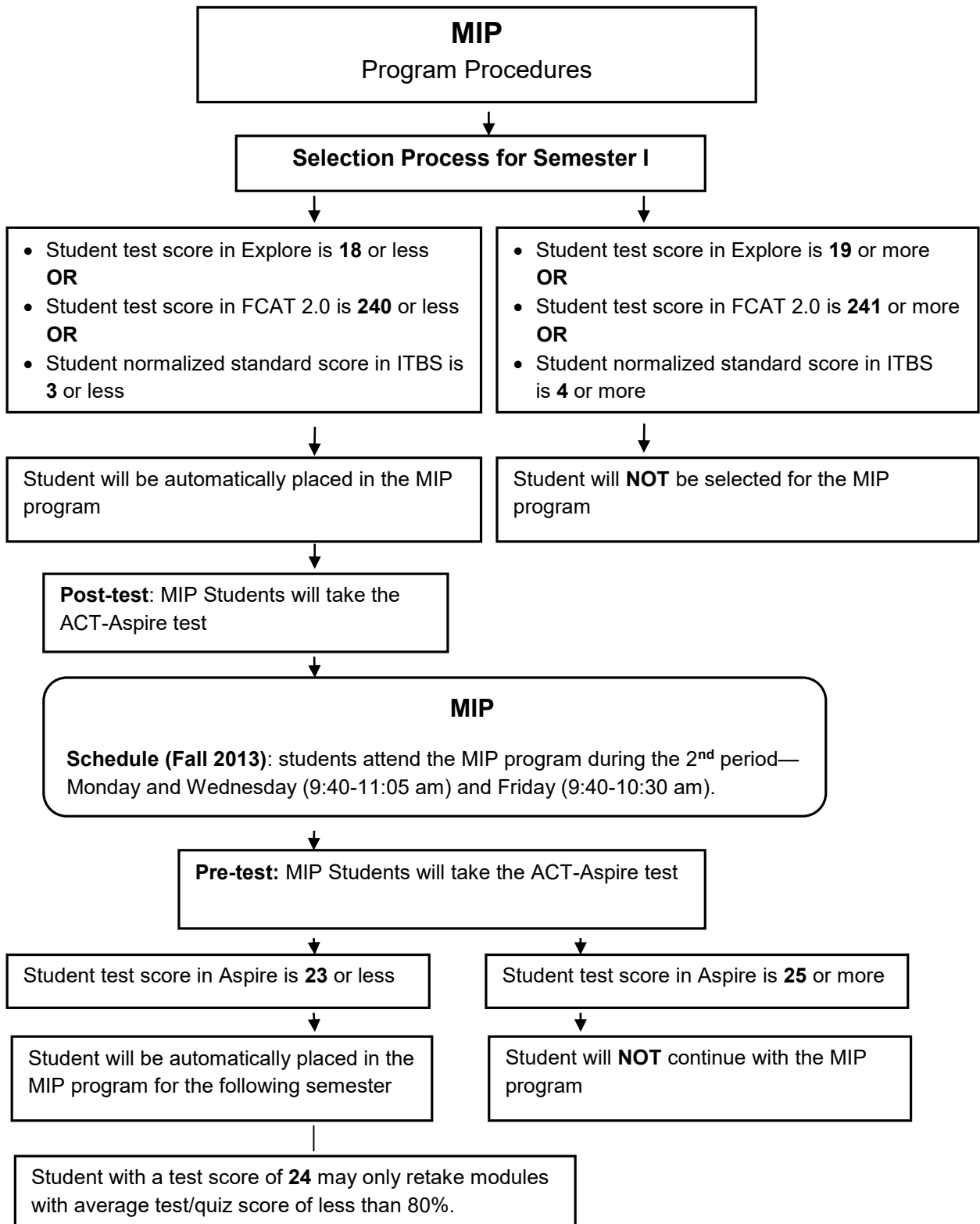
1. Students who met the placement criteria for the MIP were automatically placed in the program during the first semester.
2. During the first week of the program students will take the ACT-Aspire test—pre-test.
3. During the regular class sessions, students studied each section in the selected module, completed the section activities and exercises, and worked with the teacher and tutor when necessary. Then, they reviewed the section and completed the corresponding quiz(s). After completing each module, they reviewed the assigned module and completed the corresponding end-of-module test.
4. At the end of the semester, students took the ACT-Aspire test again (post-test). Student who scored 25 (%83.3) or above on the ACT-Aspire test were removed from the MIP program. However, students with the score of 23 (%76.6) or less continued with the MIP program in the following semester.
5. A student whose score was 24 (80%, borderline score) were considered for further consideration. In such case, the MIP teacher compared the student's average percentage for each module with the cutoff percentage of 83 percent (grade "B" at RHS). The result helped the teacher to determine whether the student would pass

the corresponding module, and thus only retake modules which she/he has earned less than 83 percent.

6. The results will also be analyzed and compared with students' corresponding pre-test scores to determine the success of the program.

Figure 6 demonstrates the procedures in detail.





**Figure 6 – MIP Program Procedure**

## Program Design

The purpose of this program design is to address the overall mathematics remediation needs of the MIP students and teacher, Mathematics Department, and the administration at RHS. It is designed for a face-to-face (F2F) classroom environment.

The overall design of this program is based on prior research, general principles of design and learning, and personal experience (as a teacher, designer, and artist). The MIP program is designed to include the following characteristics:

- Promoting a student-center learning environment;
- Empowering students to get directly involved in their own learning;
- Using differentiated instructional strategies to maximize efficiency and learning;
- Using the flipped classroom model to maximize student involvement;
- Using appropriate technology and digital media to maximize learning and differentiation;
- Using elements of backward design principles and universal design for learning to maximize efficiency and promote learning;
- Using universal principles of design to enhance the overall usability and aesthetics aspects of the design;
- Using the learning styles theory to maximize differentiation and learning;
- Incorporating theoretical approaches to learning that are derived from cognitive psychology (aspects of information-processing approaches, motivational models, Vygotsky's sociocultural-cognitive theory, and Bandura's social-cognitive theory);
- Incorporating aspects of both teacher-led and constructivist approaches to teaching and learning; and

- Including assignments, activities, and assessment that are designed based on cognitive process dimensions included in the Bloom's Taxonomy for learning, teaching, and assessing.

Although often neglected, the overall satisfaction of those who actually use the product is central to a successful design. As Norman (2013) indicates, designs should be human-centered—a philosophy that encourages designers to make products that meet people's needs and satisfaction, in terms of being functional, understandable, usable, and visually pleasing. To accomplish these important results, designers must have a “good understanding of people and the needs that the design is intended to meet” (Norman, 2013, p. 9), which is accomplished primarily through observation of the intended users and research. Such approaches are, indeed, vital in designing products that are intended for use in an educational environment. The MIP program has been designed with consideration for typical characteristics of MIP students and both novice and veteran teachers. A typical MIP student is about 14 to 15 years old, mainly freshman high school student with demographic characteristics similar to those of RHS (more on this on Chapter III). Furthermore, in this design, ample consideration has been given to both novice and veteran teachers. In practice, given the (daily) classroom dynamics and teachers' sense of autonomy and personal satisfactions, providing rigid step-by-step action recipes for teachers' functions in the classroom will not be practical. In this regard, numerous resources, information, and guidelines are provided for novice teachers. And, at times, flexible recipe-like actions are also provided to maximize efficiency and productivity (especially for the novice teachers). Furthermore, the design is flexible enough for a veteran teacher to modify certain aspects of the lesson plans

without changing the integrity of the program (more on these two points later in this chapter).

Designing products that earn users' overall satisfaction is a complex task given the variety of individuals' needs, preferences, interests, knowledge, and abilities. However, designing a product for an educational learning environment which, along with utilizing sound design principles, requires knowledge of multiple aspects of human behavior and learning processes, and more, is a colossal task. Correspondingly, designing a comprehensive and successful curriculum, in addition to an understanding of the learners' characteristics and needs, requires the knowledge of relevant learning theories, and the necessary design elements among others. Several design and learning principles and theories have been used in the design of the MIP program.

## **Theoretical Framework**

### **Learning Theories**

The theoretical approaches to learning that are derived from cognitive psychology (information-processing approaches, motivational models, Vygotsky's sociocultural-cognitive theory, and Bandura's social-cognitive theory); learning styles theory, and constructivist approaches to teaching and learning; and cognitive process dimensions included in the Bloom's Taxonomy for learning, teaching, and assessing are used in the design of the MIP program.

Vygotsky's emphasis on the importance of social interactions during the learning process is used in the design to promote a more collaborative program (student-to-student during the group work activities; peer-tutoring) in which more experienced

students are used to help the teacher with the processes of “imitation and invention” (Gredler, 2009). This theory is used hand-in-hand with Bandura’s emphasis on observation, imitation, and modeling and their impact on learners’ cognitive processes (Gredler, 2009). In this program, an experienced teacher, the designated tutor, and online videos demonstrate how to approach learning new concepts, perform activities, and solve problems. The Goal Orientation Models address the learners’ rationale for engagement in a task and “how they approach and engage in learning activities” (Gredler, 2009, p. 397). Correspondingly, the modules in this program (semi self-directed and peer-coaching) are designed to enable students mastering desired tasks, making progress in learning new skills, and/or feeling good about engaging in those tasks—the very definition of success for learners with learning-goal orientations (Gredler, 2009). Given the environment of a remediating classroom, especially in mathematics, student motivation has a great impact on learning—thus the success of the program. Therefore, the design of the program must maximize student motivation to learn—an essential contributing factor in the learning process. In a learning environment, such as a classroom which embodies learners from different cultures, ethnicities, emotions, beliefs, and socioeconomic backgrounds, individual and group’s motivation to learn become very complex and its analysis a colossal task. Nonetheless, motivational principles seem comparable, although “specifics of motivational beliefs will vary developmentally, culturally, and along other dimensions” (Rueda, 2011, p. 39).

Motivation, according to Mayer (2011), is a reflection of the amount of effort learners exert to “engage in the appropriate processes of selecting, organizing, and integrating” the material during learning (p. 39). As such, it is necessary to study

carefully the common indicators of motivational factors. These indicators, according to Schunk, Pintrich, and Meece (as cited in Rueda, 2011), are identified as *active choice*—actively choosing an activity over another—, *persistence*—commitment to follow an activity over time, and *effort*—investing the necessary mental work. Moreover, the importance of “variables” associated with these indicators—i.e., self-efficacy, attributions, values, goals, and goal orientations (Rueda, 2011)—in the analysis of the students’ motivation to learn is emphasized. Self-efficacy, according to Bandura (as cited in Rueda, 2011), refers to “people’s judgments of their capabilities to organize and execute the course of action required to attain designated levels of performances” (p. 39). More specifically, in an academic setting, it refers to the beliefs that learners can successfully perform particular academic tasks (Zimmerman, as cited in Gredler, 2009). The research indicates that people with higher self-efficacy tend to be highly motivated to “engage in, persist at, and work hard at a task or activity” and that learners who perceive themselves as competent for the task tend to learn better (Rueda, 2011, p. 41). Gredler, (2009) asserts that student self-efficacy may be “enhanced by observing the success of peers who are perceived to be similar in competence” (p. 753). Rueda (2011) recommends the following strategies to address motivational gaps with respect to self-efficacy: 1) Frequently provide clear, accurate, and concise feedback, focusing on the development of students’ expertise and skills; and 2) design tasks that provide opportunities for success.

Usher and Pajares (2008) emphasize the powerful role of social modeling in “the development of self-efficacy, especially when students are uncertain about their own abilities or have limited experience with the academic task at hand” (p. 753). They

stress that such an impact is evident when learners "...who struggle through problems until they reach a successful end, are more likely to boost the confidence of observers than are mastery models..." (p. 753). However, Schunk (as cited in Gredler, 2009) asserts that the use of modeling alone in a classroom seems to be "less effective than when combined with some form of verbal instruction" (p. 375). In this regard, to promote exerting extra effort to make sense of the presented lessons and maximize learning, Mayer (2011) recommends providing instruction that fosters generative processing: Providing relevant graphics along with the words, using a conversational style, relating the new material with learners' familiar knowledge to encourage motor activity, and presenting the new material in a context of familiar situations. Furthermore, he asserts that people learn better when a complex concept is presented in manageable parts (segmenting) which also help learners to better manage their essential (cognitive) processing. He further recommends providing worked examples with step-by-step explanation of how to solve a problem using a variety of coaching, scaffolding, and modeling techniques. Worked examples, according to Gredler (2009), are "effective in facilitating learning in situations involving highly structures tasks or problems..." (p. 247). To facilitate meaningful learning, Mayer (2011) recommends providing pre- and post-questions which help learners better focus "on parts of the lesson that help answer the question" and develop expectations "for a certain type of questions" (p. 76). In addition, providing familiar material relevant to learners' prior knowledge and immediate explanative feedback are highly recommended (Mayer, 2011). The MIP program is designed to provide several solved examples (modeling) and numerous problems

(including answers) for each topic. This would help students to study and practice individually and in groups both in class and at home.

Constructivism maintains that “meaning cannot be taught; it must be fashioned by the learner via artful design and effective coaching by the teacher” (Wiggins & McTighe, 2006, pp. 103-104). In comparison to teacher-centered, the higher benefits of the constructivist’s approach (student-centered) in learning are well established. However, “there is increasing consensus that the two approaches are compatible and...that a balanced instructional paradigm will ultimately provide comprehensive and effective instructional practices...” (Zemelman, Daniels, & Bizar, as cited in Johnson, 2004, p. 73). As Tomlinson (2001) observes, there are occasions in which sharing information or using the same activity with the entire class is more effective or efficient. She further observes that such instruction “establishes common understandings and a sense of community of students by sharing discussion and review” (p. 5). Johnson (2004) observes that a simultaneous combination of both constructivist approaches (resulting in a “meaningful student learning, student-centered instruction, active student involvement, student interest and motivation, and student personal satisfaction with learning” (p. 83)) and instructionist approaches (systematic instruction, and curricular efficiency as well as teacher control, organization, corrective feedback, and specific student learning objectives) is essential in an all-reaching learning environment. As such, although primarily relying on the constructivist approach to learning, the MIP program is designed to incorporate aspects of the teacher-led approach as well.



## Design Framework

The Backward Design model, Universal Design for Learning, Flipped Classroom concept, and general principles of technology and digital media integration in instruction are used in the design of the MIP program.

The MIP program is generally designed according to the principles of *backward design* which is an approach in curriculum design that begins with desired results in mind (Tomlinson & McTighe, 2006; Wiggins & McTighe, 2006). The essence of backward design, according to (Wiggins & McTighe, 2006), is: “Given the desired results and the targeted performances, what kind of instructional approaches, resources, and experiences are required to achieve these goals?” (p. 192). Planning curricula using the backward design process, the designer must consider three stages: 1) identifying desired results (to what students should know and be able to do), 2) determining acceptable evidence (to determine whether students have achieved their desired results), and 3) planning learning activities and instruction (to determine what activities and resources are best necessary to accomplish learning goals) (Tomlinson & McTighe, 2006; Wiggins & McTighe, 2006). In addition, as a theoretical framework for the development of curricula, Universal Design for Learning (UDL) emphasizes on the design of “curricula with the needs of all students in mind, so that methods, materials, and assessment are usable by all” (Little, 2009, p. 10). As Meyer, Rose and Gordon (2014) put it, the basic premise of UDL is to “provide equitable opportunities to reach high standards across variable students in our schools” by providing multiple means of engagement, representation, action, and expression (p. 7). These principles have been

used in constructing the backbone of the design of this program which is extensively explained in the Curriculum Module section which follows later in this chapter.

The integration of technology and digital media in mathematics classrooms (and other subjects) has continuously been encouraged, especially the use of mobile technology, such as tablets, which is second nature to many students (Carr, 2012). With its vast available application programs (*apps*), using iPads has become very popular in learning institutions, most of which cannot afford providing it to all students. Given its popularity and increased usage in the classroom, “scholarly research on the effects of iPad use on education has been limited in general and nonexistent for mathematics achievement since the device became available in 2010...” (Carr, 2012, p. 270). Using mobile devices, in particular, has been important to RHS, given its recent paperless initiative. At the present time, iPads are primarily used at RHS to replace physical textbooks, maximize electronic communications between students and teachers, facilitate electronic homework and project submissions, and utilize somewhat limited other classroom usage—uniform related policies of which are yet to be determined at the school level. Furthermore, there is no clear policy with regard to access to sites in the Internet. This situation has contributed to limiting access to online resources to both teachers and especially students. A lack of a general policy, in this regard, has also affected the integration of some innovative instructional tools and strategies, such as game-based learning applications—integration of which in the design of the MIP program was highly desirable.

Flipped learning is not a new concept; however, it has become more popular, manageable, and beneficial given the Internet, current technology, and mobile devices.

In addition, online resources such as Khan Academy with its wealth of reliable audio-visual resources—providing more than “3,250 digital lectures at no cost” (Paslow, 2010, p. 337) to the consumers—have made flipping classroom a reality for many. Although this model stresses the use of instructional videos, it is important to note that flipped learning is not about using videos in lessons; it is “about how to best use your in-class time with students” (Sams & Bergmann, 2013, p. 16). The flipped classroom model provides more opportunity for direct student involvement in their learning, and extends the responsibility for learning to the students—enabling the teacher to allocate more personalized attention to students in the classroom. According to Fulton (as cited in Herreid & Schiller, 2013), teachers who are using this method “report seeing increased levels of student achievement, interest, and engagement...” (p.62). Bergmann and Sams (2012) observe that using the flipped classroom model helps struggling students by providing more attempt to study using the videos; increases student-teacher and student-student interactions during the class-time; enables slow learners to maximize their learning—given that they can “pause and rewind their teacher” using the provided videos (p. 24)—; and maximizes differentiated instructions. In contrast, Herreid and Schiller (2013) indicate that the flipped model depends “heavily on students preparing outside of class,” and so students “may come unprepared to class to participate in the active learning phase of the course” (p. 63). Given this valid observation, a provision has been made in the design of the MIP program to incorporate reviews of the assigned studies during the (daily) bell-work session in class. Using the flipped classroom model in the design of the program enables the MIP teacher (and tutor) to spend more time with individual students. In addition, it helps them to provide a timely feedback to

individuals and groups of students during the class sessions. The provided online videos in each module are at students' disposal for immediate help, especially at home.

## **Design Specifications**

This section provides detailed information about the design of the components central to the MIP program itself—learning goals and objectives, instructional strategies, assessment, individual modules, and more. It explains how elements of the identified design and learning framework, explained earlier in this chapter, and research findings are utilized to design and develop these vital components. The MIP program is modular, and each module has two aspects: 1) the actual module contents that are used mainly by the students and occasionally the teacher (e.g., Module I), and 2) the overall lesson plans, standards, prerequisites, goals and objectives, and resources among others related to each module that are used primarily by the teacher the teacher and occasionally the academic dean (e.g., Curriculum Module I). This naming convention—Module and Curriculum Module—is developed to help distinguishing these two aspects of each module, and thus prevent confusion. The section is subdivided into two main parts: 1) Curriculum Module, and 2) Module.

### **Curriculum Module**

#### **Framing Questions and Learning Goals**

What we ought to teach and want students to know, understand, and be able to do are central to teaching (Tomlinson & McTighe, 2006). Thus identifying the relevant and appropriate goals and direction is essential to any educational program. Learning goals, according to Marzano (2009), “provide a set of shared expectations among

students, teachers, [and] administrators...” (p. 4). McTighe and Wiggins (2013) stress the establishment of essential questions—fundamental and necessary questions that are thought-provoking and intellectually engaging—is essential to promote higher-order thinking in the classroom as well as designing well-established learning goals. They identify two kinds of essential questions: topical (specific questions) and overarching (more general)—both of which are necessary in designing learning units. Designing clear learning goals and objectives enables the teacher to guide the learner into the nature of content and thus learning (Marzano, 2009). This is important because if educators “aren’t sure of instructional goals, their instructional activities will not be focused, and unfocused instructional activities do not engender student learning” (Marzano, 2009, p. 1). Learning goals and learning objectives are usually used interchangeably. However, learning goals are more global in nature—what students ought to *know*—and learning objectives are specific in nature—what student should *be able to do* (sometimes under certain condition) according to a certain criterion. In addition, in line with the essential questions and learning goals and objectives, a set of *focused questions* are developed in each unit (in the MIP program) to better align the content-focused formal assessment tools. Given the backward design principles, teachers should identify specific learning goals and objectives, select learning activities which best align with them, and design appropriate assessment processes to determine whether learning of the desired goals and objectives is achieved. Table 3 identifies sample essential questions, learning goals and objectives, and related standards for Module I. In addition, a complete curriculum Module, including the information specific to the section for Module I, is provided in Appendix B.

**Table 3** — Essential Questions and Learning Goals and Objectives for Module I

Content Standards	Essential Questions	Learning Goals and Objectives
<ul style="list-style-type: none"> <li>• <b>M.I.P.M.1:</b> Know the real number system, and be able to add, subtract, multiply, and divide rational numbers.</li> <li>• <b>M.I.P.M.2:</b> Solve multi-step arithmetic problems using rational numbers.</li> <li>• <b>M.I.P.M.3:</b> Solve problems involving integer exponents, roots, and radicals.</li> <li>• <b>M.I.P.M.4:</b> Understand estimating and rounding, absolute value, primes, and greatest common factor.</li> <li>• <b>M.I.P.M.5:</b> Understand the scientific notation.</li> <li>• <b>M.I.P.M.6:</b> Solve problems involving converting units of measurement.</li> <li>• <b>M.I.P.M.7:</b> Understand ratio and use its applications.</li> <li>• <b>M.I.P.M.8:</b> Analyze proportional relationships and use their applications.</li> <li>• <b>M.I.P.M.9:</b> Solve problems involving percentage and interest.</li> </ul>	<ul style="list-style-type: none"> <li>• Why is it necessary to have different types of numbers in mathematics?</li> <li>• How are negative numbers used in real life situations?</li> <li>• What are the benefits and drawbacks of estimating?</li> <li>• Why is using the scientific notation important?</li> <li>• When would using proportions become necessary? Why?</li> </ul>	<p>Upon the completion of this module, the student will <b>know/understand</b>:</p> <ul style="list-style-type: none"> <li>• The real number system and their characteristics and relationship;</li> <li>• Estimating, scientific notation, rounding, and primes and greatest common factor;</li> <li>• Proportion and use its applications.</li> </ul> <p>Upon the completion of this module, the student will be able to:</p> <ul style="list-style-type: none"> <li>• Solve simple and multi-step arithmetic problems using rational numbers.</li> <li>• Solve problems involving integer exponents, roots, and radicals.</li> <li>• Solve problems involving converting units of measurement.</li> <li>• Analyze proportional relationships and use their applications.</li> <li>• Solve problems involving percentage and interest.</li> </ul>

## Differentiated Instructions and Learning Activities

The United States is a melting pot composed of people from many different backgrounds (cultures, languages, habits, preferences, economics, and more). Inevitably such differences are also present in a learning environment. As Tomlinson and McTighe (2006) observe, “culture, race, language, economics, gender, experience, motivation to achieve, disability, advanced ability, personal interests, learning preferences...are just some of the factors that students bring to school with them in almost stunning variety” (p. 1). Given these diverse personal, social, and economical factors, “diverse learners at risk and the demands of the new global economy of the 21<sup>st</sup> century, educational leaders are requiring more from all students” (Coyne, Kame’enui, & Carnine, 2011, p. 4). Furthermore, “Students with diverse learning and curricular needs, primarily children living in poverty, children with disabilities, and children with limited English-speaking skills face numerous forces—cultural, familial, sociological, political, educational, and economic—that place them at increasing social and educational risk” (Coyne et al., 2011, p. 2). Naturally, in addition to demographics and characteristic diversity, students differ in their background knowledge, preferred styles, and the pace at which they learn. Such learners’ diversity demands a variety of instructional strategies in order to help them becoming better learners, thinkers, and skilled in order to be better prepared for the demands of the 21<sup>st</sup> century and global economy. Unlike providing instructions predominantly through teacher direction, differentiating instruction enables diverse students to become more independent and self-regulated (Coyne et al., 2011). Tomlinson (2001) identifies the following conditions under which people learn best: a) when content is personally meaningful, challenging, and appropriate for the

learner's developmental level, b) when learner has choice and feels in control, c) when there exists "opportunities for social interaction," d) when learner receives timely and helpful feedback, and e) the learning "environment supports the intended learning" among others (p. 18). Naturally, such consideration, when designing instructional strategies, enforces the teacher to create units of instructions that promote and maximize student learning. A differentiated classroom, as Tomlinson (2001) observes, "provides different avenues to acquiring content, to processing or making sense of ideas, and to developing products so that each student can learn effectively" (p. 1).

Similar to the flipped classroom model, differentiated instructions help the teacher to maximize interactions with students and attend to their specific needs, and thus become more of a coach, guide, or mentor in the classroom. A differentiated classroom environment facilitates and promotes direct student involvement in learning. By incorporating students' learning personalities, background knowledge, and preferred style of learning as well as accommodations for students with special needs, differentiated instructions truly promote and facilitate a student-centered learning environment. Stressing that learning happens "within students, not to them" (p. 22), Tomlinson and McTighe (2006) recommend the following guidelines and strategies which promote differentiating instruction: a) continually, seek opportunities to get to know students, b) "offer more ways to explore and express learning" (p. 20), c) regularly use informal assessment strategies to monitor student progress, d) "teach in multiple ways" (p. 21), e) allow student working individually or in groups, f) respond to struggling students by adjusting instruction to address their gap in knowledge and skills, g) use clear and concise rubrics that "coach for quality" (p. 21), and h) "cultivate a taste for



diversity” (p. 22). To address student readiness, interest, and learning profile, Tomlinson and McTighe (2006) stress using small group instruction, designing task at different degrees of difficulty, expressing learning in a variety of models, and incorporating a variety of teacher presentation approaches among others.

The central instructional issue, according to Bottge et al. (2010), is “how to deliver engaging instruction that values procedural fluency (e.g., computing with fractions) while also giving attention to conceptual understanding (e.g., the meaning behind computational rules)” (p. 82). In this regard, research recommends incorporating a variety of authentic (real-world) problems and hands-on activities in the instruction along with clear and timely feedback. In addition, Wiggins and McTighe (2006) recommend designing activities that focus on “clear and worthy goals” that help student to develop “greater skill and understanding,” and providing ample opportunities for students for self-assessment and self-adjustment on feedback (p. 196). Bottge et al. (2010) recommend designing instructional strategies that include problems with real-world applications, providing “in-depth instruction on skills and concepts as students need them,” and allowing students to “work together in small groups to discuss, test, and find solutions to the problems” (p. 83). The use of modeling and demonstrating techniques in instruction is essential in successful teaching and learning, especially in complex subjects, such as mathematics. Students’ strengths even in a single subject area do vary as they do in their preferences in working individually or in groups. A differentiated classroom highly encourages teachers to make accommodations for both preferred styles in instructional planning. To maximize differentiation, teachers may allow flexible group formation either by selecting the group members or permit students

to form their own. Both strategies are useful; however, certain instructional activities may require the teacher to create “skills-based or interest-based groups that are heterogeneous in readiness level”—based on “the match of the task to student readiness, interest, or learning style” (Tomlinson, 2001, p. 102). The use of modeling and demonstrating techniques in instruction is essential in successfully teaching and learning mathematics. Doabler et al. (2012) stress regularly using the modeling and demonstration techniques in instructional tasks, presenting “visual representations of math ideas” (p. 50), and providing “frequent and meaningful practice and review opportunities” (p. 52). Archer and Hughes (as cited in Doabler et al., 2012) suggest using the following three ways to improve the quality of teacher models: 1) using “clear and concise language,” 2) providing several (yet not overwhelming) models, and 3) allowing “students to actively participate in the models, such as answering questions” (p. 52).

