Research Foundation of McGraw-Hill My Math

"For over a decade, research studies of mathematics education in high-performing countries have pointed to the conclusion that the mathematics curriculum in the United States must become substantially more focused and coherent in order to improve mathematics achievement in this country."
--CCSSM, page 3

McGraw-Hill My Math was developed to assist today's teachers with the challenge of helping students in the 21st century acquire a solid mathematical foundation. The misalignment between coursework within the K-12 spectrum has been identified by the National Governors Association (NGA, 2007) as a contributing factor in the U.S. educational system failing to keep pace with our international competitors and to meet the needs of the American workforce. Moving away from the mile wide and inch deep format of previous curricula, ***McGraw-Hill My Math*** is written to meet the demands of the Common Core State Standards for Mathematics (CCSSM)[1]. For any mathematics program to be effective, it must provide a consistent instructional format and design that creates a firm foundation upon which all students can be successful. In creating this new program, our authorship team took into consideration the needs of today's students who are familiar with the fast-paced digital world we live in. With the needs of those students in mind and a foundation with an instructional emphasis on focus, coherence, and rigor, ***McGraw-Hill My Math*** infuses strong deliberate content and a fresh, inviting style to engage students by making math enjoyable and memorable and thus resulting in mathematical success and access for all students.

Scope of Content

McGraw-Hill My Math was developed after the completion of the Common Core State Standards and follows the intended scope and conceptual development as prescribed by the CCSSM[2]. By identifying the key benchmarks and developing specific lessons to meet those expectations, ***McGraw-Hill My Math*** can insure content coverage and student success. At each grade level the content is organized around the CCSSM domains and in every chapter, the content is built around an Essential Question.

[1] http://www.corestandards.org/assets/CCSSI_Math%20Standards.pdf

[2] For references to research consulted during the development of the CCSSM see p. 91 of the Standards document listed above.

The Standards for Mathematical Practices are embedded throughout ***McGraw-Hill My Math***. These are clearly labeled for easy teacher access and are especially evident in the hands-on modeling approach, the strong problem-solving emphasis in every lesson and in the higher-order thinking exercises found throughout the student pages. The teaching model includes formative assessment opportunities identified with the mathematical practices. The online training modules help teachers create the classroom environment to foster those 'habits of mind' that are core to the practices.

Focus, Coherence and Rigor

Based on the recommendations of the Math Publishers Criteria K-8, the teacher materials are organized to point out the elements of focus, coherence and rigor. [3]

Focus—Students will learn fewer math concepts in each grade, but they will focus on them in greater depth and detail. The overwhelming heart of the CCSSM in early grades is arithmetic, along with the components of measurement that support it. That includes the concepts underlying arithmetic, the skills of arithmetic computation, and the ability to apply arithmetic to solve problems and put arithmetic to engaging uses.

McGraw-Hill My Math follows the intended scope and conceptual development as prescribed by the CCSSM. With that in mind, the majority of lessons are devoted to the coverage of the standards with emphasis on the major and supporting clusters. This includes attention to supporting the goals of proficiency and fluency for computational skills while emphasizing real-world mathematical connections. The following is an overall break down of the content covered in each grade level:

Grade	Major Cluster Lessons	Total Number of Lessons	Percent of Lessons Devoted to Major Cluster
K	64	89	72%
1	70	95	74%
2	71	99	72%
3	81	110	74%
4	92	119	77%
5	97	129	75%

[3] From http://www.corestandards.org/assets/Math_Publishers_Criteria_K-8_Spring%202013_FINAL.pdf

Coherence—Coherence is about making math make sense. It means students make learning connections within and across grades. The standards define progressions of learning from one grade to another that build knowledge and understanding across the grades. These connections help students approach each standard as an extension of what they learned previously not as a separate, discrete occurrence.

The conceptual understanding developed both within one grade and across multiple grades is evidenced by the following example of fraction development in the ***McGraw-Hill My Math*** program. Fraction development begins in grade three with students investigating how fractions can be used to represent numbers and their parts and then moves to grade four where students explore how different fractions name the same amount; they discover how to use operations to model real-world fractions, and students learn how fractions and decimals are related. In grade five, students use factors and multiples to solve problems; use equivalent fractions to add and subtract fractions; and they multiply and divide fractions.

