



# **BEYOND TRADITIONAL: A GUIDE FOR EQUITABLE AND RESPONSIVE MATHEMATICS CURRICULUM**

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*Midwest and Plains Equity Assistance Center*

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## About the Centers

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The Region III Equity Assistance Center is a project of the Great Lakes Equity Center, an educational research and service center located in Indiana University's School of Education at IUPUI. The Midwest & Plains Equity Assistance Center is funded by the U.S. Department of Education under Title IV of the Civil Rights Act to provide equity-focused technical assistance to states, districts, and public schools focused on systemic improvements to ensure educational access, participation and positive outcomes for students who have been historically marginalized based on race, sex, national origin, or religion, at the request of public schools, districts, state departments of education, and other responsible governmental agencies.



## Introduction

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*“When educators use culturally responsive and sustaining curricular materials, they prepare students for responsible and meaningful participation in school and society” (Moore et al., 2015, p. 1).*

*Beyond Traditional: A Guide for Equitable and Responsive Mathematics* tool aims to provide teachers, administrators, and other stakeholders a resource to critically review mathematics curricula to determine the extent to which it supports equitable and responsive mathematics learning experiences. To create this tool, I drew upon multiple existing resources, including rubrics for culturally responsive lessons (Aguilar-Valdez, 2015; Teach Math, 2012), authentic intellectual work (RISER, 2000), and culturally relevant, cognitively demanding mathematics tasks (Matthew, Jones & Parker, 2013). I also drew upon the culturally responsive curriculum scoreboard (Bryan-Gooden, Hester, Peoples, 2019), and frameworks for equity-based mathematics teaching (Aguirre, Mayfield, Martin, 2013) and socially transformative STEM curriculum (Mutegi, 2011).

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### What is Culturally Responsive Mathematics Teaching (CRMT)?

Geneva Gay (2000) defined culturally responsive teaching as using diverse students' cultural knowledge, frame of reference, prior experiences, and performance styles to make learning more appropriate and effective. Culturally responsive mathematics teaching (CRMT) is built on centering learners' multiple identities, cultures, and lived experiences throughout the mathematics learning process (Aguirre & Zavala, 2013). Some critical components of CRMT are (1) *supporting deep learning*, (2) *engaging and valuing identities*, (3) *sharing authority*, and (4) *applying mathematics* (Ellis, 2019, p. 5). [Reading Classroom Mathematics: Knowing and Valuing Every Learner: Culturally Responsive Mathematics Teaching](#) more fully details CRMT.



## Introduction (Continued)

### Why Culturally Responsive Mathematics Curriculum?

*“Using curricular materials that are reflective of the cultures, linguistic practices, norms, and values of all students supports equal opportunities to learn” (Moore et al., 2015, p.2).*

Multiple studies have shown that culturally responsive mathematics curricula increase student’s engagement and outcomes (Dee & Penner, 2016; Ellis, 2009). Curricula is a crucial component of culturally responsive mathematics teaching. The Midwest and Plains Equity Assistance Center defines curriculum *as the total learning experience provided by a school. It includes the content of courses, the methods employed, and other aspects, like norms and values, which relate to how a school is organized* (Ahlstrom, 2003). The focus of this tool is curricular materials that inform course content. Examples of curricular materials include textbooks and supplemental teaching resources. Even though textbooks are static and are not responsive to students the way teachers can, textbooks provide teachers with opportunities to engage in culturally responsive practices (Bryan-Gooden et al., 2019).



## About This Tool

The *Beyond Traditional: A Guide for Equitable and Responsive Mathematics* tool has been designed for any educational context and grade level. Completing the entire document provides a more comprehensive review. The *Beyond Traditional Guide for Equitable and Responsive Mathematics Curriculum* is sectioned into the following six domains:

- I. Depth of Mathematical Understanding
- II. Opportunities for Inquiry-Based Learning, Discourse, and Collaboration
- III. Acknowledging and Affirming Multiple Identities
- IV. Connecting Learning to Life and Change
- V. Decolonization
- VI. Teacher Materials

### Recommended Steps for Implementation

1. Assemble evaluation teams representing the school stakeholders (leadership, staff, families, students, and community partners) and the student population's diversity.
2. Choose the grade level(s), unit, and lessons to analyze. Since curricula can consist of thousands of pages, you may need to select smaller units to evaluate and complete multiple reviews.

3. Provide notes to support your ratings.
4. Discuss the result of the evaluation with your team. Some questions to consider are:
  - Does the evaluation provide an accurate picture of the curricular materials?
  - Is more information needed to complete a more comprehensive review?
  - What are the next steps based on this review?