The differentiated classroom is designed with consideration to learners’ diversity and needs in many areas. Accommodations, according to Little (2009), may be considered and implemented in “instructional methods and materials; assignments and classroom assessments; time demands and scheduling; learning environment; and use of special communication systems” (p. 9). In addition to struggling students, a differential classroom also requires accommodations for students with special needs, such as advanced and ELL students, among others. It is important to note that advanced learners’ special needs are usually dismissed or unrecognized, and thus they are not accommodated. These students also require teacher’s help to develop their abilities and achieve their potentials (Tomlinson, 2001). To accommodate advanced

learners’ needs, Tomlinson (2001) recommends raising “ceiling for expectations so that advanced learners are competing with their own possibilities rather than with a norm,” identifying “what constitutes excellence,” and ensuring to “balance rigor and joy in learning” (p. 12). Table 4 identifies a list special accommodation for designated students in a differentiated classroom.

**Table 4 — Accommodation for Designated Students**

<b>Designated Students</b>	<b>Accommodations</b>
<b>ESOL/ELL/LEP</b>	<ul style="list-style-type: none"> <li>• Pair students with bilingual peers, if available.</li> <li>• Provide bilingual dictionaries in class.</li> <li>• Provide verbal and written directions.</li> <li>• Designate extra time (as needed) for activities, quizzes, and tests.</li> </ul>
<b>ESE/SLD/ESE</b>	<ul style="list-style-type: none"> <li>• Provide visual aids (hand-outs with large prints, etc.).</li> <li>• Designate extra time (as needed) for activities, quizzes, and tests.</li> <li>• Provide specific student needs as resources permit.</li> <li>• Follow direction recommended and/or directed by the school counselor or administration.</li> </ul>
<b>Struggling</b>	<ul style="list-style-type: none"> <li>• Adjust instruction to address students’ gap in knowledge and skills.</li> <li>• Use small group instruction.</li> <li>• Provide more peer-tutoring opportunities.</li> <li>• Design tasks at different degrees of difficulty.</li> <li>• Use a variety of presentation approaches.</li> <li>• Designate extra time (as needed) for activities, quizzes, and tests</li> </ul>
<b>Advanced/Gifted</b>	<ul style="list-style-type: none"> <li>• Raise expectations.</li> <li>• Design more challenging exercises and activities.</li> <li>• Constitute levels of excellence.</li> </ul>

Table 5 identifies sample differentiated instructional strategies and learning activities. In addition, a complete curriculum module including related lesson plans for Module I is provided in Appendix B.

**Table 5 — Differentiated Instruction and Learning Activities**

<b>Differentiated Instruction</b>	<b>Learning Activities</b>
<ul style="list-style-type: none"> <li>• Providing visual aids, PowerPoint (visual-aural);</li> <li>• Providing verbal explanations (aural);</li> <li>• Using written materials (aural-visual);</li> <li>• Assigning hands-on activities (kinesthetic);</li> <li>• Providing (online) video clips (visual-aural);</li> <li>• Providing links to appropriate website(s) related to the topic;</li> <li>• Allowing collaborations, using flexible grouping techniques;</li> <li>• Using modeling techniques (using teacher, student, videos, etc.);</li> <li>• Chunking—especially complex topics (breaking concept into smaller with parts/patterns—grouping);</li> <li>• Allowing students to work individually;</li> <li>• Providing special activities for struggling and advanced students;</li> <li>• Providing special assistance and activities for ESOL and ESE students;</li> <li>• Providing student-tutoring (peer-tutoring);</li> <li>• Providing guided practice—step-by-step directions;</li> <li>• Providing individual teacher/tutor assistance;</li> <li>• Providing ongoing feedback.</li> </ul>	<p><b><u>Bell-work</u></b>            Teacher invites students to ask questions about their study and problems that may have. Then the teacher and students review the new topic which students have already studied. Most elements of instructionist teaching will be used during the bell-work session. This session could last up to 20 minutes.</p> <p><b><u>Class-work</u></b>            Working individually or in groups, students engage in performing a variety of tasks and activities the selected by both students and the teacher—activities such as solving select problems from the module, MIP textbooks, and online; watching the designated video clips; and exploring the identified websites.</p> <ul style="list-style-type: none"> <li>• The teacher observes (individual and groups) of students while they work on their activities and assignments. The teacher provides feedback, and may actively and/or passively participate in students’ activities, during which the teachers provided feedbacks. In addition, as student work on their activities, they also evaluate their progress and achievement using the guidelines set by individual students and the teacher.</li> <li>• Students may take a tutoring role and rotate this responsibility while working in groups. During these activities, students may perform certain task, demonstrating their mastery of the designated content. In addition to participating in these groups, the teacher and the tutor will work with the students who work individually on their selected and/or designated tasks and activities.</li> </ul> <p><b><u>Recap</u></b></p>

About 10 minutes before the bell, the teacher ask students to go back to the normal seating arrangement, provides a recap of the topic and general suggestions (if any), and reminds student about the next topic and the designated topic and related assignment and activities at home.

## Assessment

Essential to backward design principles, an ongoing assessment is vital to the learning and instructional processes. In this regard, taking a test at the end of a module will, at best, represent an insufficient or incomplete picture of student mastery of the content and thus learning achievement. To obtain a relevant and reliable picture/outcome, determination, given the desired results, of evidence is required to ensure that students have achieved them. Little (2009) views assessment as a “systematic process whereby information about student learning is collected to make instructional decisions,” and indicates that assessment should “match student’s needs, the curriculum, and instructional strategies” (p. 9). The purpose of testing, according to Kubiszyn and Borich (2007), is to “collect objective information that may be used in conjunction with subjective information to make better educational decision” (p. 65). A balanced approach in assessment, i.e., using a variety of assessment techniques—in line with the spirit of the backward design—is necessary in order to analyze “student accomplishment against specific goals and criteria” (Wiggins & McTighe, p. 337). Given the diversity of learners, a variety of assessment processes are required in order to measure and subsequently make valid inferences about the degree to which students truly know, understand, and be able to do (Tomlinson & McTighe, 2006; Wiggins & McTighe, 2006). An assessment may be formal (preplanned, such as a test) or informal (spontaneous, such as teacher observation). Both assessments may be quantitative and qualitative in nature, although informal assessments are usually viewed as qualitative. Tomlinson and McTighe (2006) identify three major types of assessments:

- 1) Formative—ongoing assessments which “occur concurrently with instruction,”

2) Summative—generally “used to summarize what has been learned,” and  
3) Diagnostic—generally “used to check students’ prior knowledge and skill levels” (p. 71). In the design of the MIP program, formal, informal, formative, and summative types of assessment are used to assist instruction and evaluate student learning. Furthermore, formal assessment tools in MIP are criterion-based. A criterion-based assessment tool measures a student performance against selected criteria (standards)—in this case, MIP standards.

Student learning assessment is enhanced with greater use of a variety of formative assessment techniques such as observation, performance task, demonstration, oral explanations, and peer-assessment. In addition, as Wiggins and McTighe (2006) observe, empowering students to take greater role in learning is greatly enhanced when assessment techniques such as self-monitoring and self-assessment are incorporated. In this regard, constructing a variety of response items allows “students to show their work and reveal their thinking” (Wiggins and McTighe, 2006, p. 161). As part of the instructional design, provisions must be made for teachers to assist students to “self-monitor, self-assess, and self-adjust their work, individually and collectively, as the work progresses” (Wiggins & McTighe, p. 215). To have an accurate measure of student learning, assessment items should measure what it is supposed to measure—also referred as the *validity* of an assessment tool. In other words, there must be an *alignment* between the test items and their related contents and thus related standards. As such, it is considered to be the “...evidence of an achievement test’s content validity” (Kubiszyn & Borich, 2007, p. 35). To ensure alignment and maximize validity for formal quizzes and end-of-module tests, test items for each module are



selected and/or designed directly from the related sections in the module—content focused. Unlike the on-going informal assessments which directly or indirectly address the essential questions and learning goals and objectives, the formal assessment processes in MIP are directly related to the learning objectives and focused questions.

Whether formal or informal, assessment tools and processes should be clear and concise, include the necessary information such as required time and total value points, identify permitted tools and materials; and provide references to the related content for each item and more. In addition, Wiggins and McTighe (2006) recommend using the following techniques when developing assessment tools and materials: 1) deriving items from the goals and objectives, 2) using a reasonable number of questions, and 3) framing the question in “kid language [simple and age appropriate] as needed to make them more accessible” (p. 121). Student learning assessments should follow a timely, clear, and specific feedback to the student, resulting in the necessary instructional adjustment. As Marzano (2009) puts it, “If goals provide clear target for learning, then feedback may be thought of as information that facilitates the process of reaching those target” (p. 10). Hattie and Timperley (as cited in Marzano, 2009) indicate that the main purpose of feedback in educational settings is to “reduce discrepancies between current understandings and performance and a goal” (p. 10). Assessment tools in MIP are designed to include two to three problems from each section in the module. This process will assist teachers to assess students’ performance and learning achievement specific to each topic in the module, and provide detailed feedback to students and their parents. Availability of rubrics is very important, especially for the assessment purposes. Using rubrics, teachers can provide timely, detailed, and

meaningful feedback more efficiently. Rubrics describe “the degree of quality, proficiency, or understanding along a continuum” (Wiggins & McTighe, 2006, p. 173), and facilitates student “self-assessment and self-improvement” as well as “communication with students, parents, faculty, and administration” (Stevens & Levi, 2005, pp. 21, 23).

Embedded in its design, the MIP program requires a comprehensive assessment process which includes a variety of assessment procedures, such as observation, performance tasks, demonstration, self- and peer-evaluation, quizzes, and tests. Assessment types and related processes and examples are provided in Table 6. Furthermore, the overall formal assessment tools (including Taxonomy specification, test items, and related rubrics) for Module I are available in Appendix C.

**Table 6** — Assessment Type, Characteristic, and Process

Assessment Type/Characteristic		Process
<b>Observation</b>	formative, informal	An on-going assessment process — The teacher’s observe (individual and groups) of students while they work on selected assignment and activities during the bell-work and/or subsequent class-time. During this evaluation process, the teacher will actively and/or passively participate in students’ activities, and share thoughts and observation when necessary.
<b>Performance Task</b>	formative, informal	An on-going assessment process — Working individually or in groups, students engage in performing a variety of tasks and activities, such as solving problems, as selected by both students and the teacher.
<b>Demonstration</b>	formative, informal	An on-going assessment process — Students may take a tutoring role and rotate this responsibility while working in groups. During these activities, students may perform certain task, demonstrating their mastery of the designated content. In addition to participating in these groups, the teacher will work student who work individually while they perform selected tasks.
<b>Self- and peer-evaluation</b>	formative, informal	An on-going assessment process — As student works progress, they evaluate progress and achievement using guidelines set by individual students and the teacher.
<b>Quiz</b>	formative, formal or informal, criterion-bases (rubrics provided)	A minimum of one to two <i>formal</i> quizzes are designated for each module including content-focused items. At the discretion of the teacher, short/pop-quizzes ( <i>informal</i> ) may also be takes in class for diagnostics purposes. B

<b>Test</b>	summative, formal criterion-bases (rubrics provided)	End-of-module test—one test is designated for each module. The related assessment items are content-focused.
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## Syllabus

Many educators, rightfully, consider syllabus as a contract between the students and the teacher with respect to the related course. A well-developed syllabus is essential in communicating the course contents; learning goals and objectives; list of required and recommended resources, tools, and materials; list of prerequisites; communication protocols; grading policy; course calendar; list of activities, assignment, projects, tests and related rubrics; and relevant school policies among others. In addition to including the necessary components mentioned above, the MIP syllabus is designed to include age-appropriate visually pleasing elements. A copy of the MIP syllabus is provided in Appendix E.

## Module

In this section, the overall design on the modules is explained. Modules are extremely important in the overall design of the MIP program, for they are used primarily by the students. Although the teacher may use MIP modules (from time-to-time) for different purposes, students routinely use them as a primary source during the entire program. Modules include, identify, and refer to a variety of physical and virtual sources relevant to each topic as well as information about the module content, learning goals and objectives, assessment, and schedule among others. Given its importance, especially with respect to the students, utmost attention has been paid to the aesthetics aspects of the modules, in addition to its usability and functionality as a product. The human-centered design concept has been considered in the overall design of the MIP program which Norman (2013) defines as “an approach that puts human

needs, capabilities, and behavior first, then designs to accommodate those needs, capabilities, and ways of behaving” (p. 8). Discoverability, in a system, is defined as, “discovering what it does, how it works, and what operations are possible” (Norman, 2013, p. 10). Among the psychological concepts resulting discoverability, affordance and signifiers concepts are used in the process of designing modules in MIP program. For example, several navigation buttons and labels are presented in each module which communicate possible actions (e.g. content) with the user—*affordance*—and where these actions should be taken—*signifiers* (Norman, 2013). A successful design, according to Lidwell, Holden, and Butler (2010), must meet people’s basic needs, such as needs for functionality of its components—for example, do the online links provided in the module function? b) reliability needs for stable and consistence performance—for example, do the navigation buttons in the module work consistently? c) proficiency needs—for example, do students feel that they are making progress when they use (the content of) the module? In addition, it is utterly important to note that “designs should be usable by people of diverse abilities, without special adaptation or modification” (Lidwell et al., 2010, p. 16). The characteristics of an accessible design, such as *perceptibility* (being able to use the design regardless of the user’s sensory abilities) and *simplicity* (being able to use the design regardless of the user’s experience and literacy level) have been incorporated in the design of the MIP module (Lidwell et al., 2010, p. 16). For example, the modules’ components are presented using redundant coding (consistent text, icon, color, etc.)—*perceptibility*— and excluding the unnecessary complexity (usage of simple and concise works and expressions, etc.)—*simplicity*. In order to

identify and explain the overall design of the modules more specifically and efficiently, these design aspects are grouped according to their usability and aesthetics principles.

## Usability

Usability of a design has to do with its simplicity, forgiving (Lidwell et al., 2010), and usefulness. To enhance the usability of the MIP modules, as recommended by Lidwell et al. (2010), the following principles are used: the 80/20 rule, consistency, layering, performance load, progressive disclosure, and readability principles.

The *80/20 rule* indicates that “approximately 80 percents of the effects generated by any large system are caused by 20 percent of the variables in the system” (p. 14). Most teachers and students concur with this principle that applies to the majority of textbooks in the market—i.e., approximately 80 percent of the information in many textbooks is provided by about 20 percent of its content. In this regard, special consideration has been made so that the overall content of the modules in the MIP program is kept to an absolute minimum—excluding any unnecessary information, graphs, images, etc. The “usability of a system is improved when similar parts are expressed in similar ways,” and *functional consistency* refers to the consistency of symbol, meaning, and action (Lidwell et al., 2010, p. 56). For example each icon in a module corresponds to a specific function. Using the functional consistency principle, these relationships have been replicated in all modules. To manage complexity and reinforce relationships in information, module contents are organized into related groups—a process that is identified as *layering* (Lidwell et al., 2010). Topics in each module are grouped into separate sections—accessible by their corresponding

navigation buttons, according to their relationships—, which also helps with managing the complexity of topics. *Performance load* is defined as the degree of mental activity (i.e., the “amount mental activity—perception, memory, problem solving”—cognitive load) and physical activity (i.e., “degree of physical activity—number of steps or movements, or amount of force”—Kinematic load) required to accomplish a goal (Lidwell et al., 2010, p. 178). The cognitive load management has been combined with the layering principles in the design of the MIP modules. Furthermore, to manage its Kinematic load in its design—in addition to the menu buttons at the beginning of each module—, several ‘return buttons’ are included to facilitate navigation and reduce extra and/or unnecessary steps. To prevent information overload and manage information complexity, “only necessary or requested information is displayed at any given time” which is identified as *progressive disclosure* (Lidwell et al., 2010, p. 188). The principle of *readability*—expressing “complex materials in the simplest way possible” (Lidwell et al., 2010, p. 198)—along with layering, cognitive load, and readability principles have been the basis, using which topics in each module are grouped and presented. To enhance readability, Lidwell et al. (2010) recommend omitting needless words or punctuation, avoiding acronyms or jargon, managing sentence length, and using simple (and age appropriate) language.

## Aesthetics

Aesthetic aspect of a design is concerned with the overall appearance of the design and its appeal to the end-user. Aesthetic designs, according to Lidwell et al. (2010), are “effective at fostering positive attitudes;” are perceived as easier to use and



more readily accepted; promote “creative thinking and problem solving;” and foster “positive relationship with people” (p. 20). Among the principles used which enhance the appeal of a system, recommended by Lidwell et al. (2010), the following are used in the design of the MIP modules: alignment, color, picture superiority effect, proximity, and similarity principles.

To create a sense of unity, cohesion, and stability, elements in a design should be aligned with one another (Lidwell et al., 2010). Common elements of the modules are consistently placed such that edges line up along common rows, columns, or center. As Williams and Tollett (2006) observe, color can “create moods, add emphasis, attract attention, organize information, and entertain the viewer” (p. 100); however, its excessive or inappropriate use can be counterproductive. In the design of modules, colors have been used consistently yet conservatively for grouping and aesthetics in a balance with the graphs and icons present in each module. To improve recognition and recall of key information, the *picture superiority effect* principle used for “pictures are generally more easily recognized and recalled than words” (Lidwell et al., 2010, p. 184). The picture superiority effect along with the *proximity* principle—the developed relationships as the result of placing items close together (Williams, & Tollett, 2006)—and *similarity* principle—similar elements are perceived to be more related than elements that are dissimilar (Lidwell et al., 2010)—are used in designing modules to maximize optimal effect and improve cognitive load when presenting the same information. As a sample, a full copy of Module I is provided in Appendix D.

## Program Completion

### Deliverables

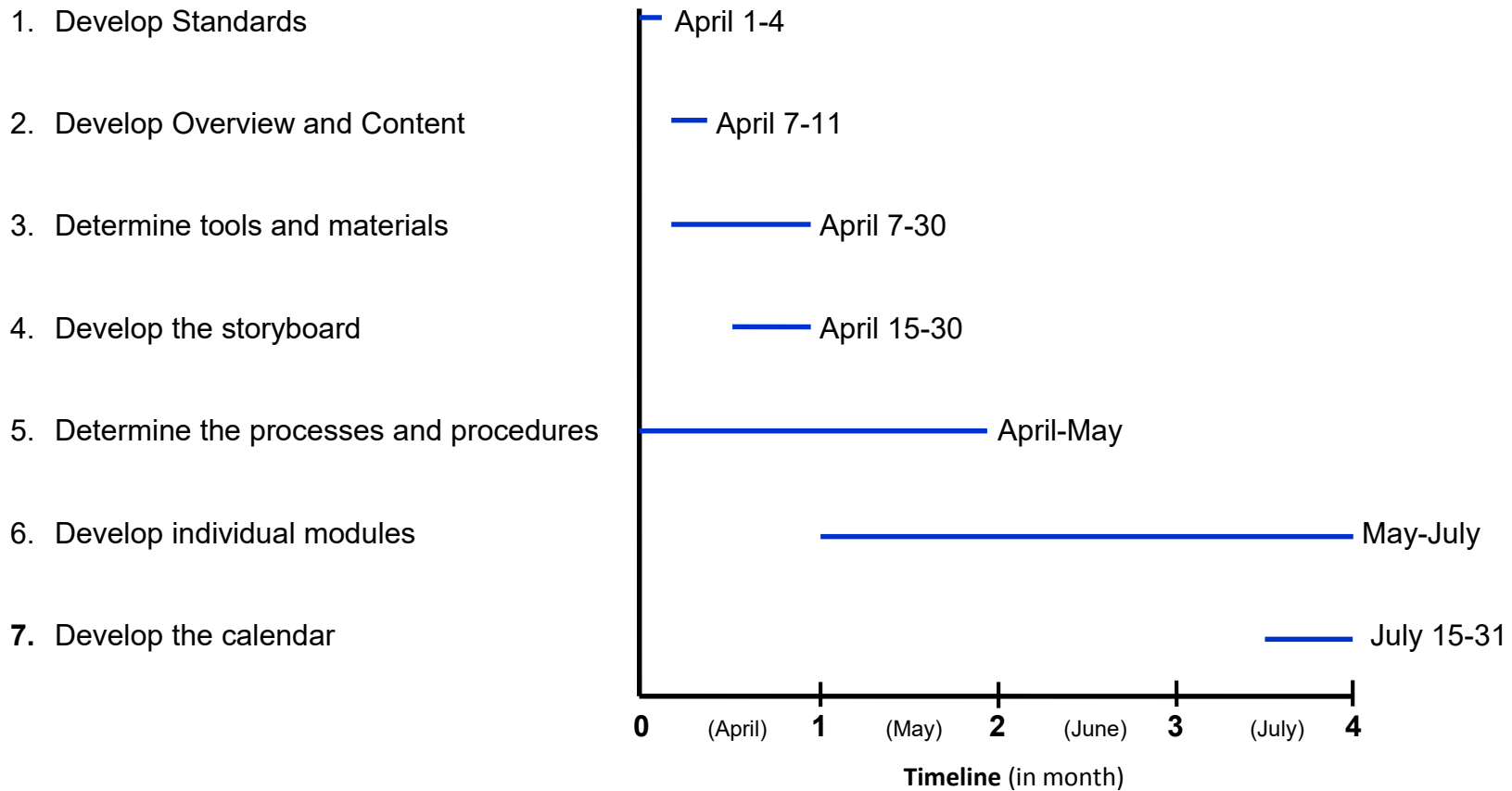
The list of deliverables upon the completion of the design and development of the MIP program and the corresponding recipients is presented in Table 7.

**Table 7** — List of Deliverables

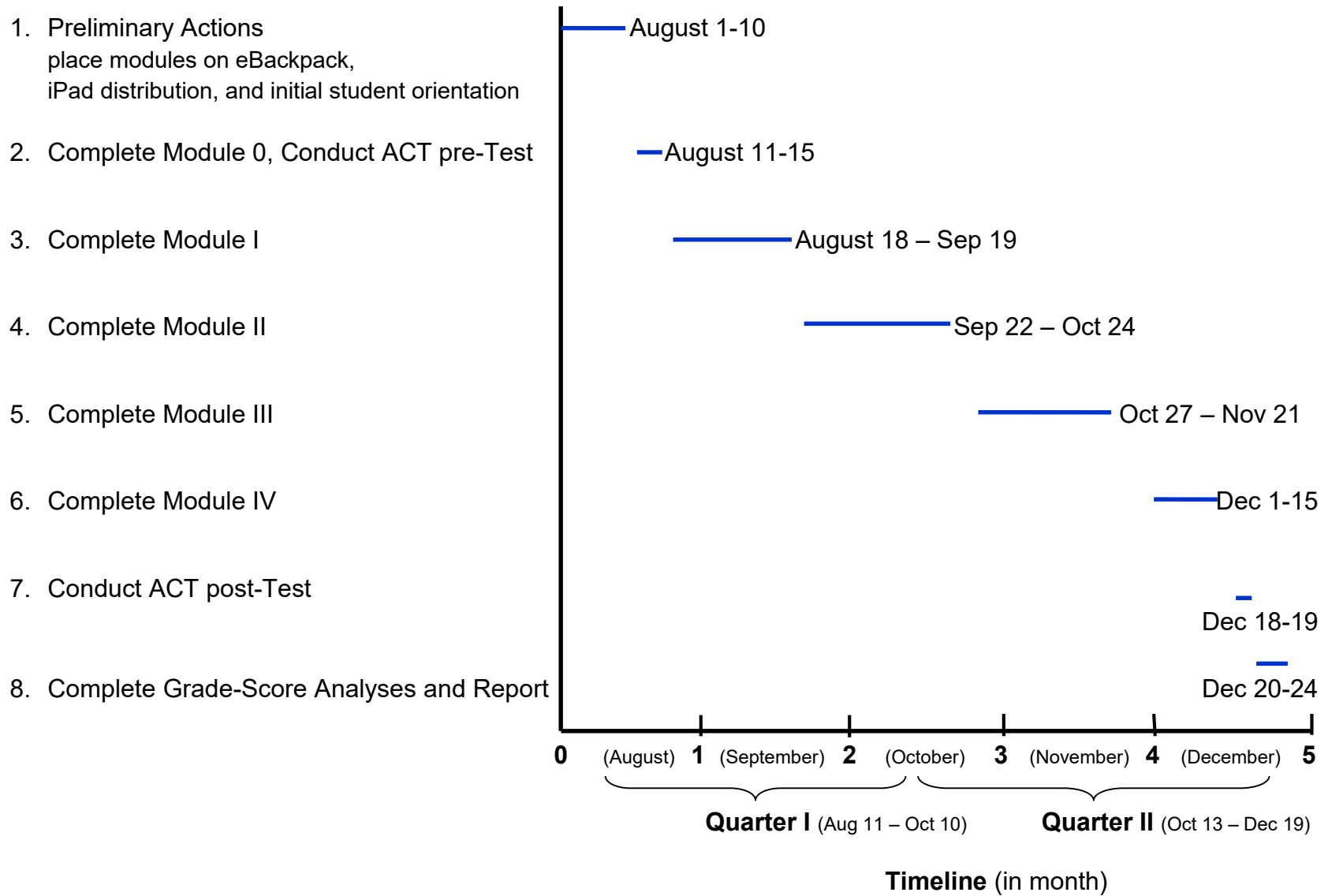
<b>Deliverables</b>	<b>Recipient(s)</b>
MIP overview, objectives, and standards	MIP program director
MIP contents and storyboard	MIP program director
MIP student selection process and program procedures	MIP program director
The List of necessary tools and materials	MIP program director <u>and</u> the designated teacher
MIP calendar ( <i>for the first semester—Fall 2014</i> )	MIP program director <u>and</u> the designated teacher
Individual modules ( <i>contents, lesson plans, and assessment tools</i> )	MIP designated teacher

## Timeline

The allocated time for the design and development of the program is four months (April-July 2014). The related timeline is provided in Figure 7. In addition, the implementation timeline (for Fall 2014) is provided in Figure 8.



**Figure 7** – Design and Development Timeline



**Figure 8** – Implementation Timeline (Fall 2014)

## **CHAPTER THREE: EVALUATION**

The research and evaluation related to this study are explained in this chapter. A correlational study is conducted to examine the relationship between students' ACT Explore scores and their Algebra 1 grades. The evaluation of the MIP program is conducted in two stages: 1) evaluation of the program design, and 2) evaluation of the program effectiveness.

### **Correlational Study**

#### **Purpose**

A correlational study is conducted to determine the relationship between students' ACT Explore mathematics scores and their Algebra I grades. More specifically, it is used to determine the correlation between student's background knowledge of the middle school mathematics and predict a possible failure or successful completion of Algebra I (i.e., scoring 83 percent or higher) using their Explore scores. (The test score of the mathematics portion of the ACT Explore test reflects students' knowledge of middle school mathematics.) This study will also be helpful in determining the minimum score below which students will be placed in the MIP program.

#### **Methodology**

#### **Population and Instrumentation**

The population in this study is all freshmen students for each designated schoolyear. The instruments used in this portion of the study are the ACT Explore

standardized tests (mathematics scores) as well as RHS Algebra 1 semester grades for the 2011-2012, 2012-2013, and 2013-2014 schoolyears. These data reflect students' scores prior to the implementation of the MIP program in Fall 2014.