Rigor—To help students meet the expectations of the CCSSM, educators need "to pursue with equal intensity three aspects of rigor in the major work of each grade: (1) conceptual understanding, (2) procedural skill and fluency, and (3) applications." [3]

Conceptual Understanding: Students need to demonstrate solid conceptual understanding of core mathematical concepts. They need to be able to confidently and effectively maneuver within a math concept. They need to view mathematics as more than a set of rules or steps to follow to get the right answer.

Procedural Skill and Fluency: Students must develop fluency in core functions, such as addition, subtraction, multiplication, and division, so they are able to understand and manipulate more complex concepts. Procedural and computational fluencies imply accuracy with reasonable speed and refer to knowledge of procedures, when and how to use procedures appropriately, and skill and confidence in performing them accurately and efficiently.

Application: Students are expected to use mathematics and choose the appropriate concepts for application. They need to apply mathematical concepts in real-world situations. Applications can be motivational and interesting, and there is a need for students at all levels to connect the mathematics they are learning to the world around them.

McGraw-Hill My Math supports a balance among the development of conceptual understandings, the need for instilling fluency and proficiency, and the desire to make mathematics rich and meaningful to every student. The overarching Essential Question in each chapter links learning across the lessons. Games and activities designed to build computational efficiency as well as online digital resources make use of practice routines to promote the automaticity of computational facts as well as reasoning skills. Students are involved in the application of lesson concepts as they engage in contextual problem-solving scenarios.

Preparing Students for Success in the 21st Century

In addition to mastering the core subject area of math as an essential component for student success in the 21st century, students today must be prepared for the workplace of the future, which increasingly calls for creative thinkers, problem-solvers and individuals who are comfortable with constantly changing technology.[4] Planning instruction for "digital natives" (Prensky, 2001) must take into account interactive and engaging lesson content.

Sue Z. Beers, ASCD author, emphasizes that today's classroom instruction must include:

- A variety of learning opportunities and activities
- The use of appropriate technology tools to accomplish learning goals
- Project- and problem-based learning
- Cross-curricular connections
- A focus on inquiry and the student-led investigations
- Collaborative learning environments, both within and beyond the classroom
- High levels of visualization and the use of visuals to increase understanding
- Frequent, formative assessments including the use of self-assessment. [5]

McGraw-Hill My Math supports teachers and students in reaching for the goals of appropriate value-added technology tools by integrating engaging games for fluency practice, videos for making connections with the real-world application concepts for chapters, digital personal tutors for remediation support or review of key concepts, online lesson planning opportunities and lesson presentations, collaborative learning opportunities, inquiry opportunities, and project-based learning support for teachers and students, and frequent formative assessment opportunities including Self-Check evaluation.

[4] http://www.p21.org/storage/documents/P21_Framework_Definitions.pdf

[5] From *21st Century Skills: Preparing Students for THEIR Future* at https://www.mheonline.com/mhmymath/pdf/21st_century_skills.pdf

Cross-curricular connections are aligned through Real World Problem-Solving Readers both at different leveled reading options or in digital formats, and student led investigations through digital lesson assets allow students to explore their learning to solidify key concepts and applications. Students who are exposed to and comfortable with technologically enhanced learning with a teacher who can facilitate learning will be better prepared for learning in the 21st century that requires “continuous cycles of learning” (Lemke, et al., 2003) which leads to deeper understanding of mathematical concepts while developing critical skills needed for the challenges of the future.

The question on whether technology can enhance or distract learning in the mathematics classroom has been examined by many researchers including Atsusi Hirumi in *Does the Use of Technology Improve Learning? The Answer Lies in Design.*[6] Based on his reviews of current research, the relative effectiveness of games and other educational technological tools found that well designed technology components can result in higher levels of achievement. Shelly, et al., (2010) confirm that when the technology enhances the classroom support, the results can be positive. By integrating technology options into the ***McGraw-Hill My Math*** program, the teacher can use the media when it fits well into the classroom plan, thus benefitting from the tight connections between both print and digital learning resources.