## Procedures

In this study, all incoming freshman students' prior ACT Explore scores and their corresponding Algebra 1 semester grades for the 2011-2012, 2012-2013, and 2013-2014 schoolyears were necessary. Upon following the necessary procedures required by the Registrar and Records Office at RHS, these datasets were extracted from the school archived database. The collected student data included student name, gender, grade level, Algebra 1 grade, and related Explore test scores. Generic names, such as Student 1, Student 2, etc., are used to protect student identity. The related student identifier will remain confidential and secure both electronically and physically. These datasets were then cleaned to ensure each student who entered RHS had an Explore score and that completed, at least, the first semester at RHS, and thus having a score in Algebra 1. Duplicate entries were removed. There were students who were admitted to RHS without prior Explore scores, and thus their records were removed from the data. In addition, there were students who had completed Algebra I in the middle school—and their records did not include the necessary information—, and thus their records were removed from the datasets as well. Furthermore, these datasets were labeled as Dataset I (for the 2011-2012 schoolyear), Dataset II (for the 2012-2013 schoolyear), and Dataset III (for the 2013-2014 schoolyear). The final datasets included paired-data for

each student—comprising the following populations for further analyses:  $N_i=34$  for Dataset I,  $N_{ii}=35$  for Dataset II, and  $N_{iii}=43$  for Dataset III.

## Results and Discussion

To analyze the correlation between the students' Explore scores and their Algebra 1 (semester) scores, the IBM SPSS Statistics (version 22) software program was used. Furthermore, to demonstrate the correlation between these two variables, all three datasets were analyzed.

The null hypothesis indicates that there is no relationship between the two variables, and the alternative hypothesis indicates that there is—that is, Dataset I ( $H_0: r_i = 0$  and  $H_1: r_i \neq 0$ ), Dataset II ( $H_0: r_{ii} = 0$  and  $H_1: r_{ii} \neq 0$ ), and Dataset III ( $H_0: r_{iii} = 0$  and  $H_1: r_{iii} \neq 0$ ). Given that both variables are interval/ratio in scale, the Pearson correlation seems suitable if each dataset meets the necessary assumptions. The 'independence' assumption is met for all three datasets given that each dataset is composed of the population data rather than a sample. The overall results of the test for 'normality,' for each dataset, indicate that only Dataset I is approximately normally distributed (see Table 8, and Figures 9, 10, and 11 in Appendix A). Correspondingly, a parametric correlation test (Pearson product-moment) for Dataset I and a non-parametric correlation test (Spearman) for Datasets II and III are selected and applied. The results (see Table 9 in Appendix A) indicate that the correlation between students' Explore scores and their Algebra 1 scores are positive, moderately strong, and statistically significant in all three datasets, and thus the null hypotheses are rejected ( $r_i=.57, p < .01$  for Dataset I;  $r_{ii}=.48, p < .01$  for Dataset II; and  $r_{iii}=.51, p < .01$  for Dataset III). To

facilitate visual analyses, graphical representations (scatter plot with a linear trend/fit line) of these relationships are presented in Figure 12 in Appendix A.

### Evaluation Plan

The evaluation of the MIP program will be conducted in two stages: 1) Evaluating the program design, and 2) Evaluating the program effectiveness. After obtaining the IRB permission at the University of Central Florida (UCF), the design of the MIP program was evaluated during the Fall 2014 semester. In addition, MIP students' test scores in each program module and their ACT Aspire test scores, at the completion of the program, were also collected and examined. Furthermore, this study recommends an evaluation plan to determine the effectiveness of the MIP program.

### Design Evaluation

#### Purpose

The purpose of the design evaluation is to determine how well the program is designed with respect to its usability, functionality, and aesthetic appeal. This evaluation is based on a mixed mode design consisting of an interview of a limited number of participants (qualitative) and a survey of a larger sample (quantitative).

#### Design Evaluation Criteria

The design of the MIP program is determined to be successful when student satisfaction measures, at least, at 70 percent with respect to module design's aesthetic appeal, usability, and overall helpfulness. Furthermore, the MIP teacher and the Program Manager are fully satisfied with the MIP design and its content.



## Design Evaluation Questions

1. Do students perceive the program modules appealing?
2. Do students find the program modules' content helpful?
3. Do students relate test questions to their corresponding content in the module?
4. Does the program include the necessary components required by the Program Manager?
5. Does the teacher find the program module content and lesson plans helpful, and assessment tools valid?

## Methodology

### Evaluation Approach

In this evaluation, aspects of the case study methodology are used.

### Participants

The participants consist of 26 students, faculty, and administrators (24 students, one teacher, and one administrator) who are selected based on a purposive sampling method.

### Instrumentation

1. *Student Satisfaction Survey*: The purpose of the Student Satisfaction Survey instrument is to determine how satisfied students are with the overall design of the program modules as well as related activities and quizzes. Table 10 (in Appendix A) reflects the contents of this instrument which is used for collecting data related to evaluation question numbers one, two, and three.

2. *Interview Protocol Instrument—MIP Program Manager*: The purpose of this instrument is to determine whether the design includes all the necessary components required by the Program Manager. Table 11 (in Appendix A) reflects the contents of this instrument which is used for collecting data related to evaluation question number four.
3. *Interview Protocol Instrument—MIP Teacher*: The purpose of this instrument is to determine whether the program module content and lesson plans are helpful, and assessment tools valid. Table 12 (in Appendix A) reflects the contents of this instrument which is used for collecting data related to evaluation question number five.

The overall information with regard to data sources, selected method(s) for collecting data, instrumentation, and procedures for each evaluation questions are explained in Table 13 in Appendix A.

## Procedures

**Interview:** To recruit the participants, the names of the relevant faculty and staff were obtained from the school vice principal who is also the Program Manager. These individuals were then contacted, inviting them to participate in the study. The participants were advised of the nature of the study and the goals of the research, reviewed the informed consent process, and asked whether he or she would like to participate. Upon acceptance, an appointment was set up to meet the individual at a mutually agreed date and time. The face-to-face interview sessions were held in a safe and comfortable location to both the interviewee and researcher, which allowed for a

confidential and private environment. Upon the agreement of the interviewee, the session was recorded using an audiotape. The identities of the interviewees will remain confidential, and when necessary, only pseudonyms will be used. All data will remain confidential and secured both electronically and physically.

**Survey:** Two anonymous surveys were conducted from the MIP students during the semester in which the program is offered. The first one was conducted during the first quarter and the second during the last week of the second quarter. Both surveys were conducted by the MIP teacher on designated school days and during normal class sessions. All MIP students were encouraged to participate in the survey. Designated survey dates were determined in consultation with the MIP teacher. Few days before the start of the survey, the MIP teacher was provided with the survey instrument, and a reminder letter was sent one day before the designated survey date. The survey period was active during class sessions to ensure all students would have a chance to participate. All data will remain confidential and secured both electronically and physically.

To examine students' initial impressions of the design, maximize the efficiency of the module by incorporating the necessary modifications—based on the study of this survey—an anonymous survey was conducted on November 14, 2014. Using the Student Satisfaction Survey for Design Evaluation instrument (Table 10), this survey was conducted during the class session, monitored and collected by MIP teacher, and later submitted to me in a sealed envelope. Twenty one students participated in this survey. The survey results were evaluated, and subsequently few modifications were made in the remaining modules (e.g., improving the navigation system throughout the

module, labeling the online video clips for better referencing, and introducing more varieties of videos among others). A second anonymous survey was conducted on December, 3, 2014—the result of which the basis for evaluating the design. Seventeen students participated in this survey. Using the Student Satisfaction Survey for Design Evaluation instrument (Table 10), this survey was also conducted during the class session, monitored and collected by MIP teacher, and later submitted to me in a sealed envelope.

### Results and Discussion

In an interview session, the MIP Program Manager, Paul Smith, who is also the Academic Dean at RHS, confirms his full satisfaction with respect to the overall requirements and function of the MIP program (evaluation question number four). Regarding the characteristics of a good design, P. Smith identifies: “the functionality of the design itself, relating to the standards...and the usability of the [design] that are workable for both the student and the teacher” (personal communication, December 8, 2014). With regard to content and standards in the MIP program, P. Smith indicates that “As a new program, we have been very concerned with the standards and its contents. I think we have covered those very well, so I am very happy” (personal communication, December 8, 2014). Furthermore, “The [MIP] program is very clearly defined, and I am very pleased that we have communicated it to the parents...” (personal communication, December 8, 2014). With regard to the functionality and usability of the MIP program, P. Smith responds, “How we have actually set up the course itself. Does it actually meet the needs of the students.... Is it adjustable...and flexible? And we have done

that...these characteristics are present in this program” (personal communication, December 8, 2014). Furthermore, he concludes that “I am very happy with the program. We have been looking for ways that we can help our students. I am really excited about the possibility of continuing on, and may be even expanding” (P. Smith, personal communication, December 8, 2014). In an interview session with the MIP teacher, Jeremy Adams confirms his overall satisfaction with respect to the program module content and lesson plans as well as the validity of the assessment tools (evaluation question number five). With regard to the characteristics of a good module, J. Adams identifies: “giving kids multiple things to look at...not just one way. Showing them videos, using examples...using technology...using things that make it pop a little more...giving kids multiple examples on how to do things. These are important because you want to make them interested and have them involved and interact with it” (personal communication, February 3, 2015). J. Adams confirms the presence of these characteristics in the modules by expressing that “They have great pictures, sticky notes...which make them nice to look at. They give the kids examples, plenty of videos for them to watch. I think these modules do a great job of giving these kids what they need to be successful.” Furthermore, “When kids look for something or questions they may have, I mean, they are all there. There is plenty of stuff for them to use — especially, if they have a question, the module does a great job of making sure that kids have plenty of resources that they can use” (J. Adams, personal communication, February 3, 2015). With regard to the assessment items and their relationship with module content, J. Adams replies, “I think they correspond really well. The questions are very clear...nothing tricky about them. I think the questions on the test matched up

the contents of the module really well” (personal communication, February 3, 2015).

The results of these interview sessions clearly indicate that both the MIP teacher and the Program Manager are satisfied with the overall design of the MIP program.

The survey items are designed using a Likert scale with the following values (designated for each response to survey items): 1= Very Dissatisfied, 2= Dissatisfied, 3= Neutral, 4= Satisfied, and 5= Very Satisfied. The Microsoft Excel application program (version 2013) was used for the statistical analyses related to the design evaluation. The following strategies (grouping select survey items) were used in order to answer evaluation questions number one through three: a) grouping survey item numbers one through three to answer evaluation question number one: *Do students perceive the program modules appealing?*; b) grouping survey item numbers four through nine to answer evaluation question number two: *Do students find the program modules’ content helpful?*; and c) grouping survey item numbers ten and eleven to answer evaluation question number three: *Do students relate test questions to their corresponding module contents?* The results are presented in Figure 14 (Appendix A). Considering the design evaluation criteria, the survey analyses indicate that students, on average, perceive the design as appealing (evaluation question number one). However, students, on average, do not find the module’s content as helpful or test questions relating to module contents (evaluation questions number two and three respectively).

As an expanded approach to evaluating the design of the MIP program, in order to examine students’ perceptions on design’s usability and aesthetic aspects (the design framework—explained in Chapter II), the following strategies (grouping select survey items) were used: a) grouping survey item numbers one through three to

determine students' perceptions with respect to the aesthetic aspect of the design; and b) grouping survey item numbers four through eleven to determine students' perceptions with respect to the usability aspect of the design. The results are presented in Figure 15 (Appendix A). Considering the design evaluation criteria, the survey analyses indicate that students, on average, perceive the design aesthetically appealing. However, on average, they are not satisfied with the usability of the design of the module. Most 14/15 years old adolescence—a typical age for high school freshmen—usually perceive and react highly emotionally, even with respect to matters that are primarily cognitive in nature. In a remediation course, especially in mathematics, such reactions are usually more amplified. Given this observation as well as the limitations inherent in a self-reporting methodology—such as a survey—, this may have impacted student responses to the survey items and thus adversely affecting the results.

## **Program Evaluation**

### **Purpose**

The purpose of the program evaluations is to determine the effectiveness of the MIP program.

### **Evaluation Criteria**

The program is determined to be successful when at least 80 percent of the participants score 25 or higher on the ACT-Aspire (post-test).

### **Evaluation Questions**

1. How well is the program designed and implemented?

2. Do students attend the program regularly?
3. Do students actively participate in the program activities?
4. Do students find the modules and related activities helpful?
5. Does the program include the necessary components required by the Program Manager?
6. Does the teacher find the program contents helpful and assessment tools valid?
7. Do 80 percent of participants score 25 or higher on the ACT-Aspire test (post-test)?

## Methodology

### Evaluation Approach

The methodological approach for this study is conceptualized as non-experimental pre- and post-test with no comparison group. As explained in Table 14 (in Appendix A), this evaluation uses components of multiple approaches: Expertise-oriented, program-oriented (logic model), and case study.

### Participants

The participants consist of 27 students, faculty, and administrators (24 students, one teacher, and two administrators) who are selected based on purposive sampling method.

### Instrumentation

1. *Interview Protocol Instrument for Program Evaluation—MIP Program Manager:*

The purpose of this instrument is to determine how well the program is designed



and implemented. This instrument is used for the purpose collecting data related to evaluation question number one, and its content is explained in Table 15 (in Appendix A).

2. *Interview Protocol Instrument—IT Manager*: The purpose of this instrument is to determine how well the program is implemented. This instrument is used for the purpose collecting data related to evaluation question number one, and its content is explained in Table 16 (in Appendix A).
3. *Student Participation Observation*: The purpose of this instrument is to determine the degree to which students participate in the program activities. This instrument is used for the purpose of collecting data related to evaluation question number three, content of which is explained in Table 17 (in Appendix A).
4. *Student Satisfaction Survey for Program Evaluation*: The purpose of this instrument is to determine how satisfied students are with the program modules and related activities, tests, quizzes, and tasks. Table 18 (in Appendix A) reflects the contents of this instrument which is used for collecting data related to evaluation question number four.
5. *Interview Protocol Instrument for Program Evaluation —MIP Teacher*: The purpose of this instrument is to determine whether the program contents are helpful and assessment tools valid. Table 19 (in Appendix A) reflects the contents of this instrument which is used for collecting data related to evaluation question number five.
6. *The ACT Aspire Test*: The ACT standardized test (mathematics scores) is used for the selection process as well as pre- and post-tests. The analysis of the data

related to pre- and post-test scores will answer the evaluation question number six.

The overall information with regard to data sources, selected method(s) for collecting data, instrumentation, and procedures for each evaluation questions are explained in Table 20. In addition, the MIP program logic model is explained in Table 21—both of which are present in Appendix A.

### Limitations

The pre- and post-test design with no comparison group is relatively weak thus impacting the generalization possibility. Other possible limitations of the study may be related to the selected methods of collecting data such as survey (self reporting), observation, and interview—although having many advantages—also introduce the possibilities for bias, thus impacting the results of the evaluation. Although the risk was minimal since the survey was conducted anonymously, students may still feel being threatened if the teacher or administration becomes aware of their personal views on the course. If so, this feeling may have impacted their selected answers. The researcher in this study is also the program designer and evaluator thus the possibilities for bias exist which may adversely impact the outcome of this study. In addition, the designated mathematics teacher who facilitated the MIP may not entirely and faithfully follow the program content and procedures which would impact students' post-test scores, thus also adversely affecting the outcome of the study. Unforeseen events impacted the implementation, thus impacting evaluation results. For example, the unforeseen issues with regard to the iPad distribution at school caused delay in the actual start of the

program. In addition, the decision by ACT to discontinue offering the Explore test and enforcing the Aspire test earlier than expected caused the cancellation of the planned pre-post; therefore, the students took only the post-test. Furthermore, factors such as the type of (standardized) assessment tests, the cutoff score by which remediation is required as well as successful remediation achieved may also impact the evaluation results of the program. It is worthy to note that the impact of the MIP program would be best measured if the participants do not concurrently attend the Algebra 1 class. However, given the limited resources at RHS, such option was not feasible—especially given that RHS does not offer any summer courses.

## CHAPTER FOUR: CONCLUSION

In this study, the problem associated with a high percentage of freshman students at RHS—who either fail Algebra 1 or pass it with a low percentage rate—has been studied. After examining the internal and external causes associated with this problem, designing and implementing a remediation course in mathematics (the MIP program) was recommended—the content of which is based on grade 8 Mathematics and Pre-Algebra. In addition to studying the literature and examining the prior research on the remediation problem in general and mathematics in particular, this decision was also based on a correctional study that determined the relationship between students' prior knowledge in middle school mathematics and their semester grades in Algebra I (in high school). The MIP program design is based on a solid theoretical formwork, including established learning and design theories and principles.

This study is important given that remediation, as a serious national problem, is nurtured in the middle and high school—although its roots are developed in the elementary school system in the United States. Research indicates that a good portion of students who attend the postsecondary schools are not prepared to undertake related courses, especially in mathematics and English, for they lack necessary prior knowledge they should have obtained in high school. Fine et al. (2009) indicate that higher education institutions are finding that ever increasing numbers of entering freshman students are unprepared for college-level coursework, particularly in mathematics. Furthermore, 75 percent of postsecondary institutions in the United States, according to the U.S. Department of Education, “offer remedial courses in mathematics and English catering to the 28% of first-time college freshmen at both two-

and four-year postsecondary institutions who lack the skills necessary to perform college-level work (Parsad & Lewis, as cited in Howell, 2011, p. 296). The cost associated with remediation has been exponentially growing as the rate of the number of students who require remediation has been increasing. Perin (2006) asserts that more than half of community college students need remediation, and up to 80 percent enroll in at least one remedial course. Furthermore, Bahr (2008) estimates “the national direct cost of public postsecondary remedial programs at 1–2 billion dollars annually, and the total direct and indirect public and private costs at nearly 17 billion dollars annually” (p. 421). This is a staggering number that reveals the magnitude of the remediation which is a real burden on our educational system.

The MIP program was implemented in Fall 2014, during which the design of the program was evaluated to determine its usability, functionality, and aesthetic appeal with respect to MIP students, teacher, and the Program Manager. The correlational study indicated that there is a positive and moderately strong correlation between students’ background knowledge in (middle school) mathematics and their grades in Algebra 1. The evaluation concluded that students find the design of the MIP program helpful and aesthetically appealing; however, its usability did not meet the evaluation criteria. Furthermore, the MIP Program Manager and teacher are fully satisfied with its design, content, and components. Given the results of this study, RHS has now a solid (research-based) understanding of the relationship between students’ prior knowledge in middle-school mathematics and their grades in Algebra 1, and developed an internal mathematics remediation program—the design of which is approved and supported by its administration as well as the MIP teacher and students. In this regard, this study has

laid the groundwork for future studies at RHS and beyond. Future evaluations will help to establish the effectiveness of the curriculum and provide information to continue to develop the MIP program. Furthermore, the next step would be redesigning the MIP program to include a progress monitoring computer program and expanding its external resources—aspects of which are included in the *Recommendations* section which follows later in this chapter. It is also important to note that most studies and research on remediation have been concentrated on the post-secondary level; however, it is absolutely necessary to study this problem at all K-12 levels as well—especially grades 4 through 9. In addition, designing remedial courses suitable for these grade levels and age groups are at outmost important.

### Recommendations

The following is a list of recommendations that is based on the results of this study:

As Thayer (2008) asserts, the Adventist educational system should develop a “system-wide assessment plan that periodically determines the extent to which its goals have been met” (p. 16). Such system should “include assessment of a broad range of outcomes in all domains: cognitive, affective, and behavior, and outcomes that are both spiritual and non-spiritual (p. 16). Furthermore, regular research studies should be conducted at the Conference (or possibly at the corresponding Union) to determine achievement in core subjects, such as mathematics and English. Quality mathematics education is essential—lack of which has been detrimental to our educational system. As the body of research indicates, mathematics remediation is a serious problem and a

national concern. As such, the Adventist education has not been immune from this problem. The mathematics problem, subject to this study at RHS, is a testimony to this fact. In this regard, Thompson (1985) asserts: “The challenges facing young people in our schools mandate quality mathematics instruction that emphasizes mastery of basic arithmetic and general mathematics skills, development of a “number sense,” and command of problem-solving and logical-thinking skills” (p. 4). Thompson’s assertion still resonates after thirty years. It is strongly recommended that the Conference establish a policy to regularly evaluate mathematics achievement at 4<sup>th</sup>, 8<sup>th</sup> and 9<sup>th</sup> grade levels throughout its school jurisdiction. The findings of these studies will be helpful in terms of making instructional decisions, and establishing new policies and/or improving the existing ones. Furthermore, initiating such studies, the Office of Education at the Conference will promote collaboration—by expanding interactions and dialogue as well as sharing experience and resources—among the faculty and school administrations within its junior and senior academies.

It is recommended that the Conference provide the necessary funds and resources, and incorporate expertise and experience from all junior and senior academies in its jurisdiction to expand the MIP program. Furthermore, the Conference may initiate establishing similar mathematics remedial courses for other grade levels. External resources, such as Florida Virtual, are available to provide remedial courses; however, like RHS, other junior and senior academies may also prefer using internal resources and establishing programs such as the MIP program.

Currently, the Conference utilizes the ACT (including Aspire), Iowa tests (ITBS and ITED), and SAT standardized achievement tests, from which schools select their

desired tests. As such, there is no uniform standardized testing policy at the Conference level. Given the routine student transition within the Adventist schools and student admissions from public and other private schools, this creates complications during the admission process, academic advising, and conducting research among others. It is strongly recommended that the Conference adopt a uniform standardized testing policy to measure academic achievement. Furthermore, given its reliance on ACT-Aspire test, it is recommended that RHS require all incoming students to take this test upon admissions, ensuring uniformity which enhances academic advising, and facilitates MIP placement, and conducting research among others.

It is recommended that RHS assign an experienced instructor to teach the MIP program. This will maximize the effectiveness of the MIP program and thus student learning.

Although the designer of the MIP program is considered an expert in both instructional design and mathematics content, it is recommended that the module contents in the MIP program be reviewed by external experts in the field for validation and improvement—process of which would have been beneficial to this study as well.

Placing the MIP students concurrently in Algebra 1 may cause confusion for students and parents and/or result in unexpected problems. In addition, such placement introduces an external factor influencing the result of the MIP program, and thus negatively impacting the evaluation of its effectiveness. Although, RHS has limited resources, it is strongly recommended that the Conference assist RHS in order to



accommodate offering the MIP program during summer—either face-to-face or a blended mode.

During the course of design evaluation of the MIP program, a possible inverse relationship between student satisfaction and mathematics anxiety became apparent—a possible result of which may have impacted the design evaluation (especially the usability aspect) of this study. The future study may also include, but not limited to, determining students' mathematics anxiety and satisfaction.

Currently, the Mathematics Department at RHS offers teacher-designed tests as final exams for all courses that it offers. Instead, offering a valid and reliable independent criterion-based test (as final exam), at least in Algebra 1, is strongly recommended. This will maximize the integrity and accuracy of research and evaluation with respect to the impact of the MIP program and Algebra 1, mathematics achievement in general, and correlational studies similar to the one conducted in this study. In addition, it will minimize the possibility of grade inflation which facilitates conducting a meaningful evaluation of the MIP program. Furthermore, it will facilitate a reliable research to compare students who did and did not take the MIP program, and compare their performance on the final exam in Algebra 1.

Using a progress monitoring application program in mathematics is strongly recommended. There are excellent computer programs in the market, such as Accelerated Math, which help both students and teachers to monitor progress, provide numerous examples and problems, and facilitate instructional differentiation and assessment among others. Using such a program in the Mathematics Department will maximize efficiency and learning.

## APPENDIX A: DATA ANALYSIS

The research and evaluation related to this study are explained here. A correlational study is conducted to examine the relationship between students' ACT Explore scores and their Algebra 1 grades. The evaluation of the MIP program is conducted in two stages: 1) evaluation of the program design, and 2) evaluation of the program effectiveness.

### **Correlational Study**

#### Purpose

A correlational study is conducted to determine the relationship between students' ACT Explore mathematics scores and their Algebra I grades. More specifically, it is used to determine the correlation between student's background knowledge of the middle school mathematics and predict a possible failure or successful completion of Algebra I (i.e., scoring 83 percent or higher) using their Explore scores. (The test score of the mathematics portion of the ACT Explore test reflects students' knowledge of middle school mathematics.) This study will also be helpful in determining the minimum score below which students will be placed in the MIP program.

#### Methodology

##### **Population and Instrumentation**

The population in this study is all freshmen students for each designated schoolyear. The instruments used in this portion of the study are the ACT Explore standardized tests (mathematics scores) as well as RHS Algebra 1 semester grades for

the 2011-2012, 2012-2013, and 2013-2014 schoolyears. These data correspond to students' grades/scores prior to the implementation of the MIP program in Fall 2014.

### Procedures

In this study, all incoming freshman students' prior ACT Explore scores and their corresponding Algebra 1 semester grades for the 2011-2012, 2012-2013, and 2013-2014 schoolyears were necessary. Upon following the necessary procedures required by the Registrar and Records Office at RHS, these datasets were extracted from the school archived database. The collected student data included student name, gender, grade level, Algebra 1 grade, and related Explore test scores. Generic names, such as Student 1, Student 2, etc., are used to protect student identity. The related student identifier will remain confidential and secure both electronically and physically. These datasets were then cleaned to ensure each student who entered RHS had an Explore score and that completed, at least, the first semester at RHS, and thus having a score in Algebra 1. Duplicate entries were removed. There were students who were admitted to RHS without prior Explore scores, and thus their records were removed from the data. In addition, there were students who had completed Algebra I in the middle school—and their records did not include the necessary information—, and thus their records were removed from the datasets as well. Furthermore, these datasets were labeled as Dataset I (for the 2011-2012 schoolyear), Dataset II (for the 2012-2013 schoolyear), and Dataset III (for the 2013-2014 schoolyear). The final datasets included paired-data for each student—comprising the following populations for further analyses:  $N_i=34$  for Dataset I,  $N_{ii}=35$  for Dataset II, and  $N_{iii}=43$  for Dataset III.

## Results and Discussion

To analyze the correlation between the students' Explore scores and their Algebra 1 (semester) scores, the IBM SPSS Statistics software program (version 22) was used. Furthermore, to demonstrate the correlation between these two variables, all three datasets were analyzed.

The null hypothesis indicates that there is no relationship between the two variable, and the alternative hypothesis indicates that there is—that is, schoolyear I ( $H_0: r_i = 0$  and  $H_1: r_i \neq 0$ ), schoolyear II ( $H_0: r_{ii} = 0$  and  $H_1: r_{ii} \neq 0$ ), and schoolyear III ( $H_0: r_{iii} = 0$  and  $H_1: r_{iii} \neq 0$ ). Given that both variables are interval/ratio in scale, the Pearson correlation seems suitable if each dataset meets the necessary assumptions. The 'independence' assumption is met for all three datasets given that each is composed of the population data rather than a sample. To test for 'normality' for each dataset, the related descriptive statistics are analyzed. The following indicate the results of these analyses:

- **Dataset (I): Explore Scores**— this distribution is slightly positively skewed (.389,  $SE=.403$ ) with a relatively small negative kurtosis ( $-.144$ ,  $SE=.788$ )— z-values of which are within the accepted range of absolute value of two—indicating normality; and **Algebra 1 scores**: this distribution is slightly negatively skewed ( $-.766$ ) with a relatively small positive kurtosis (.533)—z-values of which are within the accepted range of absolute value of two—indicating normality.

- **Dataset (II): Explore Scores**— this distribution is positively skewed (1.052, SE=.398) and positively kurtotic 2.466, SE=.788)— z-values of which are outside the accepted range of absolute value of two—indicating that this distribution is not relatively normal; and **Algebra 1 scores**: this distribution is negatively skewed (-.926) with a relatively small positive kurtosis (.692)—the z-value of which is not within the accepted range of absolute value of two—indicating that this distribution is not relatively normal.
- **Dataset (III): Explore Scores**—this distribution is negatively skewed (-1.764, SE=.361) and positively kurtotic (5.382, SE=.709)— z-values of which are outside the accepted range of absolute value of two—indicating that this distribution is not relatively normal; and **Algebra 1 scores**: this distribution is negatively skewed (-.603) and negatively kurtotic (-.150)—the z-value of which is not within the accepted range of absolute value of two—indicating that this distribution is not relatively normal.

These results are also verified using the Shapiro-Wilk test of normality (see Table 8) as well as Q-Q plots and Boxplots for each dataset (see Figures 9, 10, and 11).

**Table 8 — Test of Normality for Datasets I, II, and III**

**Tests of Normality (Dataset I)**

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Explore Score	.134	34	.129	.958	34	<b>.214</b>
Algebra 1 Score	.099	34	.200*	.946	34	<b>.095</b>

\*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

**Tests of Normality (Dataset II)**

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Explore Score	.230	35	.000	.893	35	<b>.003</b>
Algebra 1 Score	.129	35	.148	.935	35	<b>.039</b>

a. Lilliefors Significance Correction

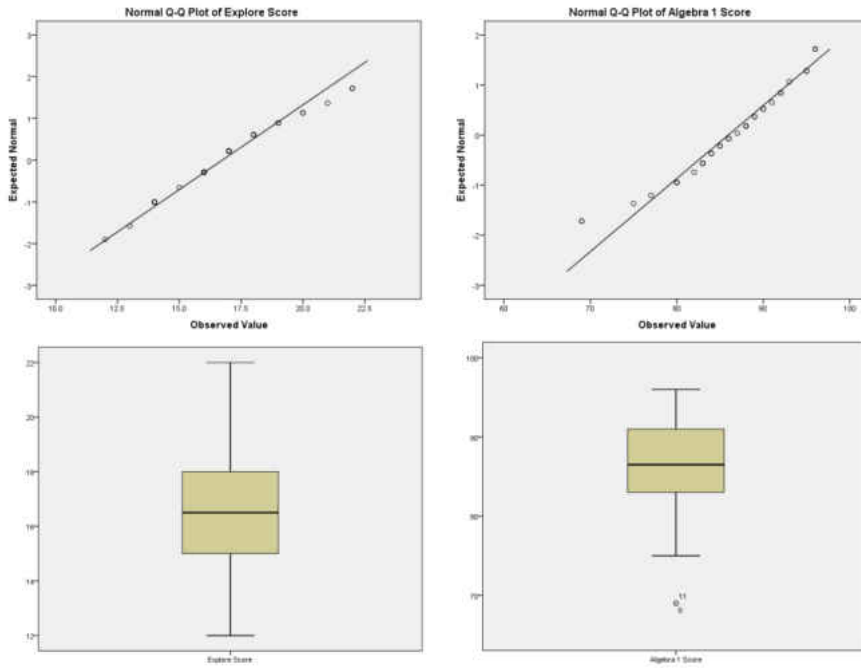
**Tests of Normality (Dataset III)**

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Explore Score	.207	43	.000	.839	43	<b>.000</b>
Algebra 1 Score	.104	43	.200*	.955	43	<b>.088</b>

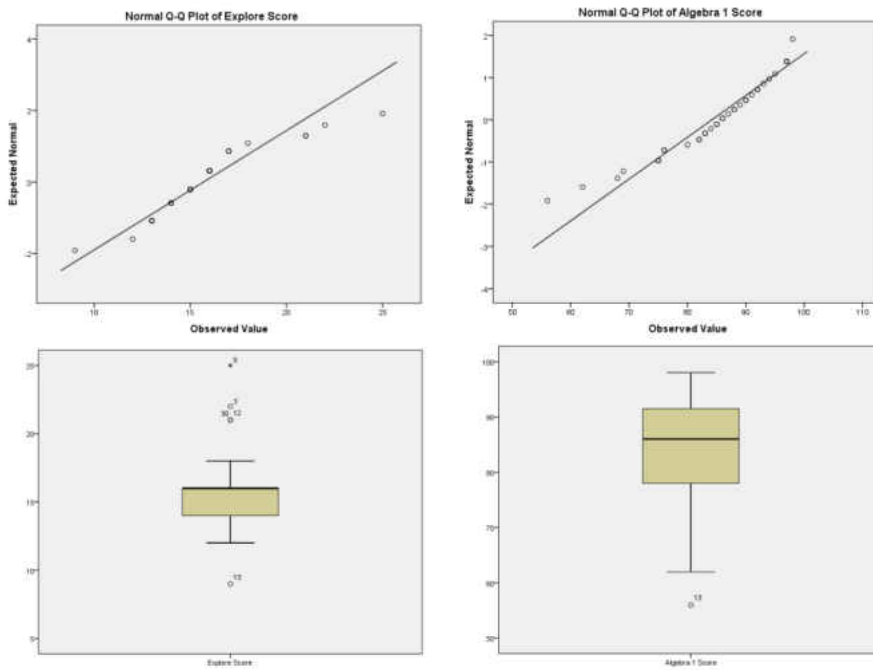
\*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

As the results in Table 8 indicate, only variables in Dataset I indicate significance by having significant values greater than the selected alpha of .05 ( $p > .05$ ). Furthermore, these results may be verified by visually analyzing their relative linearity (using the Q-Q plots) and relative symmetry (using the Boxplots) for both variables which are mainly present for Dataset I (see Figures 9, 10, and 11).

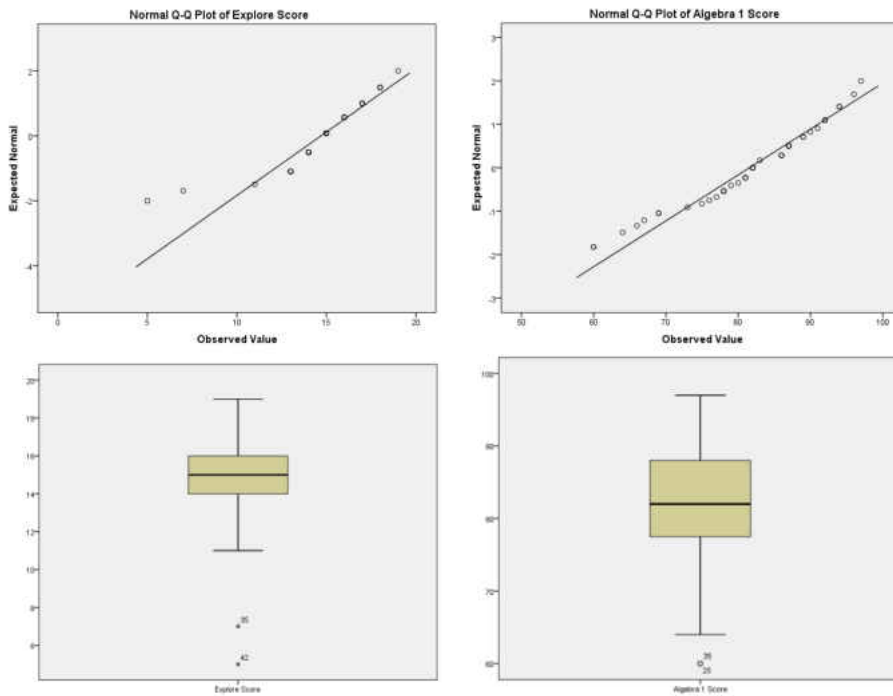


**Figure 9** — Q-Q plots and Boxplots for Distributions in Dataset I



**Figure 10** — Q-Q plots and Boxplots for Distributions in Dataset II





**Figure 11** — Q-Q plots and Boxplots for Distributions in Dataset III

Correspondingly, a parametric correlation test (Pearson product-moment) for Dataset I and a non-parametric correlation test (Spearman) for Datasets II and III are selected and applied. The results (see Table 9) indicate that the correlation between students' Explore scores and their Algebra 1 scores are positive, moderately strong, and statistically significant in all three datasets, and thus the null hypotheses are rejected ( $r_i=.57, p < .01$  for Dataset I;  $r_{ii}=.48, p < .01$  for Dataset II; and  $r_{iii}=.51, p < .01$  for Dataset III).

**Table 9** — Correlation Tests for Datasets I, II, and III

<b>Correlations (Dataset I)</b>			
		Explore Score	Algebra 1 Score
Explore Score	<b>Pearson Correlation</b>	1	<b>.568**</b>
	Sig. (2-tailed)		<b>.000</b>
	N	34	34
Algebra 1 Score	Pearson Correlation	.568**	1
	Sig. (2-tailed)	.000	
	N	34	34

\*\* . Correlation is significant at the 0.01 level (2-tailed).

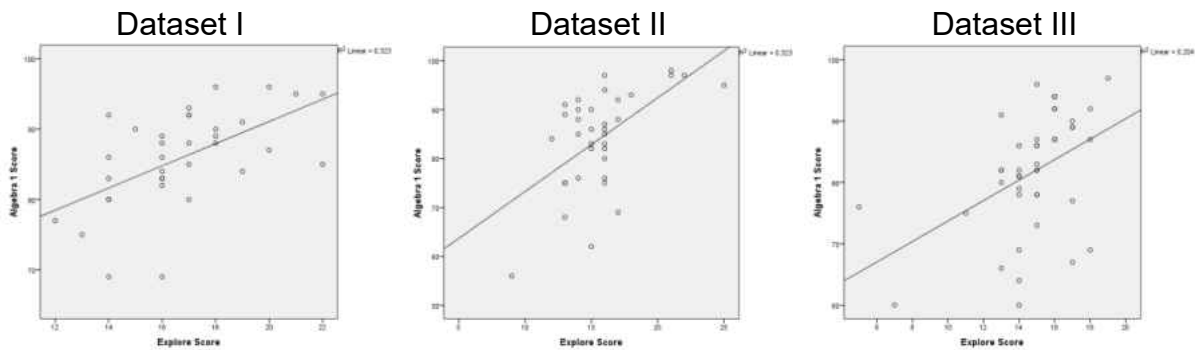
<b>Correlations (Dataset II)</b>			
		Explore Score	Algebra 1 Score
<b>Spearman's rho</b>	Explore Score	Correlation Coefficient	1.000
		Sig. (2-tailed)	<b>.004</b>
		N	35
Algebra 1 Score	Algebra 1 Score	Correlation Coefficient	.475**
		Sig. (2-tailed)	1.000
		N	.004
		N	35

\*\* . Correlation is significant at the 0.01 level (2-tailed).

<b>Correlations (Dataset III)</b>			
		Explore Score	Algebra 1 Score
<b>Spearman's rho</b>	Explore Score	Correlation Coefficient	1.000
		Sig. (2-tailed)	<b>.506**</b>
		N	<b>.001</b>
Algebra 1 Score	Algebra 1 Score	Correlation Coefficient	1.000
		Sig. (2-tailed)	<b>.001</b>
		N	43
		N	43

\*\* . Correlation is significant at the 0.01 level (2-tailed).

To facilitate visual analyses, graphical representations (scatter plot with a linear trend/fit line) of these relationships are presented in Figure 12.



**Figure 12** — Graphical Presentations of the Correlation for Datasets I, II, and III

### Evaluation Plan

The evaluation of the MIP program will be conducted in two stages: 1) Evaluating the program design, and 2) Evaluating the program effectiveness. After obtaining the IRB permission at the University of Central Florida (UCF), the design of the MIP program was evaluated during the Fall 2014 semester. In addition, MIP students' test scores in each program module and their ACT Aspire test scores, at the completion of the program, were also collected and examined. Furthermore, this study recommends an evaluation plan to determine the effectiveness of the MIP program.

### Design Evaluation

#### Purpose

The purpose of the design evaluation is to determine how well the program is designed with respect to its usability, functionality, and aesthetic appeal. This evaluation is based on a mixed mode design consisting of an interview of a limited number of participants (qualitative) and a survey of a larger sample (quantitative).

### Design Evaluation Criteria

The design of the MIP program is determined to be successful when student satisfaction measures, at least, at 70 percent with respect to module design's aesthetic appeal, usability, and overall helpfulness. Furthermore, the MIP teacher and the Program Manager are fully satisfied with the MIP design and its content.

### Design Evaluation Questions

1. Do students perceive the program modules appealing?
2. Do students find the program modules' content helpful?
3. Do students relate test questions to their corresponding module contents?
4. Does the program include the necessary components required by the Program Manager?
5. Does the teacher find the program module content and lesson plans helpful, and assessment tools valid?

### Methodology

#### Evaluation Approach

In this evaluation, aspects of the case study methodology are used.

#### Participants

The participants consist of 26 students, faculty and administrators (24 students, one teacher, and one administrator) whom are selected based on purposive sampling method.

#### Instrumentation

1. *Student Satisfaction Survey*: The purpose of the Student Satisfaction Survey instrument is to determine how satisfied students are with the overall design of

the program modules as well as related activities and quizzes. Table 10 reflects the contents of this instrument which is used for collecting data related to evaluation question numbers one, two, and three.

**Table 10** — Student Satisfaction Survey for Design Evaluation

<b>Student Satisfaction Survey</b> Design Evaluation																																			
<p>The purpose of this anonymous survey is to give you a chance to express your experience and satisfaction about <b>the way modules are designed</b>. Please,</p> <ul style="list-style-type: none"> <li>• Read each statement carefully.</li> <li>• Decide <b>how satisfied you feel about the aspect of the design</b> described by the statement.</li> <li>• Try your best to <b>answer every</b> item.</li> </ul> <p><b>Very Sat.</b> means I am very satisfied with aspect of the design.  <b>Sat.</b> means I am satisfied with aspect of the design.  <b>N</b> means I can't decide whether I am satisfied or not with aspect of the design.  <b>Dissat.</b> means I am dissatisfied with aspect of the design.  <b>Very Dissat.</b> means I am very dissatisfied with aspect of the design.</p> <hr/> <p><b>This is how I feel about...</b></p> <table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="width: 10%; text-align: center;">Very Sat.</th> <th style="width: 10%; text-align: center;">Very Dissat.</th> <th style="width: 10%; text-align: center;">Dissat.</th> <th style="width: 10%; text-align: center;">N</th> <th style="width: 10%; text-align: center;">Sat.</th> </tr> </thead> <tbody> <tr> <td>1. The way visual attributes (clipart, color, font face/size, and so on) are selected</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>2. The way visual attributes are consistent</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>3. Being able to easily access sections in the module</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>4. The way topics are explained in the module</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> </tbody> </table>							Very Sat.	Very Dissat.	Dissat.	N	Sat.	1. The way visual attributes (clipart, color, font face/size, and so on) are selected	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2. The way visual attributes are consistent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3. Being able to easily access sections in the module	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4. The way topics are explained in the module	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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5. The variety of examples in the module	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. The online video clips for each topic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. The number of activities in the module	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Being able to understand and complete activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. The way module contents are engaging	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. The way quizzes are related to topics in each module	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. The way module examples relate to quiz questions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Very	Very Dissat.	Dissat.	N	
	Sat.	Sat.			
Please select one:	Male <input type="checkbox"/>	Female <input type="checkbox"/>			

2. *Interview Protocol Instrument—MIP Program Manager*: The purpose of this instrument is to determine whether the design includes all the necessary components required by the Program Manager. Table 11 reflects the contents of this instrument which is used for collecting data related to evaluation question number four.

**Table 11** — Interview Protocol Instrument for Design Evaluation — Program Manager

Interview Protocol Instrument for Design Evaluation MIP Program Manager		
Data	Questions	Prompts
<ul style="list-style-type: none"> <li>Conception about the design content and characteristics</li> </ul>	1. What are the essential characteristics of a good curriculum design to you, and are they present in the design of the MIP program?	<ul style="list-style-type: none"> <li>Overall program characteristics of the design</li> <li>Overall content of the design</li> </ul>

<ul style="list-style-type: none"> <li>• Conception about the design functionality</li> </ul>	<ol style="list-style-type: none"> <li>2. What are your requirements for the functionality of a curriculum design?</li> <li>3. How would you evaluate the functionality of the design of a program?</li> <li>4. Does the current MIP design meet your functionality requirement? Please explain.</li> </ol>	<ul style="list-style-type: none"> <li>• Requirements for functionality of a design</li> <li>• Overall functionality of the MIP design</li> </ul>
<ul style="list-style-type: none"> <li>• Conception about the design usability</li> </ul>	<ol style="list-style-type: none"> <li>5. Who are the direct users of the MIP program?</li> <li>6. How would you measure the usability of a design?</li> <li>7. Does the current design satisfy such measures? Please explain.</li> </ol>	<ul style="list-style-type: none"> <li>• Who will be directly impacted by the design of the program?</li> <li>• Measuring usability of a design</li> </ul>

3. *Interview Protocol Instrument—MIP Teacher*: The purpose of this instrument is to determine whether the program module content and lesson plans are helpful, and assessment tools valid. Table 12 reflects the contents of this instrument which is used for collecting data related to evaluation question number five.

**Table 12** — Interview Protocol Instrument for Design Evaluation—MIP Teacher

<b>Interview Protocol Instrument</b> for Design Evaluation MIP Teacher		
<b>Data</b>	<b>Questions</b>	<b>Prompts</b>
<ul style="list-style-type: none"> <li>• Conception about the design content and characteristics</li> </ul>	<ol style="list-style-type: none"> <li>1. What are the essential characteristics of a good module to you?</li> </ol>	<ul style="list-style-type: none"> <li>• Overall module characteristics of the design</li> </ul>

	2. Are such characteristics present in the design of the modules?	<ul style="list-style-type: none"> <li>Overall content of the design</li> </ul>
<ul style="list-style-type: none"> <li>Conception about the design usability</li> </ul>	3. How would you measure the usability of a design?  4. Do current modules satisfy such measures? Please explain.	<ul style="list-style-type: none"> <li>Measuring usability of a design</li> <li>Overall usability of the modules</li> </ul>
<ul style="list-style-type: none"> <li>Conception about the validity of assessment tools</li> <li>Conception about assessment rubrics</li> </ul>	5. How do you see the relation between the test/quiz items and corresponding modules? Please explain.  6. How useful did you find the assessment rubrics?	<ul style="list-style-type: none"> <li>Test/Quiz relations to the module contents</li> <li>Assessment rubric usefulness</li> </ul>

The overall information with regard to data sources, selected method(s) for collecting data, instrumentation, and procedures for each evaluation questions are explained in Table 13.



**Table 13** — Design Evaluation Questions, Data Sources, Methods, and Procedures

<b>Evaluation Question</b>	<b>Information Required</b>	<b>Design</b>	<b>Information Source</b>	<b>Method for Collecting Info</b>	<b>Instrumentation/ Sampling</b>	<b>Info Collecting Procedures</b>
<p><u>Q1</u> Do students perceive the program modules appealing?</p> <p><u>Q2</u> Do students find the program modules' content helpful?</p> <p><u>Q3</u> Do students relate test questions to their corresponding module contents?</p>	students' thoughts and feelings about the design of the modules and related activities	case study elements	students	survey	Student Satisfaction Survey for Design Evaluation instrument	conduct survey sessions
<p><u>Q4</u> Does the program include the necessary components required by the</p>	MIP Program Manager's thoughts and experience with the design of the program	case study elements	MIP Program Manager	interview	Interview Protocol Instrument for Program manager	arrange and conduct an interview session

Program Manager?						
<u>Q5</u> Does the teacher find the program module content and lesson plans helpful, and assessment tools valid?	MIP Teacher's thoughts and experience with the design of modules and related assessment tools	Case study elements	MIP Teacher	interview	Interview Protocol Instrument for MIP Teacher	arrange and conduct an interview session

## Procedures

**Interview:** To recruit the participants, the names of the relevant faculty and staff were obtained from the school vice principal who is also the Program Manager. These individuals were then contacted, inviting them to participate in the study. The participants were advised of the nature of the study and the goals of the research, reviewed the informed consent process, and asked whether he or she would like to participate. Upon acceptance, an appointment was set up to meet the individual at a mutually agreed date and time. The face-to-face interview sessions were held in a safe and comfortable location to both the interviewee and researcher, which allowed for a confidential and private environment. Upon the agreement of the interviewee, the session was recorded using an audiotape. The identities of the interviewees will remain confidential, and when necessary, only pseudonyms will be used. All data will remain confidential and secured both electronically and physically.

**Survey:** Two anonymous surveys were conducted from the MIP students during the semester in which the program is offered. The first one was conducted during the first quarter and the second during the last week of the second quarter. Both surveys were conducted by the MIP teacher on designated school days and during normal class sessions. All MIP students were encouraged to participate in the survey. Designated survey dates were determined in consultation with the MIP teacher. Few days before the start of the survey, the MIP teacher was provided with the survey instrument, and a reminder letter was sent one day before the designated survey date. The survey period was active during two class sessions to ensure all students would have a chance to

participate. All data will remain confidential and secured both electronically and physically.

To examine students' initial impressions of the design, maximize the efficiency of the module by incorporating the necessary modifications—based on the study of this survey—an anonymous survey was conducted on November 14, 2014. Using the Student Satisfaction Survey for Design Evaluation instrument (Table 10), this survey was conducted during the class session, and monitored and collected by MIP teacher who placed them in a sealed envelope and delivered it to me. The survey results were evaluated, and subsequently few modifications were introduced in the remaining modules (e.g., improving the navigation system throughout the module, labeling the online video clips for better referencing, and introducing more varieties of videos among others). A second anonymous survey was conducted on December, 3, 2014—the result of which was the basis for evaluating the design. Seventeen students participated in this survey. Using the Student Satisfaction Survey for Design Evaluation instrument (Table 10), this survey was also conducted during the class session, monitored and collected by MIP teacher, and later submitted to me in a sealed envelope.

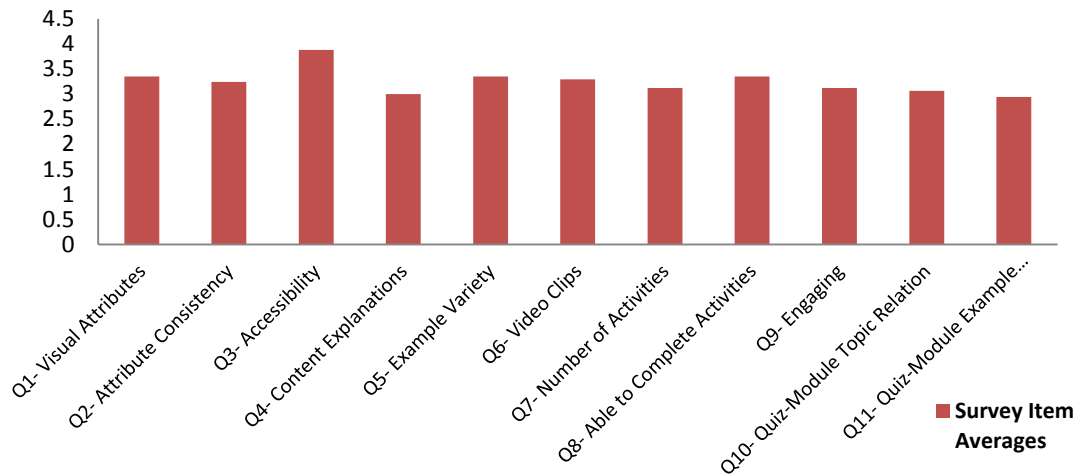
### Results and Discussions

In an interview session, the MIP Program Manager, Paul Smith, who is also the Academic Dean at RHS, confirms his full satisfaction with respect to the overall requirements and function of the MIP program (evaluation question number four). Regarding the characteristics of a good design, P. Smith identifies: “the functionality of the design itself, relating to the standards...and the usability of the [design] that are workable for both the student and the teacher” (personal communication, December 8,

2014). With regard to content and standards in the MIP program, P. Smith indicates that “As a new program, we have been very concerned with the standards and its contents. I think we have covered those very well, so I am very happy” (personal communication, December 8, 2014). Furthermore, “The [MIP] program is very clearly defined, and I am very pleased that we have communicated it to the parents...” (personal communication, December 8, 2014). With regard to the functionality and usability of the MIP program, P. Smith responds, “How we have actually set up the course itself. Does it actually meet the needs of the students.... Is it adjustable...and flexible? And we have done that...these characteristics are present in this program” (personal communication, December 8, 2014). Furthermore, he concludes that “I am very happy with the program. We have been looking for ways that we can help our students. I am really excited about the possibility of continuing on, and may be even expanding” (P. Smith, personal communication, December 8, 2014). In an interview session with the MIP teacher, Jeremy Adams confirms his overall satisfaction with respect to the program module content and lesson plans as well as the validity of the assessment tools (evaluation question number five). With regard to the characteristics of a good module, J. Adams identifies: “giving kids multiple things to look at...not just one way. Showing them videos, using examples...using technology...using things that make it pop a little more...giving kids multiple examples on how to do things. These are important because you want to make them interested and have them involved and interact with it” (personal communication, February 3, 2015). J. Adams confirms the presence of these characteristics in the modules by expressing that “They have great pictures, sticky notes...which make them nice to look at. They give the kids examples, plenty of videos

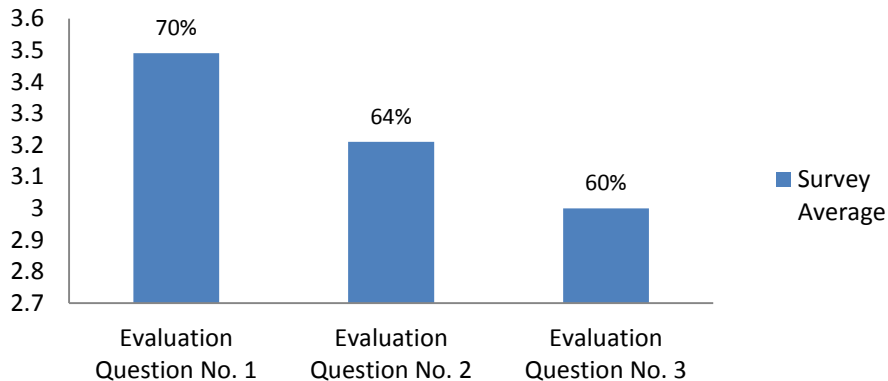
for them to watch. I think these modules do a great job of giving these kids what they need to be successful.” Furthermore, “When kids look for something or questions they may have, I mean, they are all there. There is plenty of stuff for them to use — especially, if they have a question, the module does a great job of making sure that kids have plenty of resources that they can use” (J. Adams, personal communication, February 3, 2015). With regard to the assessment items and their relationship with module content, J. Adams replies, “I think they correspond really well. The questions are very clear...nothing tricky about them. I think the questions on the test matched up the contents of the module really well” (personal communication, February 3, 2015). The results of these interview sessions clearly indicate that both the MIP teacher and the Program Manager are satisfied with the overall design of the MIP program.

The survey items are designed using a Likert scale with the following values (designated for each response to survey items): 1= Very Dissatisfied, 2= Dissatisfied, 3= Neutral, 4= Satisfied, and 5= Very Satisfied. The Microsoft Excel application program (version 2013) was used for the statistical analyses related to the design evaluation. The results for individual survey items (averages) are presented in Figure 13.