Interactive Write-In Text and Vocabulary Support

Language development opportunities and the ability to summarize key points and concepts, understand academic vocabulary, and access knowledge through charts, captions, images, and diagrams is a key developmental aspect of preparing digital natives for success in the the academic world – including in the math classroom. Conley (2008) reports that “to successfully operate in college and in the workplace, now and in the future, adolescents will need to master cognitive strategies for reading, writing, and thinking in complex situations where texts, skills, or requisite knowledge are fluid and not always clearly understood.” Along these lines, direct support of academic vocabulary and a move from read-only to more interactive formats supports the retention of skills and improved content understanding. “Write-in texts give students opportunities to create a personal recording of their thinking and learning by encouraging them to write down their ideas and questions, by asking them to share a point of view or to defend their thinking on a particular point.” [7] Opportunities for extending thinking,

[6] https://www.mheonline.com/mhmymath/pdf/technology.pdf

[7] From *The Benefits of Write-In Textbooks* https://www.mheonline.com/mhmymath/pdf/write_in.pdf

ownership over their learning, and keeping a living and changing document of their work/progress supports the process of meaning-making. ***McGraw-Hill My Math*** builds on the research supporting the use of interactive write-in texts by extending the personal student Interactive Write-in Texts from grades K through 5. Older students benefit from the format allowing them to read, write, answer, question, illustrate, graph, and self-assess all in one personalized place. For more research supporting the use of interactive student texts, see the white paper *The Benefits of Write-In Textbooks.*[7]

Academic vocabulary instruction is a key to academic success, especially for students from diverse backgrounds.[8] Therefore, teaching vocabulary in the math classroom is a critical area for effective instruction (Shostak, 2002). Students who are strong in conceptual skills may still need support with classroom vocabulary and with content specific vocabulary in order to be successful in school learning (Monroe, et al., 2002). ***McGraw-Hill My Math*** follows a strong language support philosophy for mathematics instruction including vocabulary support throughout and also the incorporation into the student interactive text with Foldables®-- three dimensional , interactive graphic organizers created by educator Dinah Zike. [9] Foldables®, for native English speakers and non-native English speakers alike, provide students with kinesthetic learning opportunities for vocabulary and key concepts, thus promoting long-term retention of knowledge. The notion that a picture is worth a thousand words is supported by research completed by the National Reading Panel (2000) concluding that graphic and semantic organizers are one of the seven most effective categories of instruction. Building background knowledge with language support is well documented in the research for successful content learning (Marzano, 2004) and Foldables® have a long track record of being an effective learning strategy. For more detailed support of the research, see *Using Foldables® in the Classroom* at https://www.mheonline.com/mhmymath/pdf/foldables.pdf.

Differentiation and ELL Support

With the implementation of the CCSSM, the push for the goals of focus, rigor and coherence has been strong. With fewer mathematics standards, the need for differentiation in instruction is essential. Jennifer Taylor-Cox outlines the educational needs for *Differentiating Mathematics*

[8] See *Developing Academic Vocabulary* at https://www.mheonline.com/mhmymath/pdf/academic_vocab.pdf

[9] See *Using Foldables in the Classroom* https://www.mheonline.com/mhmymath/pdf/foldables.pdf

Instruction So EVERYONE Learns.[10] She calls for a focus on differentiation guided by formative assessment, flexible grouping, targeted instruction, adjusted levels of cognitive demands, utilization of learning frameworks, and progress monitoring as ways to make sure that students have access to a deep understanding of math content. Formative assessment is crucial in targeting student needs and progress (Popham, 2008). Formative assessment opportunities are provided throughout ***McGraw-Hill My Math*** including Chapter diagnostics and pretests, Am I Ready? Assessments, Common Core Quick Checks, Check My Progress, and My Review & Reflect. Students are routinely engaged in assessment situations which allow them to verbally display what they know; give reasons that support their thinking; ask for evidence when something doesn't sound correct; and ask for clarification questions. For students who are excelling, options for extension are provided. Students who need more practice, or who need intervention, are provided with additional option suggestions in the Teacher Edition of the ***McGraw-Hill My Math*** program. Options for targeted instruction or different levels of cognitive demand were created using research on depth of knowledge levels (Webb, 1999) and suggestions for progress monitoring (Taylor-Cox, 2009).