**Figure 13** — Individual Survey Item Averages

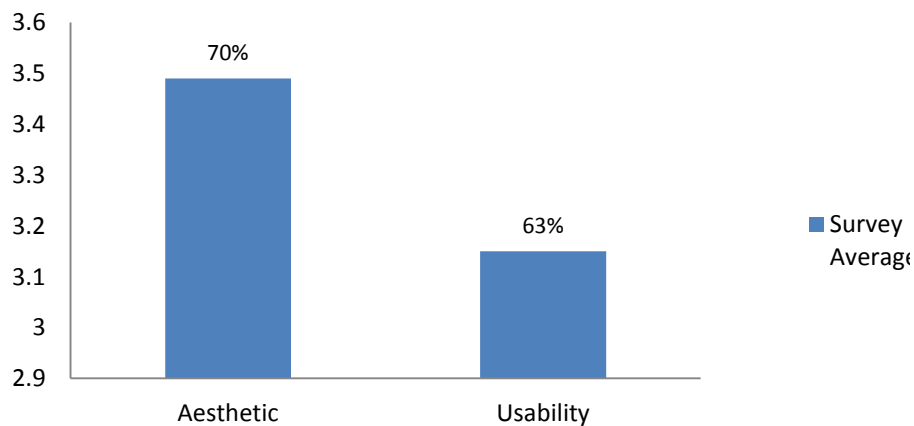
Furthermore, the following strategies (grouping select survey items) were used in order to answer evaluation questions number one through three: a) grouping survey item numbers one through three to answer evaluation question number one: *Do students perceive the program modules appealing?*; b) grouping survey item numbers four through nine to answer evaluation question number two: *Do students find the program modules' content helpful?*; and c) grouping survey item numbers ten and eleven to answer evaluation question number three: *Do students relate test questions to their corresponding module contents?* The results are presented in Figure 14



**Figure 14** —Survey Results for Evaluation Questions 1-3

Considering the design evaluation criteria, the survey analyses indicate that students, on average, perceive the design as appealing (evaluation question number one). However, students, on average, do not find the module’s content as helpful or test questions relating to module contents (evaluation questions number two and three respectively).

As an expanded approach to evaluating the design of the MIP program, in order to examine students’ perceptions on design’s usability and aesthetic aspects (the design framework—explained in Chapter II), the following strategies (grouping select survey items) were used: a) grouping survey item numbers one through three to determine students’ perceptions with respect to the aesthetic aspect of the design; and b) grouping survey item numbers four through eleven to determine students’ perceptions with respect to the usability aspect of the design. The results are presented in Figure 15.



**Figure 15** — Survey Results for the Design Framework

Considering the design evaluation criteria, the survey analyses indicate that students, on average, perceive the design aesthetically appealing. However, on



average, they are not satisfied with the usability of the design of the module. Most 14/15 years old adolescence—a typical age for high school freshmen—usually perceive and react highly emotionally, even with respect to matters that are primarily cognitive in nature. In a remediation course, especially in mathematics, such reactions are usually more amplified. Given this observation as well as the limitations inherent in a self-reporting methodology—such as a survey—, this may have impacted student responses to the survey items and thus adversely affecting the results.

## Program Evaluation

### Purpose

The purpose of the program evaluations is to determine the effectiveness of the MIP program. The following is the list of program information necessary for the purpose of the program evaluation:

Goal: Improve the incoming freshman students' mathematics abilities

Objective: 80 percent of the students score 25 or higher on the Aspire test (post-test)

Duration: Approximately 19 Weeks — 3 hours and 40 minutes weekly

Schedule: Monday and Wednesday (7:50-9:50 am) and Friday (7:50-8:40 am)

Maximum Capacity: 30 students

Cost: None (to students)

Content: Mathematics grades 6-8 and Pre-Algebra

Standards: MIP standards—developed in comparison with the NAD, ACT

Explore/Aspire and Sunshine State Standards.

## Measurement

- Summative Assessment: The ACT-Aspire test for both pre- and post-tests
- Formative Assessment: Quizzes and Tests in each module

## Criteria for Student Selection:

1. Full or partial acceptance to RHS
2. Students whose scores are 18 or less on the ACT Explore test, 240 or less on FCAT 2.0, and/or their normalized standard score in ITBS is 3 or less.

## Stakeholders

- Students, parents, Algebra 1 teacher, Mathematics Department, and school administration
- Primary stakeholder: Vice Principal for Academics at RHS who is also the designated Program Manager

## Evaluation Criteria

The program is determined to be successful when at least 80 percent of the participants score 25 or higher on the ACT-Aspire (post-test).

## Program Evaluation Questions

1. How well is the program designed and implemented?
2. Do students attend the program regularly?
3. Do students actively participate in the program activities?
4. Do students find the modules and related activities helpful?
5. Does the teacher find the program contents helpful and assessment tools valid?
6. Do 80 percent of participants score 25 or higher on the ACT-Aspire test (post-test)?

## Methodology

### Evaluation Approach

The methodological approach for this study is conceptualized as non-experimental pre- and post-test with no comparison group. As explained in Table 14, this evaluation uses components of multiple approaches: Expertise-oriented, program-oriented (logic model), and case study.

**Table 14** — Program Evaluation Approach

<b>Approach</b>	<b>Components Used</b>	<b>Purpose</b>
Expertise-Oriented	<ul style="list-style-type: none"><li>• Expert judgment</li></ul>	<ul style="list-style-type: none"><li>• Judging the program content, lesson plans, and assessment tools</li></ul>
Program Oriented	<ul style="list-style-type: none"><li>• Logic Modeling</li></ul>	<ul style="list-style-type: none"><li>• Identifying program inputs, activities, outputs, and outcomes</li></ul>
Case Study	<ul style="list-style-type: none"><li>• In-depth information over time</li></ul>	<ul style="list-style-type: none"><li>• Providing in-depth description and understanding of the program</li></ul>

Source: Stufflebeam (2001)

### Participants

The participants consist of 27 students, faculty and administrators (24 students, one teacher, and two administrators) whom are selected based on purposive sampling method.

### Instrumentation

1. *Interview Protocol Instrument for Program Evaluation—MIP Program Manager:*

The purpose of this instrument is to determine how well the program is designed and implemented. This instrument is used for the purpose collecting data related to evaluation question number one, and its content is explained in Table 15.

**Table 15** — Interview Protocol Instrument for Program Evaluation—Program Manager

<b>Interview Protocol Instrument for Program Evaluation Program Manager</b>		
<b>Data</b>	<b>Questions</b>	<b>Prompts</b>
<ul style="list-style-type: none"> <li>• Conceptions about the program characteristics</li> <li>• Conception about the placement process</li> <li>• Conceptions about steps of the program implementation</li> </ul>	<ol style="list-style-type: none"> <li>1. What are the essential MIP program characteristics?</li> <li>2. How are students selected for the MIP program?</li> <li>3. What steps are necessary to implement the program?</li> </ol>	<ul style="list-style-type: none"> <li>• Overall program characteristics</li> <li>• Criteria and placement process</li> <li>• Steps of implementing the program</li> </ul>
<ul style="list-style-type: none"> <li>• Conception about implementing these steps and their completion</li> </ul>	<ol style="list-style-type: none"> <li>4. How was the implementation plan scheduled and responsibilities assigned?</li> <li>5. How was the implementation plan supervised?</li> </ol>	<ul style="list-style-type: none"> <li>• Implementation plan schedule</li> <li>• People responsible for implementing steps and monitoring</li> </ul>
<ul style="list-style-type: none"> <li>• Conception about testing the functionality at each step and when the program was fully implemented</li> </ul>	<ol style="list-style-type: none"> <li>6. Was the implementation of each step tested? If so, how?</li> <li>7. Was the program pilot-tested after its completion? If so, how?</li> </ol>	<ul style="list-style-type: none"> <li>• Methods of testing the implementation of each step</li> <li>• Methods of testing the full functionality of the program</li> </ul>

2. *Interview Protocol Instrument—IT Manager*: The purpose of this instrument is to determine how well the program is implemented. This instrument is used for the purpose collecting data related to evaluation question number one, and its content is explained in Table 16.

**Table 16** — Interview Protocol Instrument for the IT Manager

Interview Protocol Instrument IT Manager		
Data	Questions	Prompts
<ul style="list-style-type: none"> <li>• Conception about the MIP technical requirement, both hardware and software</li> </ul>	<ol style="list-style-type: none"> <li>1. What are the hardware and software requirements for the MIP program?</li> <li>2. Are these requirements met during the implementation of the MIP program?</li> </ol>	<ul style="list-style-type: none"> <li>• Overall hardware and software requirements</li> <li>• Overall implementation of the technical requirements</li> </ul>
<ul style="list-style-type: none"> <li>• Conception about online access policies and limitations</li> <li>• Conception about on the related impacts on the MIP students and teachers</li> </ul>	<ol style="list-style-type: none"> <li>3. What are the school policies with regard to online access for the students?</li> <li>4. How do these policies may impact MIP students and teacher</li> </ol>	<ul style="list-style-type: none"> <li>• School online access policies</li> <li>• The impact of related policies on MIP students and teacher</li> </ul>

3. *Student Participation Observation*: The purpose of this instrument is to determine the degree to which students participate in the program activities. This instrument is used for the purpose of collecting data related to evaluation question number three, content of which is explained in Table 17.

**Table 17** — Student Participation Observation Protocol

Student Participation Observation Protocol	
Data	Notes

<ul style="list-style-type: none"> <li>• Conceptions about students engaging in module activities</li> </ul>	
<ul style="list-style-type: none"> <li>• Conceptions about students staying on task</li> </ul>	
<ul style="list-style-type: none"> <li>• Conceptions about students completing module quizzes</li> </ul>	

4. *Student Satisfaction Survey for Program Evaluation*: The purpose of this instrument is to determine how satisfied students are with the program modules and related activities, tests, quizzes, and tasks. Table 18 reflects the contents of this instrument which is used for collecting data related to evaluation question number four.

**Table 18** — Student Satisfaction Survey for Program Evaluation

<b>Student Satisfaction Survey</b> Program Evaluation
<p>The purpose of this anonymous survey is to give you a chance to express your experience and satisfaction about <b>modules and related activities</b>. Please,</p> <ul style="list-style-type: none"> <li>• Read each statement carefully.</li> <li>• Decide <b>how satisfied you feel about the aspect of the design</b> described by the statement.</li> <li>• Try your best to <b>answer every</b> item.</li> </ul> <p><b>Very Sat.</b> means I am very satisfied with aspect of the design.</p> <p><b>Sat.</b> means I am satisfied with aspect of the design.</p> <p><b>N</b> means I can't decide whether I am satisfied or not with aspect of the design.</p>

**Dissat.** means I am dissatisfied with aspect of the design.

**Very Dissat.** means I am very dissatisfied with aspect of the design.

---

**This is how I feel about...**

	Very Sat.	Very Dissat.	Dissat.	N	Sat.
1. The way visual attributes (clipart, color, font face/size, and so on) are selected	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. The way visual attributes are consistent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Being able to easily access sections in the module	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. The way topics are explained in the module	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. The variety of examples in the module	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. The online video clips for each topic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. The number of activities in the module	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Being able to understand and complete activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. The way module contents are engaging	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Being able to keep busy all the time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. The way I receive assistance when I have questions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. The way I receive feedback on tests and quizzes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. The time it takes to receive test/quiz results	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. The way quizzes are related to topics in each module	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. The way module examples relate to quiz questions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. The way modules' contents helped me to prepared for the Aspire test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

17. The way modules' tests/quizzes helped me to prepared for the Aspire test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Very	Very Dissat.	Dissat.	N	
	Sat.	Sat.			
Please select one:	Male <input type="checkbox"/>		Female <input type="checkbox"/>		

5. *Interview Protocol Instrument* for Program Evaluation —*MIP Teacher*: The purpose of this instrument is to determine whether the program contents are helpful and assessment tools valid. Table 19 reflects the contents of this instrument which is used for collecting data related to evaluation question number five.

**Table 19** — Interview Protocol Instrument for Program Evaluation—MIP Teacher

Interview Protocol Instrument for Program Evaluation MIP Teacher		
Data	Questions	Prompts
<ul style="list-style-type: none"> <li>Conception about the design content and characteristics</li> </ul>	7. What are the essential characteristics of a good module to you?  8. Are such characteristics present in the design of the modules?	<ul style="list-style-type: none"> <li>Overall module characteristics of the design</li> <li>Overall content of the design</li> </ul>
<ul style="list-style-type: none"> <li>Conception about the design usability</li> </ul>	9. How would you measure the usability of a design?  10. Do current modules satisfy such measures? Please explain.	<ul style="list-style-type: none"> <li>Measuring usability of a design</li> <li>Overall usability of the modules</li> </ul>



<ul style="list-style-type: none"> <li>• Conception about the validity of assessment tools</li> <li>• Conception about assessment rubrics</li> </ul>	<p>11. How do you see the relation between the test/quiz items and corresponding modules? Please explain.</p> <p>12. How useful did you find the assessment rubrics?</p>	<ul style="list-style-type: none"> <li>• Test/Quiz relations to the module contents</li> <li>• Assessment rubric usefulness</li> </ul>
--	--	--

6. *The ACT Aspire Test*: The ACT standardized test (mathematics scores) is used for the selection process as well as pre- and post-tests. The analysis of the data related to pre- and post-test scores will answer the evaluation question number six.

The overall information with regard to data sources, selected method(s) for collecting data, instrumentation, and procedures for each evaluation questions are explained in Table 20.

**Table 20** — Program Evaluation Questions, Data Sources, Methods, and Procedures

<b>Evaluation Question</b>	<b>Information Required</b>	<b>Design</b>	<b>Information Source</b>	<b>Method for Collecting Info</b>	<b>Instrumentation/ Sampling</b>	<b>Info Collecting Procedures</b>
<p><u>Q1</u> How well is the program designed and implemented?</p>	<p>program documents and implementation plans; ease of access to eBackpack and module online links; modules' contents and activities; program function in action</p>	<p>case study elements; logic model; expertise-oriented elements</p>	<p>program designer, program manager, school IT director, mathematics teacher, tutor and students</p>	<p>documentation review, interviews, and observation</p>	<p>Interview Protocol instrument for Program Evaluation— Program Manager, Interview Protocol for IT Director, Student Participation Observation Protocol</p>	<p>obtain program documentation; arrange and conduct interview sessions; student observations are done during daily class sessions</p>
<p><u>Q2</u> Do students attend the program regularly?</p>	<p>attendance records</p>	<p>case study elements</p>	<p>school Registrar and Records</p>	<p>school records</p>	<p>related school request form</p>	<p>obtain, complete, and submit the Attendance Request form from the office of school Registrar and Record.</p>
<p><u>Q3</u> Do students actively participate in the program activities?</p>	<p>student attentiveness during daily class sessions</p>	<p>case study elements</p>	<p>students</p>	<p>observation (quite participation)</p>	<p>Student Participation Observation Protocol</p>	<p>the evaluator collects data by conducting multiple direct quite observation sessions</p>

<u>Q4</u> Do students find the modules and related activities and quizzes helpful?	students thoughts and feelings about the modules and related activities	case study elements	students	survey	Student Satisfaction Survey for Program Evaluation	conduct survey sessions
<u>Q5</u> Does the teacher find the program contents helpful and assessment tools valid?	MIP Teacher's thoughts and experience with the program modules and related assessment tools	case study elements	MIP Teacher	interview	Interview Protocol Instrument for Program Evaluation —MIP Teacher	arrange and conduct an interview session
<u>Q6</u> Do 80 percent of participants score 25 or higher on the ACT Aspire (post-test)?	students' scores on the ACT Aspire test (pre- and post-test)	descriptive; pre- and post-test	school Registrar and Records	school records	related school request form	obtain, complete and submit the Grade Request form from the Office of Registrar and Record.

In addition, the MIP program logic model is explained in Table 21.

**Table 21** — MIP Program Logic Model

Inputs	Activities	Outputs	Outcomes		Impact
			Short Term	Medium Term	
<ul style="list-style-type: none"> <li>• A large room with the necessary furniture</li> <li>• 32 iPads connected to the network</li> <li>• 32 headsets with microphone</li> <li>• 32 basic calculators</li> <li>• Network access ID and password for 32 people</li> <li>• One mathematics teacher</li> <li>• One mathematics tutor</li> <li>• One person to design and develop</li> <li>• Implement the MIP program</li> <li>• One administrator (to select teacher and tutor)</li> <li>• One person to order textbooks</li> <li>• One person to order ACT Aspire tests</li> <li>• The necessary stationary materials</li> <li>• The eBackpack tutorial training session for students</li> <li>• The necessary budget</li> <li>• One IT Director</li> </ul>	<ul style="list-style-type: none"> <li>• Select a classroom with suitable furniture</li> <li>• Obtain iPads, headphones, and calculators</li> <li>• Obtain network IDs and password for students and tutors, and test them</li> <li>• Designate persons to order textbooks and Aspire tests</li> <li>• Research and select the overall resources in order to develop course modules</li> <li>• Develop modules, assessment tools and related rubrics</li> <li>• Check the module contents, and related quizzes, tests, and rubrics</li> <li>• Upload modules on the eBackpack program</li> <li>• Check the links in the modules</li> <li>• Assign one mathematics teacher</li> <li>• Select students</li> <li>• Recruit a tutor</li> <li>• Create seat assignment for students and tutor</li> <li>• Write a concise information on the MIP program for parents</li> </ul>	<ul style="list-style-type: none"> <li>• Students will take the ACT Aspire test (pre-test).</li> <li>• Students study each section in the module</li> <li>• Students complete the section activities and exercises, and work with the teacher and tutor if necessary.</li> <li>• Students review the section and complete the corresponding quiz.</li> <li>• Students review the assigned module and complete the corresponding end-of-module test</li> <li>• Mathematics teacher takes attendance (students and tutor), conducts a 10-15 minutes bell-work session, monitor student activities, and answer questions.</li> <li>• Tutor works with each student who desires his/her assistance.</li> </ul>	<p>Passing quizzes for each module</p>	<p>Passing end-of-modules tests</p>	<p>Students score 25 or higher on the ACT-Aspire test (post-test).</p>

A copy of the approval letter from the UCF Institutional Review Board (IRB) with respect to human research for this study is displayed below.



University of Central Florida Institutional Review Board  
Office of Research & Commercialization  
12201 Research Parkway, Suite 501  
Orlando, Florida 32826-3246  
Telephone: 407-823-2901 or 407-882-2276  
[www.research.ucf.edu/compliance/irb.html](http://www.research.ucf.edu/compliance/irb.html)

### Approval of Exempt Human Research

From: UCF Institutional Review Board #1  
FWA00000351, IRB00001138

To: Kambiz Borhon

Date: November 04, 2014

Dear Researcher:

On 11/04/2014, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review:	Exempt Determination
Project Title:	Math Remediation for High School Freshmen
Investigator:	Kambiz Borhon
IRB Number:	SBE-14-10734
Funding Agency:	
Grant Title:	
Research ID:	N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the [Investigator Manual](#).

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

A handwritten signature in black ink that reads "Joanne Muratori".

Signature applied by Joanne Muratori on 11/04/2014 09:59:36 AM EST

IRB Coordinator

## **APPENDIX B: SAMPLE CURRICULUM MODULE**

This section includes a sample curriculum module including its corresponding lesson plans. The MIP program is modular, and each module has two aspects: 1) the actual module contents that are used mainly by the students (e.g., Module I), and 2) the overall lesson plans, standards, prerequisites, goals and objectives, and resources among others related to each module that are used primarily by the teacher (e.g., Curriculum Module I). This naming convention is developed to help distinguish these two aspects of each module, and thus prevent confusion. This section includes a sample curriculum module, including its corresponding lesson plans. Table 22 includes the MIP Curriculum Module I which provides the related information for this module at a macro level.

**Table 22 – MIP Curriculum Module for Module I**

<b>Curriculum Area</b>	Mathematics
<b>Module Author</b>	Kami Borhon
<b>Curriculum Module Overview</b>	
<b>Module I</b>	Numbers, Properties and Operations
<b>Approximate Time Required</b>	4 ½ weeks
<b>Suggested Grade Level(s)</b>	9-10
<b>Module Summary</b>	
<ul style="list-style-type: none"> <li>• Real numbers and operations involving rational numbers</li> </ul>	

- Improper fraction and mixed numerals
- Problems involving integer exponents, roots, and radicals
- Estimating and rounding, absolute value, primes and greatest common factor
- Scientific notation and conversion of units of measurement
- Ratio and proportional relationships and their applications

### Targeted Content Standards

- **M.I.P.M.1:** Know the real number system, and be able to add, subtract, multiply and divide rational numbers.
- **M.I.P.M.2:** Solve multi-step arithmetic problems using rational numbers.
- **M.I.P.M.3:** Solve problems involving integer exponents, roots, and radicals.
- **M.I.P.M.4:** Understand estimating and rounding, absolute value, primes and greatest common factor.
- **M.I.P.M.5:** Understand the scientific notation.
- **M.I.P.M.6:** Solve problems involving converting units of measurement.
- **M.I.P.M.7:** Understand ratio and use its applications.
- **M.I.P.M.8:** Analyze proportional relationships and use their applications.
- **M.I.P.M.9:** Solve problems involving percentage and interest.

### Student Prerequisite Skills

- Students should know basic arithmetic computations.
- Students should be familiar with using an iPad.
- Students should be able to use the eBackpack program.
- Students should be familiar with using a basic calculator.

### Materials and Resources Required for Module/Lessons

	<b>Tools and Materials</b>	Pen-pencil and paper
	<b>Technology, Internet, Hardware and Software</b>	iPad, earphone, calculator, monitor, speakers, and access to the Internet
	<b>Other Tools and Supply</b>	None



## Curriculum-Framing Questions

### Essential Questions

- Why is it necessary to have different types of numbers in mathematics?
- How negative numbers are used in real life situations?
- What are the benefits and drawbacks of estimating?
- Why is using the scientific notation important?
- When using proportions becomes necessary? Why?

### Focus Questions

- Does the student know the real number system and its properties?
- Is the student able to add, subtract, multiply and divide rational numbers?
- Can the student solve multi-step arithmetic problems using rational numbers?
- Can the student solve problems involving integer exponents, roots, and radicals?
- Does the student understand estimating and rounding, absolute value, primes and greatest common factor as well as the scientific notation?
- Can the student solve problems that involve converting units of measurement?
- Does the student understand ratio and use its applications?
- Can the student analyze proportional relationships and use their applications?
- Can the student solve problems involve percentage and interest?

## Learning Goals and Objectives

Upon the completion of this module, the student will **know/understand**:

- The real number system and their characteristics and relationship
- Estimating, scientific notation and rounding, absolute value, primes and greatest common factor
- Proportion and use its applications

Upon the completion of this module, the student **will be able to**:

- Solve simple and multi-step arithmetic problems using rational numbers.
- Solve problems involving integer exponents, roots, and radicals.
- Solve problems involving converting units of measurement.
- Analyze proportional relationships and use their applications.
- Solve problems involving percentage and interest.

### **Learning Theories Addressed**

- Cognitive psychology (information-processing approaches, motivational models, Vygotsky's sociocultural-cognitive theory, and Bandura's social-cognitive theory)
- Learning styles theory
- and constructivist approaches to teaching and learning
- Cognitive process dimensions included in the Bloom's Taxonomy for learning, teaching, and assessing

### **Differentiated Instruction**

- Providing visual aids, PowerPoint (visual-aural)
- Providing verbal explanations (aural)
- Using written materials (aural-visual)
- Assigning hands-on activities (kinesthetic)
- Providing (online) video clips (visual-aural)
- Providing links to appropriate website(s) related to the topic
- Allowing collaborations, using flexible grouping techniques
- Using modeling techniques (using teacher, student, videos, etc.)
- Chunking—especially complex topics (breaking concept into smaller with parts/patterns—grouping)
- Allowing students to work individually
- Providing special activities for struggling and advanced students

- Providing special assistance and activities for ESOL and ESE students
- Providing student-tutoring (peer-tutoring)
- Providing guided practice—step-by-step directions
- Providing individual teacher/tutor assistance
- Providing ongoing feedback

### **Accommodations**

#### **ESOL/ELL/LEP**

- Pair students with bilingual peers, if available.
- Provide bilingual dictionaries in class.
- Provide verbal and written directions.
- Designate extra time (as needed) for activities, quizzes, and tests.

#### **ESE/SLD/ESE**

- Provide visual aids (hand-outs with large prints, etc.).
- Designate extra time (as needed) for activities, quizzes, and tests.
- Provide specific student needs as resources permit.
- Follow direction recommended and/or directed by the school counselor or administration.

#### **Struggling**

- Adjust instruction to address students' gap in knowledge and skills.
- Use small group instruction.
- Provide more peer-tutoring opportunities.
- Design task at different degrees of difficulty.
- Use a variety of presentation approaches.
- Designate extra time (as needed) for activities, quizzes, and tests

#### **Advanced/Gifted**

- Raise expectations.
- Design more challenging exercises and activities.
- Constitute levels of excellence.

### **Assessment**

- Observation (formative, informal)
- Performance task (formative, informal)
- Demonstration (formative, informal)
- Self- and peer-evaluation (formative, informal)
- Quiz (formative, formal)
- Test (summative, formal)

### **Technology Assessment**

- iPads must be functional and connected to the Internet.
- eBackpack app must be functional.
- Earphones must function properly.

Source: Author's produced content using template generated by Gunter (2010) and in-text by Gunter and Gunter (2015)

Detailed information for lesson plans 1 and 2 for this module (Module I) are provided in Tables 23 and 24 respectively. These tables include specific information for learning activities and assignment, assessment, and resources for their corresponding lesson plans.

**Table 23** – Lesson Plan 1 of Module I

<b>Subject</b>	Mathematics	<b>Week/Day</b>	3 ½ Weeks
<b>Module I</b>	Numbers, Properties and Operations	<b>Grade</b>	9-10
<b>Topic</b>	Lesson <u>1</u> : Computation and Basic Operation	<b>Author</b>	Kami Borhon
<b>Lesson Summary</b>			
<ul style="list-style-type: none"> <li>• Real numbers and operations involving rational numbers</li> <li>• Improper fraction and mixed numerals</li> <li>• Problems involving integer exponents, roots, and radicals</li> <li>• Estimating and rounding, absolute value, primes and greatest common factor</li> <li>• Scientific notation and conversion of units of measurement</li> </ul>			
<b>Benchmarks</b>			
<ul style="list-style-type: none"> <li>• <b>M.I.P.M.1:</b> Know the real number system, and be able to add, subtract, multiply and divide rational numbers.</li> <li>• <b>M.I.P.M.2:</b> Solve multi-step arithmetic problems using rational numbers.</li> <li>• <b>M.I.P.M.3:</b> Solve problems involving integer exponents, roots, and radicals.</li> <li>• <b>M.I.P.M.4:</b> Understand estimating and rounding, absolute value, primes and greatest common factor.</li> <li>• <b>M.I.P.M.5:</b> Understand the scientific notation.</li> <li>• <b>M.I.P.M.6:</b> Solve problems involving converting units of measurement.</li> </ul>			
<b>Materials</b>			
iPad, earphone, monitor, speakers, and access to the Internet			
<b>Essential Questions</b>			
<b>Essential Questions</b>	<ul style="list-style-type: none"> <li>• Why is it necessary to have different types of numbers in mathematics?</li> <li>• How negative numbers are used in real life situations?</li> <li>• What are the benefits and drawbacks of estimating?</li> <li>• Why is using the scientific notation important?</li> </ul>		
<b>Focus Questions</b>			
<b>Focus Questions</b>	<ul style="list-style-type: none"> <li>• Does the student know the real number system and its properties?</li> <li>• Can the student add, subtract, multiply and divide rational numbers?</li> <li>• Can the student solve multi-step arithmetic problems using rational numbers?</li> </ul>		

	<ul style="list-style-type: none"> <li>• Can the student solve problems involving integer exponents, roots, and radicals?</li> <li>• Does the student understand estimating and rounding, absolute value, primes and greatest common factor as well as the scientific notation?</li> <li>• Can the student solve problems that involve converting units of measurement?</li> </ul>
<b>Learning Goals and Objectives</b>	<p>Upon the completion of this module, the student will <b>know/understand</b>:</p> <ul style="list-style-type: none"> <li>• The real number system, and be able to add, subtract, multiply and divide rational numbers.</li> <li>• Estimating and rounding, absolute value, primes and greatest common factor as well as the scientific notation.</li> </ul> <p>Upon the completion of this module, the student <b>will be able to</b>:</p> <ul style="list-style-type: none"> <li>• Solve multi-step arithmetic problems using rational numbers.</li> <li>• Solve problems involving integer exponents, roots, and radicals.</li> <li>• Solve problems involving converting units of measurement.</li> </ul>
<b>Schedule</b>	<ul style="list-style-type: none"> <li>• <b>Week 1:</b> Complete sections 1.1-1.3</li> <li>• <b>Week 2:</b> Review; Quiz 1 (<i>sections 1.1-1.3</i>); complete sections 1.4-1.5</li> <li>• <b>Week 3 ½:</b> Complete sections 1.6, 1.7; review, Quiz 2 (<i>sections 1.4-1.7</i>)</li> </ul>
<b>Learning Activities &amp; Assignments and Assessments</b>	<p><b><u>Week 1</u></b></p> <p><b>I. Bellwork</b></p> <ul style="list-style-type: none"> <li>• Ask students if they have any questions about the previous lessons and/or the assigned study at home.</li> <li>• Have students work on 2-3 selected questions and exercises from the related to the Focused Questions and Module I (Sections 1.1-1.3). Have students work on them individually, and then discuss in groups (of two or three) or with the tutor and/or the teacher.</li> </ul>

- If necessary, show one or two of the related video clips and discuss in class.

## II. **Activities/Assignments**

- **(at Home)**: Assign students to study selected sections of Module I (on eBackpack) at home, and use the related resources identified in each Section. Encourage students to watch the related videos with their parents.
- **(in Class)**:
  - Working solo or in groups (of two or three) and using Module I, have students working on the selected (following) sections from the available resources (textbooks, video clips, etc.). Allow students to use the whiteboards if they so desire.
  - Teacher and/or students would select from the following resources from the textbooks, video clips, websites, and module contents:

### Section 1.1

- Module content: pp. 3-4
- TXTBK I: pp. 11-14
- TXTBK II: pp. 33-36, 39-40
- Video clip: 1

### Section 1.2

- Module content: pp. 4-5
- Video clips: 2, 3, and 4

### Section 1.3

- Module content: p. 5
- Video clip: 5

- During this time, the teacher would observe students, ask questions, and provides assistance as students work their assigned activities.

- Have the tutor available during the class, so students would have an extra help if they prefer and/or as the teacher becomes occupied by other students.
- About 10 minutes before the bell, the teacher would be providing a recap of what was studied as well sharing observations and suggestions (if any). In addition, the teacher will be reminding students about the next topic and students' assignment and activities at home referencing related sections in Module I.

### **III. Assessment**

- Observation (formative, informal)
- Performance task (formative, informal)
- Demonstration (formative, informal)
- Self- and peer-evaluation (formative, informal)

## **Week 2**

### **I. Bellwork**

- Ask students if they have any questions about the previous lessons and/or the assigned study at home.
- Have students work on 2-3 selected questions and exercises from the related to the Focused Questions and Module I (Sections 1.1-1.3). Have students work on them individually, and then discuss in groups (of two or three) or with the tutor and/or the teacher.
- If necessary, show one or two of the related video clips and discuss in class.

### **II. Activities/Assignments**

- **(at Home):** Assign students to study selected sections of Module I (on eBackpack) at home, and use the related resources identified in each Section. Encourage students to watch the related videos with their parents.
- **(in Class):**



- Working solo or in groups (of two or three) and using Module I, have students working on the selected (following) sections from the available resources (textbooks, video clips, etc.). Allow students to use the whiteboards if they so desire.
- Teacher and/or students would select from the following resources from the textbooks, video clips, websites, and module contents:

#### Section 1.4

- Module content: pp. 6-10
- TXTBK II: pp. 24, 26-26
- Video clips: 6, 7, 8, 9, 10, 11, 12, and 13

#### Section 1.5

- Module content: p. 10
  - TXTBK II: p. 28
  - Video clips: 14, 15, and 16
- During this time, the teacher would observe students, ask questions, and provides assistance as students work their assigned activities.
  - Have the tutor available during the class, so students would have an extra help if they prefer and/or as the teacher becomes occupied by other students.
  - About 10 minutes before the bell, the teacher would be providing a recap of what was studied as well sharing observations and suggestions (if any). In addition, the teacher will be reminding students about the next topic and students' assignment and activities at home referencing related sections in Module I.

### **III. Assessment**

- Observation (formative, informal)
- Performance task (formative, informal)

- Demonstration (formative, informal)
- Self- and peer-evaluation (formative, informal)
- Quiz (formative, formal)

### **Week 3½**

#### **I. Bellwork**

- Ask students if they have any questions about the previous lessons and/or the assigned study at home.
- Have students work on 2-3 selected questions and exercises from the related to the Focused Questions and Module I (Sections 1.1-1.3). Have students work on them individually, and then discuss in groups (of two or three) or with the tutor and/or the teacher.
- If necessary, show one or two of the related video clips and discuss in class.

#### **II. Activities/Assignments**

- **(at Home):** Assign students to study selected sections of Module I (on eBackpack) at home, and use the related resources identified in each Section. Encourage students to watch the related videos with their parents.
- **(in Class):**
  - Working solo or in groups (of two or three) and using Module I, have students working on the selected (following) sections from the available resources (textbooks, video clips, etc.). Allow students to use the whiteboards if they so desire.
  - Teacher and/or students would select from the following resources from the textbooks, video clips, websites, and module contents:

#### **Section 1.6**

- Module content: pp. 10-13
- TXTBK II: p. 23

- Video clips: 17, 18, 19, 20, 21, 22, and 23

### Section 1.7

- Module content: p. 13
  - TXTBK I: pp. 43-58
- During this time, the teacher would observe students, ask questions, and provides assistance as students work their assigned activities.
  - Have the tutor available during the class, so students would have an extra help if they prefer and/or as the teacher becomes occupied by other students.
  - About 10 minutes before the bell, the teacher would be providing a recap of what was studied as well sharing observations and suggestions (if any). In addition, the teacher will be reminding students about the next topic and students' assignment and activities at home referencing related sections in Module I.

### **III. Assessment**

- Observation (formative, informal)
- Performance task (formative, informal)
- Demonstration (formative, informal)
- Self- and peer-evaluation (formative, informal)
- Quiz (formative, formal)
- Test (summative, formal)

### **Lesson Resources**

- Course **Module I** on eBackpack (Section 1)
- **Textbooks:** TXTBK I & II
- **Video/Site Clips:**
  - 1) Use the link below to access a variety of exercises, solved examples and/or videos on **rational and irrational numbers**. <https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-numbers-operations/cc-8th-irrational-numbers/v/introduction-to-rational-and-irrational-numbers>

- 2) This site is an excellent site for rounding and estimating. Look at “**Rounding a whole numbers**” and “**Estimating a Sum.**” <http://www.basic-mathematics.com/rounding-and-estimating.html>
- 3) This is an excellent video clip explaining **rounding a whole number** (4:22 min.)- <https://www.khanacademy.org/math/cc-fourth-grade-math/cc-5th-place-value-rounding-topi/cc-4th-rounding/v/rounding-whole-numbers-1>
- 4) This is an excellent short video clip explaining **rounding a decimal number** (1.26 min.)- <https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-place-value-decimals-top/cc-5th-rounding-decimals/v/rounding-decimals>
- 5) Use the link below to access a variety of exercises, solved examples and/or videos on **absolute value**. [Khan Academy Website # 5](#)
- 6) This is an introductory video on **exponent** (9:46 min.)- <http://www.bing.com/videos/search?q=exponents+khan+academy&qpv=exponents+khan+academy&FORM=VDRE#view=detail&mid=50F2066405A7E6F7EC2B50F2066405A7E6F7EC2B>
- 7) Use the links below to access a variety of exercises, solved examples and/or videos on **exponents**. <https://www.khanacademy.org/math/pre-algebra/exponents-radicals/World-of-exponents>
- 8) Use the links below to access a variety of exercises, solved examples and/or videos on **exponent properties**. <https://www.khanacademy.org/math/pre-algebra/exponents-radicals/exponent-properties/v/exponent-rules-part-1>
- 9) Here is a video clip on understanding **square root** (1:21 min.)- <https://www.khanacademy.org/math/pre-algebra/exponents-radicals/radical-radicals/v/understanding-square-roots>

- 10) This is an excellent video on **simplifying square roots** (5:35 min.)-  
<http://www.bing.com/videos/search?q=roots+khan+academy&qpvt=roots+khan+academy&FORM=VDRE#view=detail&mid=FC7C1460C2633DA5CA0CFC7C1460C2633DA5CA0C>
- 11) This is an excellent video on **approximating square roots** (7:11 min.)-  
<http://www.bing.com/videos/search?q=roots+khan+academy&qpvt=roots+khan+academy&FORM=VDRE#view=detail&mid=98E3DE3EA55841C07F8D98E3DE3EA55841C07F8D>
- 12) This is a video clip on **simplifying radicals** (9:44 min.)-  
<http://www.bing.com/videos/search?q=radicals+khan+academy&qpvt=radicals+khan+academy&FORM=VDRE#view=detail&mid=5E6101527BF2E2909B045E6101527BF2E2909B04>
- 13) Use the links below to access a variety of exercises, solved examples and/or videos on **roots and radicals**.  
<https://www.khanacademy.org/math/pre-algebra/rates-and-ratios/ratios-and-proportions/v/introduction-to-ratios-new-hd-version>
- 14) This is an excellent video on **scientific notation** (4:11 min.)-  
<https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-numbers-operations/cc-8th-scientific-notation/v/scientific-notation-i>
- 15) This video explores **scientific notation** more comprehensively with more examples (11:26 min.)-  
<https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-numbers-operations/cc-8th-scientific-notation/v/scientific-notation>
- 16) Use the links below to access a variety of exercises, solved examples and/or videos on **scientific notation**.  
<https://www.khanacademy.org/math/pre-algebra/exponents-radicals/scientific-notation/v/scientific-notation-old>
- 17) This is an introductory video on **greatest common factor** (2:24 min.)-

<http://www.bing.com/videos/search?q=greatest+common+factor+khan+academy&qs=n&form=QBVR&pq=greatest+common+factor+khan+academy&sc=2-35&sp=-1&sk=#view=detail&mid=BC615A195C615372E0B9BC615A195C615372E0B9>

18) Here is another example/video (6:19 min.)-

<https://www.khanacademy.org/math/cc-sixth-grade-math/cc-6th-factors-and-multiples/cc-6th-gcf/v/greatest-common-divisor>

19) Here is a video of a few sample problems (6:49 min.)-

<https://www.khanacademy.org/math/pre-algebra/factors-multiples/greatest-common-divisor/v/greatest-common-divisor-factor-exercise#!>

20) Another good video clip on the **greatest common factor**

(6:19 min.)- <http://www.youtube.com/watch?v=jFd-6EPfneC>

21) Use the links below to access a variety of exercises, solved examples and/or videos on **prime and composite numbers**.

<https://www.khanacademy.org/math/pre-algebra/factors-multiples/prime-numbers/v/prime-numbers>

22) Use the links below to access a variety of exercises, solved examples and/or videos on **prime factorization**.

<https://www.khanacademy.org/math/pre-algebra/factors-multiples/prime-factorization/v/prime-factorization>

23) Use the links below to access a variety of exercises, solved examples and/or videos on **greatest common factor**.

<https://www.khanacademy.org/math/pre-algebra/factors-multiples/greatest-common-divisor/v/greatest-common-divisor-factor-exercise>

- **Website(s):** none
- **Others:** none

## References

Basic-Mathematics (2008). Retrieved from <http://www.basic-mathematics.com/>.

	<p>Khan Academy (2014, May 8). Retrieved from <a href="https://www.khanacademy.org/">https://www.khanacademy.org/</a>.</p> <p>Rappaport, J. (2003). <i>Algebra survival guide</i>. Santa Fe, New Mexico: Singing Turtle Press.</p> <p>Rappaport J. (2013). <i>Algebra survival guide workbook</i>. Santa Fe, New Mexico: Singing Turtle Press.</p> <p>Spectrum (2007). <i>Spectrum math – grade 8</i>. Greensboro, NC: Carson-Dellosa.</p> <p>Spectrum (2011). <i>Spectrum algebra – grades 6-8</i>. Greensboro, NC: Carson-Dellosa.</p>
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Source: Author’s produced content using template generated by Gunter (2010) and in-text by Gunter and Gunter (2015)

**Table 24** – Lesson Plan 2 of Module I

<b>Subject</b>	Mathematics	<b>Week/Day</b>	1 Week
<b>Module I</b>	Numbers, Properties and Operations	<b>Grade</b>	9-10
<b>Topic</b>	Lesson <u>2</u> : Ratio and Proportion	<b>Author</b>	Kami Borhon
<b>Lesson Summary</b>			
<ul style="list-style-type: none"> <li>Ratio and proportional relationships and their applications</li> </ul>			
<b>Benchmarks</b>			
<ul style="list-style-type: none"> <li><b>M.I.P.M.7:</b> Understand ratio and use its applications.</li> <li><b>M.I.P.M.8:</b> Analyze proportional relationships and use their applications.</li> <li><b>M.I.P.M.9:</b> Solve problems involving percentage and interest.</li> </ul>			
<b>Materials</b>			
iPad, earphone, monitor, speakers, and access to the Internet			
<b>Essential Question(s)</b>			
<ul style="list-style-type: none"> <li>When is using proportions necessary? Why?</li> </ul>			

<b>Focus Questions</b>	<ul style="list-style-type: none"> <li>• Does the student Understand ratio and use its applications?</li> <li>• Can the student analyze proportional relationships and use their applications?</li> <li>• Can the student solve problems involving percentage and interest?</li> </ul>
<b>Learning Goals and Objectives</b>	<p>Upon the completion of this module, the student will <b>know/understand</b>:</p> <ul style="list-style-type: none"> <li>• Proportion and use its applications.</li> </ul> <p>Upon the completion of this module, the student <b>will be able to</b>:</p> <ul style="list-style-type: none"> <li>• Analyze proportional relationships and use their applications.</li> <li>• Solve problems involving percentage and interest.</li> </ul>
<b>Schedule</b>	<ul style="list-style-type: none"> <li>• <b>Week 4:</b> Complete sections 2.1-2.2; Review Module I; Test 1</li> </ul>
<b>Learning Activities &amp; Assignments and Assessments</b>	<p><b><u>Week 4</u></b></p> <p><b>I. Bellwork</b></p> <ul style="list-style-type: none"> <li>• Ask students if they have any questions about the previous lessons and/or the assigned study at home.</li> <li>• Have students work on 2-3 selected questions and exercises from the related to the Focused Questions and Module I (Sections 2.1-2.2). Have students work on them individually, and then discuss in groups (of two or three) or with the tutor and/or the teacher.</li> <li>• If necessary, show one or two of the related video clips and discuss in class.</li> </ul> <p><b>II. Activities/Assignments</b></p> <ul style="list-style-type: none"> <li>• <b>(at Home):</b> Assign students to study selected sections of Module I (on eBackpack) at home, and use the related resources identified in each Section. Encourage students to watch the related videos with their parents.</li> <li>• <b>(in Class):</b> <ul style="list-style-type: none"> <li>○ Working solo or in groups (of two or three) and using Module I, have students working on the selected (following) sections from the available resources (textbooks, video</li> </ul> </li> </ul>



clips, etc.). Allow students to use the whiteboards if they so desire.

- Teacher and/or students would select from the following resources from the textbooks, video clips, websites, and module contents:

#### Section 2.1

- Module content: pp. 14-18
- TXTBK I: pp. 19, 21-22
- TXTBK II: pp. 43-44
- Video clips: 24, 25, 26, 27, 28, and 29

#### Section 2.2

- Module content: pp. 18-22
  - TXTBK I: pp. 27-38
  - TXTBK II: pp. 45-48
  - Video clips: 30, 31, 32, and 33
- During this time, the teacher would observe students, ask questions, and provides assistance as students work their assigned activities.
  - Have the tutor available during the class, so students would have an extra help if they prefer and/or as the teacher becomes occupied by other students.
  - About 10 minutes before the bell, the teacher would be providing a recap of what was studied as well sharing observations and suggestions (if any). In addition, the teacher will be reminding students about the next topic and students' assignment and activities at home referencing related sections in Module I.

### **III. Assessment**

- Observation (formative, informal)
- Performance task (formative, informal)

	<ul style="list-style-type: none"> <li>• Demonstration (formative, informal)</li> <li>• Self- and peer-evaluation (formative, informal)</li> <li>• Test (summative, formal)</li> </ul>
<b>Lesson Resources</b>	<ul style="list-style-type: none"> <li>• Course <b>Module I</b> on eBackpack (Section 2)</li> <li>• <b>Textbooks:</b> TXTBK I &amp; II</li> <li>• <b>Videos Clips:</b> <ul style="list-style-type: none"> <li><b>24)</b>This is an introductory video on <b>ratio</b> (7:27 min.)- <a href="http://www.youtube.com/watch?v=UsPmq_Ne1po">http://www.youtube.com/watch?v=UsPmq_Ne1po</a></li> <li><b>25)</b>This is an introductory video on <b>proportion</b> (1.24 min.)- <a href="http://www.youtube.com/watch?v=V3FvaClh6LY">http://www.youtube.com/watch?v=V3FvaClh6LY</a></li> <li><b>26)</b>This is a video on <b>ratios as fractions</b> (1:18 min.)- <a href="http://www.youtube.com/watch?v=JWmCiZwoyMs">http://www.youtube.com/watch?v=JWmCiZwoyMs</a></li> <li><b>27)</b>This is a video clip on a <b>word problem with respect to ratio</b> (2:03 min.)- <a href="http://www.youtube.com/watch?v=Vx5uoZAxng">http://www.youtube.com/watch?v=Vx5uoZAxng</a></li> <li><b>28)</b>This is good video on <b>finding an unknown in a proportion</b> (7:19 min.)- <a href="http://www.youtube.com/watch?v=GO5ajwbFqVQ">http://www.youtube.com/watch?v=GO5ajwbFqVQ</a></li> <li><b>29)</b>Use the links below to access a variety of exercises, solved examples and/or videos on <b>greatest common factor</b>. <a href="https://www.khanacademy.org/math/pre-algebra/rates-and-ratios/ratios_and_proportions/v/introduction-to-ratios-new-hd-version">https://www.khanacademy.org/math/pre-algebra/rates-and-ratios/ratios_and_proportions/v/introduction-to-ratios-new-hd-version</a></li> <li><b>30)</b>This is a link on the <b>meaning of percent</b> (2:21 min.): <a href="https://www.khanacademy.org/math/arithmetric/decimals/percent_tutorial/v/describing-the-meaning-of-percent">https://www.khanacademy.org/math/arithmetric/decimals/percent_tutorial/v/describing-the-meaning-of-percent</a></li> <li><b>31)</b>This link provides extensive explanation on <b>how to take percentages</b>: (9:55 min.): <a href="https://www.khanacademy.org/math/algebra/solving-linear-equations-and-inequalities/old-school-equations/v/taking-percentages#!">https://www.khanacademy.org/math/algebra/solving-linear-equations-and-inequalities/old-school-equations/v/taking-percentages#!</a></li> </ul> </li> </ul>

	<p><b>32)</b> This site provides an excellent explanation for <b>simple and compound interest with examples</b>: <a href="http://www.basic-mathematics.com/simple-vs-compound-interest.html">http://www.basic-mathematics.com/simple-vs-compound-interest.html</a></p> <p><b>33)</b> Here is the link to excellent video on <b>introduction to interest</b> (9:55 min.):  <a href="http://www.bing.com/videos/search?q=simple+and+compound+interest+khan+academy&amp;qvvt=Simple+and+compound+interest+khan+academy&amp;FORM=VDRE#view=detail&amp;mid=0A006C544C0C525AA7320A006C544C0C525AA732">http://www.bing.com/videos/search?q=simple+and+compound+interest+khan+academy&amp;qvvt=Simple+and+compound+interest+khan+academy&amp;FORM=VDRE#view=detail&amp;mid=0A006C544C0C525AA7320A006C544C0C525AA732</a></p> <ul style="list-style-type: none"> <li>• <b>Website(s)</b>: none</li> <li>• <b>Others</b>: none</li> </ul>
<b>References</b>	<p>Basic-Mathematics (2008). Retrieved from <a href="http://www.basic-mathematics.com/">http://www.basic-mathematics.com/</a>.</p> <p>Khan Academy (2014, May 8). Retrieved from <a href="https://www.khanacademy.org/">https://www.khanacademy.org/</a>.</p> <p>Rappaport, J. (2003). <i>Algebra survival guide</i>. Santa Fe, New Mexico: Singing Turtle Press.</p> <p>Rappaport J. (2013). <i>Algebra survival guide workbook</i>. Santa Fe, New Mexico: Singing Turtle Press.</p> <p>Spectrum (2007). <i>Spectrum math – grade 8</i>. Greensboro, NC: Carson-Dellosa.</p> <p>Spectrum (2011). <i>Spectrum algebra – grades 6-8</i>. Greensboro, NC: Carson-Dellosa.</p>

Source: Author's produced content using template generated by Gunter (2010) and in-text by Gunter and Gunter (2015)

## APPENDIX C: SAMPLE ASSESSMENT

## Assessment — Module I

Grade: 9-10

Age: 14/15-yearolds

Course: Mathematics Intervention

Program

- Unit of Instruction: Module I—Numbers, Properties and Operations
- Assessment Types: Students will be assessed using a criterion-referenced test (CRT) including short answer and performance-based items.
- Two Quizzes (formal, formative)  
One Test (formal, summative)
- Assessment Purpose: To assess students' mastery in using numbers and their properties and related operations in solving real work problems as determined by the corresponding MIP Standards. The result of this test will also be used to determine students' readiness for the assessment of the corresponding section in the ACT Aspire test. **Moreover, aspects of the test results will be used in preparations and/or modification of the lesson plans corresponding to the remaining modules in the course.**
- Benchmarks: The related MIP Standards relevant to this instructional unit assessment are as follow:
- **M.I.P.M.1:** Know the real number system, and be able to add, subtract, multiply and divide rational numbers.
  - **M.I.P.M.2:** Solve multi-step arithmetic problems using rational numbers.
  - **M.I.P.M.3:** Solve problems involving integer exponents, roots, and radicals.
  - **M.I.P.M.4:** Understand estimating and rounding, absolute value, primes and greatest common factor.
  - **M.I.P.M.5:** Understand the scientific notation.

- **M.I.P.M.6:** Solve problems that involve converting units of measurement.
- **M.I.P.M.7:** Understand ratio and use its applications.
- **M.I.P.M.8:** Analyze proportional relationships and use their applications.
- **M.I.P.M.9:** Solve problems that involve percentage and interest.

Learning Objectives:

- Solve simple and multi-step arithmetic problems using rational numbers.
- Solve problems involving integer exponents, roots, and radicals.
- Solve problems that involve converting units of measurement.
- Analyze proportional relationships and use their applications.
- Solve problems that involve percentage and interest.

Accommodations:

Special accommodations will be made to provide ELL and ESE students.

- Allowing up to two hours of extra time to complete the test
- Taking the test in a quiet room in the library under the direct supervision of one of the designated library personnel
- Providing the corresponding dictionaries for the each ELL student
- Providing visual aid and other necessary tools and material in accordance with the direction from the counselor/administration office

Table of Quiz 1 Specifications	Categories								
Content Outline	Remember	Understand	Apply	Analyze	Evaluate	Create	Total	Percentage	Time (minutes)
	Number of Items								
1. The student will solve (the given numbers) by adding, subtracting, multiplying, or dividing [ <i>Item numbers 1a, 1b, 2a, 2b, 4</i> ].			5				5	60%	19
2. The student will discriminate by listing a series of numbers in order [ <i>Item number 3</i> ].			1				1	20%	3
3. The student will transform a given (mixed number) into a decimal form [ <i>Item number 5</i> ].					1		1	20%	3
<b>Total Percentage Time</b>			6		1		7	100 %	25

## Quiz 1 Scoring Rubric

Student Name \_\_\_\_\_

**Rating Scale** (Assign 0-2.5 points) Total points: (10)

Test Items	Scores			
	0	1	2	2.5
Solving by adding, subtracting, multiplying, or dividing [ <i>Item numbers 1a, 1b, 2a, 2b</i> ]	No attempt or wrong answer	Partially correct procedures but with major fault	Substantially correct procedures but wrong answer	Correct procedures and correct answer

**Rating Scale** (Assign 0-5 points) Total points: (15)

Test Items	Scores			
	0	1-2	3-4	5
Listing a series of numbers in order [ <i>Item number 3</i> ]	No attempt or wrong answer	Four to six numbers are correctly listed	Seven to nine numbers are correctly listed	All numbers are correctly listed
Solving (an expression) [ <i>Item number 4</i> ]	No attempt or wrong answer	Partially correct procedures but with major fault	Substantially correct procedures but with wrong answer	Correct procedures and correct answer
Transferring a given number into decimal [ <i>Item number 5</i> ]	No attempt or wrong answer	Partially correct procedures but with major fault	Substantially correct procedures but with wrong answer	Correct procedures and correct answer
Additional Comments				



Module I – Quiz 1  
sections 1.1-1.3

Student Full Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Direction**

- You have **25 minutes** to complete this Quiz.
- This quiz has a total of **25 points**.
- Only a **basic** (scientific) **calculator** may be used.
- **No** other electronic devices are permitted.
- **Write answers** in the provided space.
- Answer **completely** and **show all works** to receive **full credit**.