Allowing for students to have a variety of learning options can include online options, individual or small group work. The ***McGraw-Hill My Math Learning Stations*** allow for student variation to meet the diverse needs of a classroom. Informal assessments, hands-on work, and collaborative conversations can be completed using these stations. For support in setting up effective classroom management of learning stations, see *Math Centers Routines* at mhmymath.com. Manipulatives and their effectiveness in helping students to bridge between the concrete and the abstract in mathematical learning can be completed in whole class or small group settings (NCTM, 2000). Explaining and critiquing mathematical reasoning are essential skills in demonstrating a deep understanding of mathematics. By using manipulatives and collaborative conversations, students can more easily express their comprehension of a math topic. Incorporating assessments using manipulatives or completing formative assessment observations will help inform the teacher of differentiation that may still need to be completed (Kelly, 2012).

For English Language Learners, the differentiation needed must allow students with language considerations access to the classroom content in ways that are equitable. Using the language proficiency levels (emerging, expanding, and bridging) established by the World-Class Instructional Design and Assessment Consortium (WIDA), ***McGraw-Hill My Math*** incorporates

[10] https://www.mheonline.com/mhmymath/pdf/differentiating_math_instruction.pdf

suggestions for English Language Learner Instructional Strategies (ELLIS) and Differentiated English Language Learner Support (DELLS) to ensure that language development can be integrated with content instruction. Established methods of instructional suggestions include activating prior knowledge, identifying cognates, using modeled talk, providing tiered sentence frames and questions, and utilizing manipulatives, realia, and hands-on activities (Herrell, 2008). These are evident in the teaching model for each lesson in ***McGraw-Hill My Math***. For more discussion on the research and approaches to providing support for English Language Learners, see *ELL Strategies in the **McGraw-Hill My Math** Program* at mhmymath.com.

Assessment

If students are to succeed in mathematics, they must be prepared in both the content being assessed and in the format of the assessment. The work of Jay McTighe and Grant Wiggins (1998, 2005) provides the Understanding by Design® planning framework for curriculum assessment. Using the seven key principles in UbD (Understanding by Design)[11] the ***McGraw-Hill My Math*** program has incorporated the concepts of Big Ideas in learning driven by Essential Questions. Students are involved in a variety of ongoing summative and formative assessment opportunities in an effort to better inform sound instruction. Students have the opportunity to respond to selected response, constructed response, or extended response in both conversations and in writing. By driving learning with Essential Questions, student understanding is supported by the ability to explain, interpret, apply, shift perspective, empathize, and self-assess. The backward design of the curriculum supports learning, checking, and transferring of knowledge.

As the next generation of assessments begin to provide students with opportunities to respond to items written in a range of formats and using a variety of technological platforms, the focus on critical thinking and problem solving skills will be clearly emphasized. The assessments developed by the Smarter Balanced Assessment Consortium[12] and the Partnership for Assessment of Readiness for College and Careers[13] require that students are able to use technology and to complete more complex applications of knowledge. To aid students in this

[11] See Jay McTighe's *Understanding by Design* at https://www.mheonline.com/mhmymath/pdf/ubd.pdf

[12] For more information on SBAC visit, http://www.smarterbalanced.org/smarter-balanced-assessments/

[13] For more information on PARCC visit, http://www.parcconline.org/parcc-assessment

new pathway of testing, ***McGraw-Hill My Math*** has developed performance tasks during which students will be required to complete real-world situations with different problem-solving parts. The depth of student understanding will be demonstrated by their ability to solve multi-step problems through the assimilation of mastered concepts.

For a more complete description of the many other types of assessment included in the ***McGraw-Hill My Math*** program, refer to *Preparing for the Next Generation Assessments* on mhmymath.com.

Research has shown that focusing more clearly on fewer topics and providing more in-depth study with formative assessment informing the needs for instruction allows the teacher to better meet the needs of student learning. Accessing technology that has value and is closely tied to the current instruction allows students to more clearly see the connections in their learning. Providing options for fluency practice and rigorous applications encourages student application of mastered skills to real-world situations and ultimately leading them further on the path of college and career readiness. The teacher plays an essential role as facilitator and engages students in becoming thoughtful mathematicians. By using the targeted resources available in the ***McGraw-Hill My Math*** program, teachers will be able to support a learning environment that empowers teachers and students to meet the demands set out by the CCSSM.

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