1. Add or subtract (as directed). Write each sum or difference in **simplest** form.  
(**Must show work to earn full credit; 2.5 points each, sec. 1.1**)

a)  $6\frac{3}{5} + 3/5 + 1/5 + 1$

Answer: \_\_\_\_\_

b)  $4/5 - 1\frac{3}{5}$

Answer: \_\_\_\_\_

2. Multiply or divide (as directed). Write each product or quotient in **simplest** form.  
(**Must show work to earn full credit; 2.5 points each; sec. 1.1**)

a)  $6/8 \times 1\frac{3}{4} \times 1.5$

Answer: \_\_\_\_\_

b)  $3\frac{1}{2} \div 0.5$

Answer: \_\_\_\_\_

3. List the following in order from **largest** to smallest.  
(**Must** show work to earn full credit; 5 points; sec. 1.3)

$-4, |0|, -2^3, 2^{1/5}, -0.01, -5, 1.3, |-0.5|, -0.1, -5.01$

Answer: \_\_\_\_\_

4. Evaluate the following. (**Must** show work to earn full credit; 5 points; sec. 1.3)

$-1^2 - (-2)^2 - |1-2|$

Answer: \_\_\_\_\_

5. Change  $5\frac{1}{5}$  to hundredth. (**Must** show work to earn full credit; 5 points; sec. 1.1)

Answer: \_\_\_\_\_

use the space below as scratch paper

Table of Quiz 2 Specifications	Categories								
Content Outline	Remember	Understand	Apply	Analyze	Evaluate	Create	Total	Percentage	Time (minutes)
	Number of Items								
1. The student will evaluate (an expression). <i>[Item numbers 1a, 1b, 1c, 1d]</i>				4			4	33%	20
2. The student will rewrite a given number in a specific format. <i>[Item numbers 2a, 2b]</i>						2	2	17%	5
3. Given a series of numbers, the student will determine their greatest common factor. <i>[Item numbers 3a, 3b]</i>		2					2	17%	8
4. The student will solve a problem. <i>[Item numbers 4, 5]</i>			2				2	33%	12
<b>Total Percentage Time</b>		2	2	4		2	10	100 %	45

## Quiz 2 Scoring Rubric

Student Name \_\_\_\_\_

**Rating Scale** (Assign 0-2.5 points) Total points: (20)

Test Items	Scores			
	0	1	2	2.5
Evaluating (an expression) <i>[Item numbers, 1a, 1b, 1c, 1d]</i>	No attempt or wrong answer	Partially correct procedures but with major fault	Substantially correct procedures but with wrong answer	Correct procedures and correct answer
Transform a given number in a scientific notation <i>[Item numbers 2a, 2b]</i>	No attempt or wrong answer	Partially correct procedures but wrong answer	--	Correct answer
Determining the greatest common factor for a given list of numbers <i>[Item numbers 3a, 3b]</i>	No attempt or wrong answer	Partially correct procedures but with major fault	Substantially correct procedures but with wrong answer	Correct procedures and correct answer

**Rating Scale** (Assign 0-5 points) Total points: (10)

Test Items	Scores			
	0	1-2	3-4	5
Solving a problem <i>[Item numbers 4, 5]</i>	No attempt or wrong answer	Partially correct procedures but with major fault	Substantially correct procedures but with wrong answer	Correct procedures and correct answer
Additional Comments				

1. Evaluate the following. (Write your answer in the **simplest** form. (**Must** show work to

Module I – Quiz 2  
sections 1.4-1.7

Student Full Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Direction**

- You have **45 minutes** to complete this Quiz.
- This quiz has a total of **30 points**.
- Only a **basic** (scientific) **calculator** may be used.
- **No** other electronic devices are permitted.
- **Write answers** in the provided space.
- Answer **completely** and **show all works** to receive **full credit**.

*earn full credit); 2.5 points each; sec. 1.4)*

a)  $-1^2 + (-2)^2 - (-3)^2 + (-2)^4$

Answer: \_\_\_\_\_

b)  $-1^2 + (-1)^2 + 1^2 - (-1)^2$

Answer: \_\_\_\_\_

c)  $\frac{1}{2} - \sqrt{1/9} + 1\frac{1}{2}$

Answer: \_\_\_\_\_

d)  $-\sqrt{(-3)^2} - 2\frac{1}{2}$

Answer: \_\_\_\_\_

2. Write each number in **scientific notation**. (*Must show work to earn full credit; 2.5 points each; sec. 1.5*)

a) 0.00401

Answer: \_\_\_\_\_

b) 19000000000

Answer: \_\_\_\_\_

3. Find the **greatest common factor** of the two numbers. (*Must show work to earn full credit; 2.5 points each; sec. 1.6*)

a) 25 and 15

Answer: \_\_\_\_\_

b) 18 and  $2^4$

Answer: \_\_\_\_\_

4. A floor is 126 inches long. How many 1-foot tiles will be needed to cover the length? (*Must show work to earn full credit; 5 points; sec. 1.7*)

Answer: \_\_\_\_\_

5. Emily's swim practice is 2 hours and 15 minutes. 1 hour 40 minutes have gone by. How much practice time is left?  
*(Must show work to earn full credit; 5 points; sec. 1.7)*

Answer: \_\_\_\_\_

use the space below and back as scratch paper

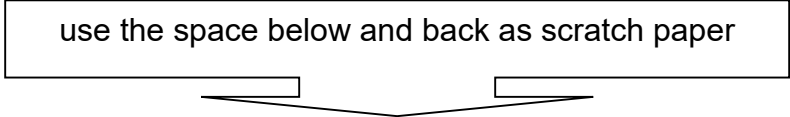


Table of Test 1 Specifications	Categories								
Content Outline	Remember	Understand	Apply	Analyze	Evaluate	Create	Total	Percentage	Time (minutes)
	Number of Items								
The student will discriminate by listing a series of numbers in specific order. <i>[Item numbers 1, 2]</i>					2		2	13%	8
The student will select from a series of numbers in specific order. <i>[Item number 3]</i>				1			1	7%	3
The student will evaluate (an expression). <i>[Item numbers 4, 5, 6]</i>				3			3	20%	12
The student will rewrite a given number in a specific format. <i>[Item numbers 7, 8]</i>						2	2	13%	5
Given a series of numbers, the student will determine their greatest common factor. <i>[Item numbers 9, 10]</i>		2					2	13%	7
The student will solve a problem. <i>[Item numbers 11, 12, 13, 14, 15]</i>			5				5	33%	30
<b>Total Percentage</b>		2	5		2	2	15		



Time				4				100 %	65
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## Test 1 Scoring Rubric

Student Name \_\_\_\_\_

**Rating Scale** (Assign 0-2.5 points) Total points: (5)

Test Items	Scores			
	0	1	2.5	
Transform a given number in a scientific notation <i>[Item numbers 7, 8]</i>	No attempt or wrong answer	Partially correct procedures but wrong answer	Correct answer	--

**Rating Scale** (Assign 0-5 points) Total points: (65)

Test Items	Scores			
	0	1-2	3-4	5
Listing a series of numbers in a specified order <i>[Item numbers 1, 2]</i>	No attempt or wrong answer	Two to three numbers are correctly listed	Four to five numbers are correctly listed	All numbers are correctly listed
Selecting rational numbers from a given list of numbers <i>[Item number 3]</i>	No attempt or wrong answer	Four to five numbers are correctly listed	Six to eight numbers are correctly listed	All numbers are correctly listed
Evaluating (an expression) <i>[Item numbers 4, 5, 6]</i>	No attempt or wrong answer	Partially correct procedures but with major fault	Substantially correct procedures but wrong answer	Correct procedures and correct answer

Determining the greatest common factor for a given list of numbers <i>[Item numbers 9, 10]</i>	No attempt or wrong answer	Partially correct procedures but with major fault	Substantially correct translation but with minor fault	Correct procedures and correct answer
Solving a given problem <i>[Item numbers 11, 12, 13, 14, 15]</i>	No attempt or wrong answer	Partially correct procedures but with major fault	Substantially correct translation but with minor fault	Correct procedures and correct answer
Additional Comments				

Module I  
Test 1

Student Full Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Direction**

- You have **65 minutes** to complete this test.
- This quiz has a total of **70 points**.
- Only a **basic** (scientific) **calculator** may be used.
- **No** other electronic devices are permitted.
- **Write answers** in the provided space.
- Answer **completely** and **show all works** to receive **full credit**.

1. List the following in order from **smallest to largest**.  
(5 points; sec. 1.3)

$|5|$  ,  $|9-7|$  ,  $|5-15|$  ,  $|0|$  ,  $|-3|$  ,  $-|0-2|$

Answer: \_\_\_\_\_

2. List the following in order from **largest to smallest**.  
(5 points, sec. 1.1)

$-4$  ,  $0$  ,  $-2$  ,  $-5$  ,  $1.3$  ,  $-0.5$  ,  $-0.1$

Answer: \_\_\_\_\_

3. Select **all rational** numbers below.  
(5 points, sec. 1.1)

$0$  ,  $-1.25$  ,  $\sqrt{8}$  ,  $\sqrt{4}$  ,  $36/4$  ,  $1/2$  ,  $0.1$  ,  $-2^3$  , **2**

Answer: \_\_\_\_\_

For questions 4-6, Evaluate. (**Must** show work to earn full credit; 5 points each)

4.  $-3^2 + (-3)^2$  (sec. 1.4)

Answer: \_\_\_\_\_

5.  $-\frac{1}{4} - \frac{3}{4} - \frac{1}{2} - 1.5 - 0.5$  (**answer must be in fraction/mixed numeral; sec. 1.1**)

Answer: \_\_\_\_\_

6.  $\sqrt{49/36} + 4/3 + 1\frac{1}{2}$  (**answer must be in fraction and in lowest term; sec. 1.4**)

Answer: \_\_\_\_\_

For questions 7-8, write each number in scientific notation. (2.5 points each, sec. 1.5)

7. 0.00013

Answer: \_\_\_\_\_

8. 20300000

Answer: \_\_\_\_\_

For questions 9-10, find the **greatest common factor** of the two numbers.  
(**Must** show work to earn full credit; 5 points each, sec. 1.7)

9. 14 and 21

Answer: \_\_\_\_\_

10. 15 and  $6^2$

Answer: \_\_\_\_\_

11. Gabby got a loan for  $1\frac{1}{2}$  years. The interest rate was 5%. She paid interest of \$450. How much was the principal?  
(**Must** show work to earn full credit; 5 points, sec. 2.2)

Answer: \_\_\_\_\_

12. All video games are on 15% off. If a video game originally cost \$49, how much does it cost now?  
(**Must** show work to earn full credit; 5 points, sec. 2.2)

Answer: \_\_\_\_\_

13. Marvin biked 7 miles in 25 minutes. At that rate, how far will he bike in 45 minutes?  
(**Must** show work to earn full credit; 5 points, sec. 2.1)

Answer: \_\_\_\_\_

14. A chocolate box contains 3.5 grams of sodium. There are 5 servings of chocolate in the box. How much sodium does each serving contain in both grams and milligrams?  
*(Must show work to earn full credit; 5 points, sec. 2.1)*

Answer: \_\_\_\_\_ grams

15. Danny ran 52 meters. How far did he run in kilometers?  
*(Must show work to earn full credit; 5 points, sec. 1.7)*

Answer: \_\_\_\_\_

use the space below as scratch paper



## APPENDIX D: SAMPLE MODULE



# Mathematics Intervention Program (MIP)

Kami Borhon

## Module I: Numbers, Properties and Operations

Section  
1.1

Section  
1.2

Section  
1.3

Section  
1.4

Section  
1.5

Section  
1.6

Section  
1.7

Section  
2.1

Section  
2.2



### Objectives and Outcomes:

In this module, we will explore the world of real numbers; study various operations involving rational numbers, study concepts such as exponents, roots, radicals, estimating and rounding, converting units of measurement, and more. In addition, we will study ratio and proportion and their applications. After completing this module, you should know/understand and be able to do:

- The real number system and their characteristics and relationship; and
- Estimating, scientific notation, rounding, and primes and greatest common factor.
- Solve simple and multi-step arithmetic problems using rational numbers.
- Solve problems involving integer exponents, roots, and radicals.
- Solve problems involving converting units of measurement.
- Analyze proportional relationships and use their applications.
- Solve problems involving percentage and interest.

**This is important** because such knowledge and understanding of mathematics would enable you to develop the basic foundation necessary for courses such as Algebra 1 and 2, Geometry and various other (higher) mathematics courses.

## Key Identifiers in the Module



Identifying goals and objectives, and explaining outcomes of the module



Online resources



Resources from the textbooks for review and practice



General information



Resources outside of textbooks for review and practice



Test/Quiz information



New concept



## Module I — Contents

### 1. Computation and Basic Operation

- 1.1. Real and Rational Numbers
- 1.2. Estimating and Rounding
- 1.3. Absolute Value
- 1.4. Exponents, Roots, and Radicals
- 1.5. Scientific Notation
- 1.6. Primes and Greatest Common Factor
- 1.7. Units of Measure and Conversions

### 2. Ratio and Proportion

- 2.1. Ratio and Proportion and Their Application
- 2.2. Percent and Interest



### Required Prior Knowledge

Knowledge of arithmetic operations: addition, subtractions, multiplications and division as well as working knowledge of using a basic calculator



### Required Tools and Materials

- Pen/pencil and notebook/pad
- Basic calculator
- iPad, headphone and internet access
- TEXTBK I (pages 1-62)
- TEXTBK II (pages 31-50)



### Assessment (in addition to ongoing in-class assessment)

- Quiz: Quiz 1 (1.1-1.3) and Quiz 2 (1.4-1.7)  
Test: End-of-Module Test (Test 1)



## Review and Practice

Study the examples and explanations for addition, subtraction, multiplication and division (TXTBK I, pp. 3-9), and do few of the problems provided on each page. Do these problems without using a calculator. Check your answers using a calculator or the answers provided at the end of the book.



## I. Computation and Basic Operation



### 1.1 Real Numbers

Numbers are an important concept using which we count a group of objects. Natural numbers and whole numbers are two sets of numbers that are used extensively.

**Natural numbers** comprise the counting numbers (1, 2, 3, 4...).

**Whole numbers** include the natural numbers and the number 0 (0, 1, 2, 3, 4,...).

**Negative numbers** include numbers on the left side of zero on the number line (...,-4, -3, -1).

**Integers** include all negative and whole numbers (...,-3, -2, -1, 0, 1, 2, 3,...).

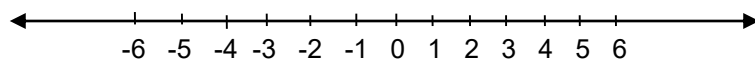
**Rational Numbers** include integers, and can be written as fraction (terminating or repeating decimals).

Examples of terminating decimals include:  $\frac{1}{2}=0.5$ ,  $\frac{3}{4}=0.75$ , and  $\frac{1}{5}=0.2$ .

Examples of repeating decimals include:  $\frac{1}{3}=0.333\dots$  and  $\frac{3}{11}=0.2727\dots$

**Irrational numbers** includes all real numbers that are not rational numbers: non-repeating or non-terminating decimals, such as  $\sqrt{2}$ ,  $\sqrt{7}$ , and  $\pi$ .

The number line:



See below for more information on rational numbers and examples for improper fraction and mixed numerals.

A number that can be written as the ratio of two integers is called a **rational number**. For example, the fraction  $\frac{1}{3}$  is a rational number because it is the ratio 1 to 3. The number 2 is a rational number because it can be written as  $\frac{2}{1}$ , or the ratio of 2 to 1. A decimal is also a rational number because it can be written as a fraction. For example,  $0.234 = \frac{234}{1,000}$ .

A fraction whose numerator is greater than its denominator is called an **improper fraction**. An improper fraction can be changed to a **mixed numeral**, a number written as a whole number and a fraction. To change an improper fraction to a mixed numeral, divide the numerator by the denominator. For example,  $\frac{18}{7}$  means  $18 \div 7$ . Because 7 divides into 18 two times with a remainder of 4,  $\frac{18}{7}$  equals  $2\frac{4}{7}$ .

To change a mixed numeral into an improper fraction, multiply the whole number by the denominator and add the numerator. Place this number over the denominator. For example,  $4\frac{3}{5} = \frac{(4 \times 5) + 3}{5} = \frac{23}{5}$

Source: Spectrum (2011)



### Read/Review/Practice

Study the examples and explanations for **renaming, adding, subtracting, multiplying and dividing fractions and mixed numerals** (TXTBK I, pp. 11-14 and TXTBK II, pp. 33-36; 39-40). Solve few of the problems provided on each page—you may use your calculator. Compare your answers with those that are provided at the end of the book.



### Assignment/Activity

Use the link below to access a variety of exercises, solved examples and/or videos on **rational and irrational numbers**.

Khan Academy Website  
# 1

Back to  
Menu



## 1.2 Estimating and Rounding

Check out the following links on rounding and estimating. We'll do more exercises in class as well.



### Online Resources

Website  
# 2

This *Website* is an excellent site for rounding and estimating. Look at “**Rounding a whole numbers**” and “**Estimating a Sum.**”

Video Clip  
# 3

This is an excellent video clip explaining **rounding a whole number** (4:22 min).

Video Clip  
# 4

This is an excellent short video clip explaining **rounding a decimal number** (1.25 min).



## 1.3 Absolute Value

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Menu

The term **absolute value** refers to the distance from zero on the number line. For example, the absolute value of 2 or -2 tells how far each number is from zero. Rather than repeating the term *absolute value*, we use the mathematical symbol “|” instead, e.g., |4|. So, given the definition, we say that |2| and |-2| are both equal 2 since both 2 and -2 are two units away from zero.

Here are more examples:  $|3| = 3$  ;  $|0| = 0$  ;  $|-23| = 23$

$$|3+1| = |4| = 4 \quad (3+1 = 4)$$

$$|-2-3| = |-5| = 5 \quad (-2-3 = -5)$$

$$|-3+1| = |-2| = 2 \quad (-3+1 = -2)$$

**Important Note:** If there is a negative sign “-“ before the absolute value, the answer become negative.

$$\text{For example: } -|3| = -3 \quad ; \quad -|-2+1| = -|-1| = -1 \quad (-2+1 = -1)$$



## Assignment/Activity

Use the link below to access a variety of exercises, solved examples and/or videos on **absolute value**.

Khan Academy Website  
# 5



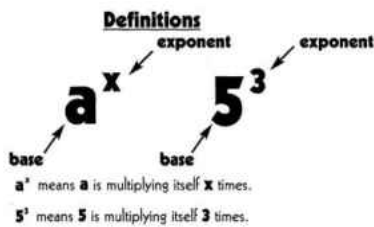
**Quiz 1** covers sections 1.1-1.3 and will be taken in Class.



## 1.4 Exponents, Roots and Radicals

### ❖ Exponents

An exponent (or power) indicates the number of times another number (base) is to multiply itself.



### Examples of exponential terms

$$a^2 = a \cdot a$$

$$a^5 = a \cdot a \cdot a \cdot a \cdot a$$

$$3^2 = 3 \cdot 3 = 9$$

$$3^5 = 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 243$$

$$(ac)^5 = (ac) \cdot (ac) \cdot (ac) \cdot (ac) \cdot (ac)$$

Source: Rappaport (2003)

Here are the general rules of exponents and related examples:

The same-base product rule says this:

$$a^x \cdot a^n = a^{x+n}$$

Or in plain English: **when you're multiplying exponential terms whose bases are the same, keep that base and add the exponents.**

**Examples of the same-base product rule**

$$m^r \cdot m^u = m^{r+u}$$

$$7^r \cdot 7^u = 7^{r+u}$$

$$m^5 \cdot m^3 = m^{5+3} = m^8$$

$$7^5 \cdot 7^3 = 7^{5+3} = 7^8$$

The same-base quotient rule tells you this:

$$\frac{a^x}{a^n} = a^{x-n}$$

Or, put more simply: **when you're dividing exponential terms whose bases are the same, keep that base and subtract the exponents.**

**Examples of the same-base quotient rule**

$$\frac{m^r}{m^u} = m^{r-u} \quad \frac{m^5}{m^3} = m^{5-3} = m^2$$

$$\frac{7^r}{7^u} = 7^{r-u} \quad \frac{7^5}{7^3} = 7^{5-3} = 7^2$$

Source: Rappaport (2003)

**Important Note:** As a rule, any base (except 0) raised to the power of zero is equal to 1, that is  $a^0 = 1$ .

$$\text{For example: } 2^0 = 1 \ ; \ (-4)^0 = 1 \ ; \ (1.5)^0 = 1$$

Here are more examples:  $1 + 3^2 = 1 + 9 = 10$  ;  $2 + (-2)^0 = 2 + 1 = 3$



### Online Resources

Video Clip  
# 6

This is an introductory video on **exponent** (9:46 min).



### Read/Review/Practice

Study the examples and explanations for **powers/exponents** (TXTBK II, pp. 24, 26-27). Solve few of the problems provided on each page—you may use your calculator. Compare your answers with those that are provided at the end of the book.



## Assignment/Activity

Solve the following problems.

	<b>Problem</b>	<b>Answer</b>
1	$2^5$	32
2	$(-2)^2$	4
3	$7^1$	7
4	$8^0$	1
5	$(-8)^0$	1
6	$-8^0$	-1
7	$5 + 3^0$	6
8	$5 \times 3^0$	5
9	$5 - 3^0$	4
10	$5/3^0$	5

Source: Rappaport (2003)

### Also

Use the links below to access a variety of exercises, solved examples and/or videos on **exponents**.

Khan Academy Website  
# 7

Use the links below to access a variety of exercises, solved examples and/or videos on **exponent properties**

Khan Academy Website  
# 8

*[space left blank]*



## ❖ Roots and Radicals

As to the word **radical**, be aware that it has three shades of meaning. Here they are:

**1) Radical** means the mere **idea** of a square root, as in the sentence: "This week we're going to study radicals." Translation: This week we're going to study square roots.

**2) Radical** also means the actual **symbol** for a root, i.e.:  $\sqrt{\quad}$   
So if a teacher points to a term like  $\sqrt{5}$  and asks: "Which term is under (or inside) the radical?" s/he is asking you what is inside the radical sign. In this case, the answer would be the number **5**.

**3) Mathematicians** use the word **radical** to mean **both the symbol and the number or term under it**. For example, if you write down  $\sqrt{25}$  as the answer to a problem, a teacher might ask you to "simplify the radical." S/he would be asking you to simplify the entire term  $\sqrt{25}$  to **5**.

**The symbol for a square root looks like this:**  $\sqrt{\quad}$

You might think of it as a division sign that had a check mark glued to the front of it.

Since  $\sqrt{\quad}$  means "square root,"  $\sqrt{5}$  is read "square root of 5";  $\sqrt{a}$  is read "square root of a," etc. As to the symbol's meaning, the square root of **a** is that special number which, when multiplied by itself, equals **a**. In math, we write the idea like this:  $\sqrt{a} \cdot \sqrt{a} = a$ , and we call this the **definition of a square root**.

### Examples of square roots

The square root of **9** is that special number, which, when multiplied by itself, equals **9**. We know that  $3 \cdot 3 = 9$ , so **3** is the square root of **9**. In math, this is written:  $\sqrt{9} = 3$

The square root of **64** is that special number which, when multiplied by itself, equals **64**. We know that  $8 \cdot 8 = 64$ , so **8** is the square root of **64**. This is written:  $\sqrt{64} = 8$

The value of this expression is so obvious, it's easy to miss — like trying to see your nose. In any case, here it is:

$$\sqrt{a} \cdot \sqrt{a} = a$$

In other words, **a square root times itself equals the very number it's the square root of.**

### Examples

$$\sqrt{9} \cdot \sqrt{9} = 9$$

$$\sqrt{7x} \cdot \sqrt{7x} = 7x$$

$$\sqrt{ax^2} \cdot \sqrt{ax^2} = ax^2$$

$$\sqrt{7xyz^2} \cdot \sqrt{7xyz^2} = 7xyz^2$$

Source: Rappaport (2003)



## Online Resources

Video Clip  
# 9

Here is a video clip on **understanding square roots** (1:21 min).

Video Clip  
# 10

This is an excellent video on **simplifying square roots** (5:35 min).

Video Clip  
# 11

This is an excellent video on **approximating square roots** (7:11 min).

Video Clip  
# 12

This is a video clip on **simplifying radicals** (9:44 min).



## Assignment/Activity

Find the square roots.

- |                |       |                  |       |
|----------------|-------|------------------|-------|
| 1) $\sqrt{16}$ | _____ | 6) $\sqrt{100}$  | _____ |
| 2) $\sqrt{25}$ | _____ | 7) $\sqrt{81}$   | _____ |
| 3) $\sqrt{4}$  | _____ | 8) $\sqrt{169}$  | _____ |
| 4) $\sqrt{64}$ | _____ | 9) $\sqrt{121}$  | _____ |
| 5) $\sqrt{49}$ | _____ | 10) $\sqrt{196}$ | _____ |

Answers

- 4
- 5
- 2
- 8
- 7
- 10
- 9
- 13
- 11
- 14

Source: Rappaport (2013)

## Also

Use the links below to access a variety of exercises, solved examples and/or videos on **roots and radicals**.

Khan Academy Website  
# 13

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**1.5 Scientific Notation** is a simplified way of writing a number or in a special way.



### Online Resources

Video Clip  
# 14

This is an excellent video on **scientific notation** (4:11 min).

Video Clip  
# 15

This video explores **scientific notation** more comprehensively with more examples (11:25 min).



### Read/Review/Practice

Study the examples and explanations for **scientific notation** (TXTBK II, p. 28). Solve few of the problems provided on each page—you may use your calculator. Compare your answers with those that are provided at the end of the book.



### Assignment/Activity

Use the links below to access a variety of exercises, solved examples and/or videos on **scientific notation**.

Khan Academy Website  
# 16

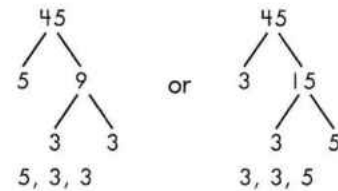
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## 1.6 Primes and Greatest Common Factor

A **factor** is a divisor of a number. (For example, 3 and 4 are both factors of 12.) A common factor is a divisor shared by two or more numbers. The greatest common factor is the largest common factor shared by the numbers. To find the greatest common factor of two numbers, list all of the factors of each. For example, the factors of 32 are 1, 2, 4, 8, 16, and 32. The factors of 40 are 1, 2, 4, 5, 8, 10, 20, and 40. The greatest common factor is 8.

A **prime number** is any number greater than 1 that has only two factors, itself and 1. (Examples: 2, 3, 5, 7) A **composite number** has more than two factors. For example, 4 has three factors: 1, 2, and 4. A composite number can be written as a product of prime numbers. This is called the prime factorization of the number. For example, the **prime factorization** of 45 is 3, 3, 5. A factor tree like the one to the right can help determine the prime factorization of a number.



Source: Spectrum (2011)



### Read/Review/Practice

Study the examples and explanations for **primes and greatest common factor** (TXTBK II, p. 23). Solve few of the problems provided on each page—you may use your calculator. Compare your answers with those that are provided at the end of the book.



### Online Resources

Video Clip  
# 17

This is an introductory video on **greatest common factor** (6:19 min).

Video Clip  
# 18

Here is an exercise video on **finding factors of a number** (9:52 min).

Video Clip  
# 19

This is an excellent video on word problems related to this topic (8:33 min).

Video Clip  
# 20

Here is a video with a few more sample problems (6:48 min).



### Assignment/Activity

Find the greatest common factor.

- |               |       |                  |       |
|---------------|-------|------------------|-------|
| 1) 35, 49, 56 | _____ | 6) 40, 64, 88    | _____ |
| 2) 15, 21, 27 | _____ | 7) 27, 81, 135   | _____ |
| 3) 14, 42, 56 | _____ | 8) 40, 60, 70    | _____ |
| 4) 36, 60, 72 | _____ | 9) 40, 60, 80    | _____ |
| 5) 36, 54, 90 | _____ | 10) 69, 115, 161 | _____ |

Answers

- 1) 7
- 2) 3
- 3) 14
- 4) 12
- 5) 18
- 6) 8
- 7) 27
- 8) 10
- 9) 20
- 10) 23

Source: Rappaport (2013)

### Also

Use the links below to access a variety of exercises, solved examples and/or videos on **prime and composite numbers**.

Khan Academy Website  
# 21

Use the links below to access a variety of exercises, solved examples and/or videos on **prime factorization**.

Khan Academy Website  
# 22

Use the links below to access a variety of exercises, solved examples and/or videos on **greatest common factor**.

Khan Academy Website  
# 23

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### 1.7 Units of Measure and Conversions

Excellent examples and conversion charts for units of length, weight, time, and volume are provided in TTXBK I.



## Read/Review/Practice

Study the examples and explanations for **units of measure** and conversions (TXTBK I, pp. 43-58). Solve few of the problems provided on each page—you may use your calculator. Compare your answers with those that are provided at the end of the book.



**Quiz 2** covers sections 1.4-1.7 and will be taken in Class.



## II. Ratio and Proportion

### 2.1 Ratio, Proportion and Their Applications

A **ratio** is a comparison of two numbers. A ratio can be expressed as 1 to 2, 1:2, or  $\frac{1}{2}$ , and it means that for every 1 of the first item, there are 2 of the other item. For example, 2 dollars per gallon is a ratio. For every 1 gallon you buy, you pay 2 dollars.

A **proportion** expresses the equality of two ratios. To check if a proportion is true, cross-multiply to determine if the two ratios are equal.

$\frac{4}{2} \times \frac{2}{1} = \frac{4}{2} = 2$     $\frac{4}{2} = \frac{2}{1}$     $4 \times 1 = 2 \times 2$ , so it is true.    $\frac{3}{4} = \frac{2}{3}$     $3 \times 3 \neq 4 \times 2$ , so it is **not** true.

To find the unknown number in a proportion, first cross-multiply to make an equation. Then, divide both sides by the number with  $n$ .

$$\frac{4}{5} = \frac{n}{15}$$

$$4 \times 15 = 5 \times n$$
$$60 = 5n$$

$$60 \div 5 = 5n \div 5$$
$$12 = n$$

In proportion problems, two things change at the same rate. Example: The Longs drove 680 miles in 2 days. At that rate, how far will they drive in 5 days?

Let  $n$  equal the unknown number—in this case, how far the Longs will drive in 5 days. Set up a proportion. For example, compare the number of days to the number of miles, or the number of miles to the number of days. Whichever you choose, do the same for both sides of the proportion. Then, cross-multiply to solve.

$$\frac{2}{5} = \frac{680}{n} \quad \text{or} \quad \frac{680}{2} = \frac{n}{5} \quad \text{In each case, } n = 1,700$$

Source: Spectrum (2011)



## Online Resources

Video Clip  
# 24

This is an introductory video on **Ratio** (7:27 min).

Video Clip  
# 25

This is an introductory video on **proportion** (1.24 min).

Video Clip  
# 26

This is a video on **ratios as fractions** (1:18 min).

Video Clip  
# 27

This is a video clip on a **word problem with respect to ratio** (2:03 min).

Video Clip  
# 28

This is good video on **finding an unknown in a proportion** (7:19 min).



## Read/Review/Practice

Study the examples and explanations for **ratio and proportion** (TXTBK I, pp. 19, 21-22, 24 and TXTBK II, pp. 43-44). Solve few of the problems provided on each page—you may use your calculator. Compare your answers with those that are provided at the end of the book.



## Assignment/Activity

Use the links below to access a variety of exercises, solved examples and/or videos on **greatest common factor**.

Khan Academy Website  
# 29

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## 2.2 Percent and Interest

### ❖ Percent

**Percent (%)** means “out of 100.”

**Examples:** 1 percent (1%) = 0.01 =  $\frac{1}{100}$ . 125% = 1.25 =  $1\frac{25}{100} = 1\frac{1}{4}$

Use this method to change a percent into a fraction:

$$12\% = \frac{12}{100} \div \frac{4}{4} = \frac{3}{25}$$

Use this method to change a decimal to a percent:

$$0.165 = \frac{16.5}{100} = 16.5\%$$

Use this method to change a fraction into a percent:

$$\frac{5}{8} = \frac{n}{100} \quad 500 = 8n \quad 62\frac{1}{2}\% = n$$

Use this method to change a percent to a decimal:

$$49.5\% = \frac{49.5}{100} = 0.495$$

Source: Spectrum (2011)



### Online Resources

Video Clip  
# 30

This is a link on the **meaning of percent** (3:00 min).

Video Clip  
# 31

This video provides extensive explanations on **how to take percentages** (9:55 min).



### Read/Review/Practice

Study the examples and explanations for **percent** (TXTBK I, pp. 27-33 and TXTBK II, pp. 45-46). Solve few of the problems provided on each page—you may use your calculator. Compare your answers with those that are provided at the end of the book.



## ❖ Interest

Interest may be paid on the principal amount only (simple interest) or paid on the principal amount plus the interest previously paid/earned.

**Interest** is the amount paid on borrowed money, or amount earned on invested money.  
**Principal** is the amount borrowed or invested. Use this formula to figure simple interest:

$$\text{interest} = \text{principal} \times \text{rate} \times \text{time (in years)}.$$

Carla got a \$3,000 car loan, to be paid in 2 years. The interest rate is 6%. What will the interest be at the end of the 2 years?

$$i = \$3,000 \times 0.06 \times 2 = \$360$$

Toni got a loan for 2 years. The interest rate was 6%. She paid \$120 in interest. How much was the principal?

$$120 = p \times 0.06 \times 2 \quad 120 = p \times 0.12$$

$$\frac{120}{0.12} = p \quad \$1,000 = p$$

Hector got a \$500 loan for  $1\frac{1}{2}$  years. He paid \$60 interest. What was the interest rate?

$$60 = 500 \times r \times 1.5 \quad 60 = 750r \quad \frac{60}{750} = r$$

$$0.08 = r \quad 8\% = r$$

David got a loan for \$1,700. The interest rate was 5%. He paid \$212.50 in interest. What was the length of the loan?

$$212.5 = 1,700 \times 0.05 \times t$$

$$212.5 = 85t \quad 2.5 = t$$

Source: Spectrum (2011)

**Compound interest** is interest paid on principal and interest already earned

A savings account earns 3% interest, compounded annually. If the amount in the account is \$500 at the start of the loan, how much will be in the account after 4 years?

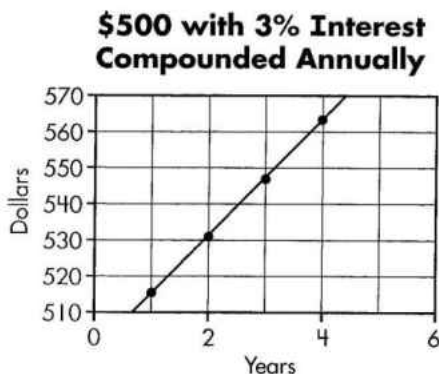
$$\text{Year 1: } 500 + (500 \times 0.03) = 515$$

$$\text{Year 2: } 515 + (515 \times 0.03) = 530.45$$

$$\text{Year 3: } 530.45 + (530.45 \times 0.03) = 546.36$$

$$\text{Year 4: } 546.36 + (546.36 \times 0.03) = 562.75$$

The graph below shows the compounding interest.



If interest is compounded more than once a year, divide the amount compounded each time by the number of times it is compounded annually.

For interest compounded:	Divide by:
semi-annually	2
quarterly	4
monthly	12

An account of \$500 pays 5% compounded monthly. At the end of Month 1, the account will have:  
 $\$500 + (\$500 \times 0.05 \div 12) = \$502.08$

Source: Spectrum (2011)



## Online Resources

Website  
# 32

This *Website* provides an excellent explanation for **simple and compound interest** with examples.

Video Clip  
# 33

Here is the link to excellent video on **introduction to interest** (9:55 min).



## Read/Review/Practice

Study the examples and explanations for interest (TXTBK I, pp. 34-38 and TXTBK II, pp. 47-48). Solve few of the problems provided on each page—you may use your calculator. Compare your answers with those that are provided at the end of the book.

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Module I test (**Test 1**) will be taken in class.



## References

Basic-Mathematics (2008). Retrieved from <http://www.basic-mathematics.com/>.


Khan Academy (2014, May 8). Retrieved from <https://www.khanacademy.org/>.

Rappaport, J. (2003). *Algebra survival guide*. Santa Fe, New Mexico: Singing Turtle Press.

Rappaport J. (2013). *Algebra survival guide workbook*. Santa Fe, New Mexico: Singing Turtle Press.

Spectrum (2011). *Spectrum algebra – grades 6-8*. Greensboro, NC: Carson-Dellosa.

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Sent: Thursday, April 16, 2015 2:49 PM  
To: [kborhon@cfl.rr.com](mailto:kborhon@cfl.rr.com)  
Subject: Re: Contact Form Submission from Kambiz Borhon

Hi Kambiz,

Thanks for your thoughtful and responsible note about using small portions of the Algebra Survival Guide and Workbook in your dissertation.

The project sounds fascinating, and I would like to learn more about what you are discovering - as well as what your thesis is - whenever you might have time to let me know.

As for your request, I wholeheartedly give you permission to use the questions and passages in which you have expressed interest. And if you would like to use more than just that, feel free to let me know. Given that you are using small portions, I have a hard time imagining that I would say no.

I have long been interested in what helps high school students learn algebra, and if there's anything else I can do to be of assistance, feel free to let me know.

Kind regards,  
- Josh Rappaport

Josh Rappaport  
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[mathchat.wordpress.com](http://mathchat.wordpress.com)

## APPENDIX E: SAMPLE SYLLABUS



# Remnant High School



## Mathematics Intervention Program (MIP) Syllabus for Fall 2014

### 1. Class Information

MIP is a one-semester course with  $\frac{1}{2}$  credit (elective), and is open to freshman (and occasionally sophomore) students.

Prerequisite: None

### 2. Instructor

Mr. Jeremy Adams

Office: Mathematics Building; Room 123

E-mail: jadams@rhs.edu

Office Number: 123-456-7899

### 3. Textbooks Required

Three textbooks are required which will be provided to the students.

1. *Spectrum Math – Grade 8* (2007) **TEXTBK I**
2. *Spectrum Algebra – Grades 6-8* (2011) **TEXTBK II**
3. *Spectrum Data Analysis & Probability – Grades 6-8* (2011) **TEXTBK III**

### 4. Tools and Materials Needed

Pen, pencil, sharpener, eraser, paper, binder (1-1  $\frac{1}{2}$ " soft or hard cover), ruler, a basic calculator, and an iPad (provided by school)

### 5. Course Description and Content

MIP is a remedial course in mathematics concentrated on Mathematics grades 6-8 and Pre-Algebra. It is designed to “help students make the transition from basic elementary mathematics to Algebra 1 and Geometry and provides a foundation for understanding a broad spectrum of mathematical topics” (NAD, 2003, p. 51).

## **Course Content**

**Module 0:** Course Overview (*Duration: ½ Week*)

**Module I:** Numbers, Properties, and Operations (*Duration: 4½ Weeks*)

**Module II:** Algebra (*Duration: 5½ Weeks*)

**Module III:** Geometry (*Duration: 4 Weeks*)

**Module IV:** Probability, Statistics, and Data Analysis (*Duration: 2½ Weeks*)

## **6. Student Outcomes**

Upon the completion of this course, students will:

1. Extend previous understandings and expand skills in arithmetic computations.
2. Know the real number system, and be able to add, subtract, multiply and divide rational numbers.
3. Solve problems involving integer exponents, roots, and radicals.
4. Understand ratio, analyze proportional relationships, and use their applications.
5. Understand variables and evaluate expressions.
6. Solve one-variable equations and Inequalities.
7. Understand and evaluate functions.
8. Understand geometric shapes and figures.
9. Solve problems involving measuring and computing angle, perimeter, area, surface area and volume.
10. Understand the concept of probability and perform statistical data analysis.

*[space left blank]*

## 7. Schedule

### 1<sup>st</sup> Quarter (9 weeks)

Week	Topic/Concept/Assessment	Dates
1	Course Overview; Mod 0; <b>Aspire Test</b> (pre-test)	Aug 11-15
2	Mod I (1.1-1.3)	Aug 18-22
3	Mod I (1.3 (cont.); Review; <b>QZ 1</b> ; 1.4)	Aug 25-29
4	Mod I (1.5-1.7; Review)	Sep 01-05
5	Mod I ( <b>QZ 2</b> ; 2.1-2.2; Review)	Sep 08-12
6	Mod I ( <b>Test 1</b> ); Mod II (1-1-1.2; 2.1)	Sep15-19
7	Mod II (2.2; 3.1-3.2)	Sep 22-26
8	Mod II (Review; <b>QZ 3</b> ; 3.3)	Sep29-Oct 03
9	Mod II (4.1-4.3)	Oct 06-10

Mod — Module; QZ — Quiz

### 2<sup>nd</sup> Quarter (10 weeks)

Week	Topic/Concept/Assessment	Dates
1	Mod II (Review; <b>QZ 4</b> ; 5.1-5.3)	Oct 13-17
2	Mod II (5.4-5.5; Review; <b>Test 2</b> )	Oct 20-24
3	Mod III (1; 2.1-2.2; 3.1-3.2)	Oct 27-31
4	Mod III (4.1-4.3; Review)	Nov 03-07
5	Mod III ( <b>QZ 5</b> ; 5; 6)	Nov10-14
6	Mod III (6 (cont.); 7; Review; <b>Test 3</b> )	Nov17-21
7	Thanksgiving Break	Nov 24-28
8	Mod IV (1.1-1.2; 2.1-2.2)	Dec 01-05
9	Mod IV (3.1-3.3; Review)	Dec 08-12
10	<b>Test 4</b> ; ACT- <b>Aspire Test</b> (post-test)	Dec15-19



## 8. Attendance

- Attendance is taken at the beginning of each class period.
- No restroom permission will be granted during the first and last 5 minutes of the class period.
- Students whose outfits do not comply with school's dress code will not be allowed until they comply in a timely manner.
- RHS attendance policy will be enforced.
  
- Tardiness
  - Students must **be in class by the bell**, otherwise he/she will be tardy.
  - Students who are late more than 10 minutes will be considered as absent.
  - Tardiness will be considered excused ONLY when the student provide a pass.
  - If a student leaves the class (e.g., bathroom breaks, etc.) and does not return within five minutes, the student will be considered tardy.
  - If a student is sent to the front office, he/she MUST have a note when returning to class.
  - If a student is sent the front office and does not return, he/she will be considered absent.
  - If a student needs to go see the nurse, he/she MUST have a note from the nurse/front offices when returning to class.

## 9. Participation

Attendance and full participation are central to the success in this course. Be on-time, ready and bring all necessary materials. Take advantage of the class activities.

## 10. Late Work

All exercises and activities are designed to be completed in class. Quizzes and tests must be taken during the class sessions unless otherwise determined by the instructor. Work missed because of unexcused absences cannot be made up. In accordance with the RHS policy, students will have two days to makeup missed assignments.

## 11. Plagiarism and Cheating

Any kind of academic dishonesty is a serious offense. Therefore, this calls into question the right of an offender to remain a part of the Remnant High School community. Cheating and plagiarism are academic dishonesty. **Plagiarism** is the presentation of the words, ideas, concepts, images, or works of another as one's own. Material (in whole or paraphrased) taken from a primary or secondary source without following standards of conventional attribution, and/or without appropriate reference citation is considered to be plagiarized. **Cheating** is obtaining (or attempting to obtain) something by dishonest or deceptive means. The Principal, Vice Principal, and Student Services Committee handle questions of academic dishonesty. Examples of academic dishonesty include but are not limited to the following:

- Possession or use of unauthorized notes or tests or copying answers from another on an exam
- Plagiarism
- Copying homework or other papers or allowing work to be copied
- Unauthorized exchange of information

## 12. Grading

The final grade for this course is designed as **Pass** or **Fail** based on the student's score on ACT-Aspire (post-test) at the end of the semester. Module quizzes and tests are to help students assess the degree of which they have mastered the concepts and their applications. As such, they are use for diagnostic purposes. Furthermore, students' quiz and test grades are not a determining factor whether students pass or fail the course.

**List of Quizzes and Tests** (for designated dates, refer to the schedule above)

- Module I:** Quiz 1 (sections 1.1-1.3)  
Quiz 2 (sections 1.4-1.7)  
Test 1 (all sections)
- Module II:** Quiz 3 (sections 1.1-1.2; 2.1-2.2; 3.1-3.2)  
Quiz 4 (sections 3.3; 4.1-4.3)  
Test 2 (all sections)
- Module III:** Quiz 5 (sections 1; 2.1-2.2; 3.1-3.2; 4.1-4.3)  
Test 3 (all sections)

**Module VI: Test 4 (all sections)**

**13. Classroom Guidelines**

The classroom is a special environment in which students and faculty come together to promote learning and growth. Show respect for others, yourselves, media, and equipment. Students are expected to comply with the school policies by being responsible for their own actions and behave in an appropriate manner. Be prepared for the class and manage your time wisely.

- Cell phones and other electronic devices must be off and not visible.
- Absolutely no food or drink (except screw-cap water bottles) in the studio.
- Do not write on the equipments or walls.
- Any class taught by a substitute teacher will follow these regulations as well.

**14. Suggestions for Success**

- Be ready, present and alert in class.
- Bring all necessary materials for work in class.
- Take advantage of the class activities.
- Stay current.

**Reference**

NAD (2003). Curriculum Guide. Mathematics Grades K-12. Office of Education. North American Division. Retrieved from [http://www.nadeducation.org/client\\_data/files/725\\_mathematicsk12.pdf](http://www.nadeducation.org/client_data/files/725_mathematicsk12.pdf).

Disclaimer: The instructor may change this syllabus without prior notice.

## REFERENCES

- ACT-Explore (2013). Interpretive guide for student and school reports. Retrieved from <http://www.act.org/explore/pdf/Explore-InterpGuide.pdf>.
- ADOE (2011). The General Conference Education Team. Adventist Department of Education. Retrieved from <http://education.gc.adventist.org/about.html>.
- American Psychological Association (2010). *Publication manual of the American Psychological Association* (6<sup>th</sup> ed.). Washington, DC: American Psychological Association.
- Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., et al. (Eds.) (2001). *Taxonomy for learning, teaching, and assessing*. New York: Addison Wesley Longman.
- Attewell, P., Lavin, D., Domina, T., & Levey, T. (2006). New evidence on college remediation. *Journal of Higher Education*, 77(5), 886-924.
- Bahr, P. R. (2007, September). Double jeopardy: Testing the effects of multiple basic skill differences on successful remediation. *Research in Higher Education*, 48(6), 695-725.
- Bahr, P. R. (2008). Does mathematics remediation work? A comparative analysis of academic attainment among community college students. *Research in Higher Education*, 49(5), 420-450.
- Balfanz, R., & Byrnes, V. (2006). Closing the mathematics achievement gap in high-poverty middle schools: Enablers and constraints. *Journal of Education for students places at risk*, 11(2), 143–159.
- Basic-Mathematics (2008). Retrieved from <http://www.basic-mathematics.com/>.

- Bergmann, J., & Sams, A. (2012). *Flip your classroom—reach every student in every class every day*. Alexandria, VA: ASCD.
- Bettinger, E. P., & Long, B. T. (2009). Addressing the needs of underprepared students in higher education: Does college remediation work? *Journal of Human Resources*, 44(3), 736-771.
- Bolman, L. G., & Deal, T. E. (2008). *Reframing organizations—artistry, choice, and leadership* (4<sup>th</sup> ed.). San Francisco: Jossey-Bass.
- Bottge, B. A., Grant, T. S., Stephens, A. C., & Rueda, E. (2010). Advancing the math skills of middle school students in technology education classrooms. *NASSP Bulletin*, 94(2), 81–106.
- Carr, J. M. (2012). Does math achievement h’APP’en when iPads and game-based learning are incorporated into fifth-grade mathematics instruction? *Journal of Information Technology Education*, 11, 269-285.
- Circle (2011). About Seventh-day Adventist Education. Retrieved from [http://circle.adventist.org/services/info/?topic=adventist\\_ed](http://circle.adventist.org/services/info/?topic=adventist_ed).
- CognitiveGenesis (2013). CognitiveGenesis research study. Retrieved from <http://www.cognitivegenesis.org/>.
- Conference (2013). The Florida Conference of the Seventh-day Adventist. Retrieved from <http://www.floridaconference.com/iym/education/>.
- Coyne, M. D., Kame’enui, E. J., & Carnine, D. W. (2011) *Effective teaching strategies that accommodate diverse learners* (4<sup>th</sup> ed.). Upper Saddle River, NJ: Pearson Education.

- Doabler C. T., Cary, M. S., JungJohann, K., Clarke, B., Fien, H., Baker, S., et al. (2012, March/April). Enhancing core mathematics instruction for students at risk for mathematics disabilities. *Teaching Exceptional Children*, 44(4), 48-57.
- Explore (2013). ACT Explore interpretive guide for student and school report—2013-2014. Retrieved from <http://www.act.org/explore/pdf/Explore-InterpGuide.pdf>.
- Field, A. (2013). *Discovering statistics using IBM SPSS Statistics* (4<sup>th</sup> ed.). Thousand Oaks, CA: SAGE Publications Inc.
- Fine, A., Duggan, M., & Braddy, L. (2009). Removing remediation requirements: Effectiveness of intervention programs. *PRIMUS*, 19(5), 433-446.
- FLDOE (2014). MAFS: Mathematics standards. Florida Department of education. Retrieved from <http://www.fldoe.org/pdf/mathfs.pdf>.
- Fitzpatrick, J. L., Sanders, J. R., and Worthen, B. R. (2011). *Program evaluation—alternative approaches and practical guidelines* (4<sup>th</sup> ed.). Upper Saddle River, New Jersey: Pearson Education.
- Gredler, M. E. (2009). *Learning and instruction* (6<sup>th</sup> ed.). Upper Saddle River, NJ: Pearson Education.
- Gunter, G. A. & Gunter, R. E. (2015, Published October 2014), Shelly-Cashman Series, *Teachers Discovering Computers: Integrating Technology in a Changing World – 8<sup>th</sup> Ed.* Boston, MA: Cengage Learning.
- Handel, S. J., & Williams, R. A. (2011, March). Reimagining remediation. *Change: The Magazine of Higher Learning*, 43(2), 28-33.
- Herreid, C. F., & Schiller, N. A. (2013). Case studies and the flipped classroom. *Journal of College Science Teaching*, 42(5), 62-66.

- Howell, J. S. (2011, May/June). What influences students' need for remediation in college? Evidence from California. *The Journal of Higher Education*, 82(3), 292-318.
- Illich, P. A., Hagan, C., & McCallister, L. (2004). Performance in college-level courses among students concurrently enrolled in remedial courses: Policy implications. *Community College Journal of Research and Practice*, 28(5), 435-453.
- Johnson, G. M. (2004). Constructivist remediation: Correction in context. *International Journal of Special Education*, 19(1), 72-88.
- Jordan, N. C., Kaplan, D., Locuniak, M. N., & Ramineni, C. (2007). Predicting first-grade math achievement from developmental number sense trajectories. *Learning Disabilities Research & Practice*, 22(1), 36–46.
- Khan Academy (2014). Retrieved from <https://www.khanacademy.org/>.
- Kubiszyn, T., & Borich, G. (2007). *Educational testing and measurement* (8<sup>th</sup> ed.). Hoboken, NJ: John Wiley and Sons.
- Lidwell, W., Holden, K., & Butler, J. (2010). *Universal principles of design*. Beverly, MA: Rockport.
- Little, M. E. (2009). Teaching mathematics: issues and solutions. *Teaching Exceptional Children Plus*, 6(1), 2-15.
- Marzano, R. J. (2009). *Designing and teaching learning goals and objectives*. Bloomington, IN: Marzano Research Laboratory.
- Mayer, R. E. (2011). *Applying the science of learning*. Boston, MA: Pearson Education.
- McTighe, J., & Wiggins, G. (2013). *Essential questions—opening doors to student understanding*. Alexandria, VA: ASCD.

- Meyen, E., & Greer, D. (2009, January). The role of instructional planning in math instruction for students with learning disabilities. *Focus On Exceptional Children*, 41(5), 1-12.
- Meyer, A., Rose, D. H., & Gordon, D. (2014). *Universal design for learning—theory and practice*. Wakefield, MA: CAST Inc.
- NAD (2003). Curriculum guide: Mathematics grades K-12. Office of education—North American Division of Seventh-day Adventists. Retrieved from [http://www.nadeducation.org/client\\_data/files/725\\_mathematicsk12.pdf](http://www.nadeducation.org/client_data/files/725_mathematicsk12.pdf).
- NAD (2013). The North American Division of the Seventh-day Adventist. Retrieved from <http://www.nadadventist.org/article/19/about-our-church/organizational-structure>.
- Norman, D. (2013). *The design of everyday things*. New York: Basic Books.
- Perin, D. (2006). Can community colleges protect both access and standards? The problem of remediation. *Teachers College Record*, 108(3), 339-373.
- Parslow (2012). Commentary: The Khan Academy and the day-night flipped classroom. *The International Union of Biochemistry and Molecular Biology*. 40(5). 337–338.
- Rappaport, J. (2003). *Algebra survival guide*. Santa Fe, New Mexico: Singing Turtle Press.
- Rappaport J. (2013). *Algebra survival guide workbook*. Santa Fe, New Mexico: Singing Turtle Press.
- Rich, B., & Schmidt, P. A. (2012). *Elementary mathematics* (2<sup>nd</sup> ed.). New York, NY: McGraw-Hill.
- Rueda, R. (2011). *The 3 dimensions of improving student performance*. New York, NY: Teachers College Press.



- Sams, A., & Bergmann, J. (2013, March). Flip your student's learning. *Educational Leadership*, 16-20.
- Spectrum (2007). *Spectrum math – grade 8*. Greensboro, NC: Carson-Dellosa.
- Spectrum (2011a). *Spectrum algebra – grades 6-8*. Greensboro, NC: Carson-Dellosa.
- Spectrum (2011b). *Spectrum data analysis & probability – Grades 6-8*. Greensboro, NC: Carson-Dellosa.
- Stevens, D. D., & Levi, A. J. (2005). *Introduction to rubrics*. Sterling, VA: Stylus.
- Stufflebeam, D., L. (2001). *Evaluation models*. New York, NY: Jossey-Bass.
- Thayer, J. (2008). The impact of Adventist schools on students. 4<sup>th</sup> symposium on the Bible and Adventist scholarship—Riviera Maya, Estado Quintana Roo, Mexico. March 16-22, 20118. Retrieved from [http://fae.adventist.org/essays/iv\\_Thayer\\_Jerry.pdf](http://fae.adventist.org/essays/iv_Thayer_Jerry.pdf).
- Thompson, G. E. (1985). Mathematics education—implications for SDA schools. *The Journal of Adventist Education*, 47(3), p. 4.
- Tomlinson, C. A. (2001). *How to differentiate instruction in mixed-ability classrooms* (2<sup>nd</sup> ed.). Alexandria, VA: ASCD.
- Tomlinson, C. A., & McTighe, J. (2006). *Integrating differentiated instruction and understanding by design*. Alexandria, VA: ASCD.
- Usher, E. L., & Pajares, F. (2008, December). Sources of self-efficacy in school: Critical review of the literature and future directions. *Review of Educational Research*, 78(4), 751–796.

Waycaster, P. (2001). Factors impacting success in community college developmental mathematics courses and subsequent courses. *Community College Journal of Research & Practice*, 25(5/6), 403-416.

Wenner, J. M., Burn, H. E., & Baer, E. M. (2011). The math you need, when you need it: Online modules that remediate mathematical skills in introductory geoscience courses. *Journal of College Science Teaching*, 41(1), 16-24.

Wiggins, G, & McTighe, J. (2006). *Understanding by design*. Upper Saddle River: NJ: Pearson Education.

Williams, R., & Tollett, J. (2006). *The non-designer's web book* (3<sup>rd</sup> ed.). Berkeley, CA: Peachpit Press.