*[Image description: Young feminine-presenting student of Color counting on an abacus.]*

# I. Depth of Mathematical Understanding

*Students' depth of understanding in mathematics is related to the extent they form connections among conceptual ideas in mathematics. Depth of understanding is something that students develop over time through sustained experiences that continually emphasize connections and reinforce concepts. Depth of understanding does not happen in one lesson or through a series of disconnected mathematics learning experiences (NCTM, 2020, p.8).*

Research shows a bidirectional relationship between students' mathematical learning and identity development with learning supporting a student's identity and a student's identity supporting their learning (NCTM, 2020, p. 9). Having a deep understanding of mathematics plays a crucial role in whether students view themselves as capable learners of mathematics (NCTM, 2020). A deep understanding of mathematical concepts also allows students to use knowledge flexibly, and apply their knowledge to new problem situations (Carpenter & Lehrer, 1999; Malloy, 2009).

	Strongly Disagree	Disagree	Agree	Strongly Agree
	0	1	2	3
A. Curricular materials include high cognitive demand tasks that support deep understanding and strengthens students' conceptual understanding, procedural fluency, problem-solving, and reasoning (Aguirre et al., 2013) rather than a narrow focus on algorithms (Stein, et al., 2000).				
B. Curricular materials provide avenues for learners to analyze and synthesize concepts and procedures that involve complex mathematical thinking, analysis, and justification. (Teach Math, 2012).				
C. Curricular materials include tasks that focus on developing conceptual understanding.				
D. Curricular materials present central mathematical concepts as integrated rather than discrete fragmented pieces of information (RISER, 2000).				
<b>Point Total:</b>				

## II. Opportunities for Inquiry-Based Learning, Discourse, and Collaboration

Inquiry based learning is an educational strategy in which students construct knowledge by engaging in methods and practices similar to professionals in order to construct knowledge. Active participation, collaboration, discourse and learner s discovery of knowledge are central to inquiry based learning (Pedaste et al., 2015).

Actively engaging students in learning is a key feature of culturally responsive teaching (Kozleski, 2010). Inquiry fosters curiosity and provides opportunities for student collaboration and discourse. Through collaboration and discourse students can make their mathematical thinking visible to others (NCTM, 2018, p. 28). Collaboration and discourse also open the door for students to clarify understanding, construct convincing arguments regarding why and how things work, develop a language for expressing mathematical ideas and learning to see things from others perspectives (NCTM, 2014, p.29).

	Strongly Disagree 0	Disagree 1	Agree 2	Strongly Agree 3
A. Curricular materials provide multiple opportunities for student-to-student interactions, student-to-teacher interactions about discipline-specific ideas.				
B. Curricular materials promote collaborative learning and allow students to share their strengths, background, interest and diverse learning experiences (Aguilar-Valdez, 2015; RISER, 2000).				
C. Curricular materials promote inquiry-based learning (GLEC, 2015).				
<b>Point Total:</b>				

### III. Acknowledging and Affirming Multiple Identities

Identity is defined as “the ways we define ourselves and how others define us” (Anderson, 2007, p.8). Mathematical identity is defined as “dispositions and deeply held beliefs that students develop about their ability to participate and perform effectively in mathematical context and to use mathematics in powerful ways” (Aguirre et al., p. 14).

Acknowledging and affirming students’ mathematics identities, and identities beyond mathematics, can lead to a greater understanding of students and their lives. Given that identity is important to shaping how students view themselves as mathematics learners, it is imperative for the curriculum to account for multiple identities and learning styles (NCTM, 2020).

	Strongly Disagree 0	Disagree 1	Agree 2	Strongly Agree 3
A. Curricular materials account for multiple learning styles by including tasks with multiple entry points (Aguirre et al., 2013).				
B. Curricular materials account for multiple learning styles by providing students opportunities to express their learning in diverse ways (Aguilar-Valdez, 2015).				
C. Ideas within the curriculum are communicated in multiple ways (Aguilar-Valdez, 2015).				
D. Curricular materials validate and build upon the “integrity of knowledge systems based in communities of Color, collectivist cultures, matriarchal societies, and non-Christian religions” (Bryan-Gooden et al., 2019, pp.11).				
<b>Point Total:</b>				



## IV. Connecting Learning to Life and Change

Curriculum provides avenues for students to connect learning to their lived experiences, the experiences of others, and helps students understand that mathematics can be used as a tool for personal and social change (Bryan Gooden et al., 2019).

Using mathematical understanding to critique the world engages students to connect the content and the world around them. When the curriculum provides avenues for students to question the conditions of their personal lives and the world around them, the utility of mathematics to impact them and their lives, and enact change, is more visible because they are empowered to be a part of the solution (NCTM, 2020). Connecting learning to students' lives is an essential component of a culturally responsive curriculum (Bryan Gooden et al., 2019).

	Strongly Disagree 0	Disagree 1	Agree 2	Strongly Agree 3
A. Curricular materials incorporate real-life connections and representations from students' communities, cultures and lived experiences (Aguilar-Valdez, 2015; GLEC, 2015).				
B. Curricular materials provide opportunities for students to confront contemporary social, political, or environmental issues impacting them personally and their communities (Bryan-Gooden et al., 2019; Mutegi, 2011; RISER, 2000).				
C. Curricular materials encourage students to take action by combatting inequities or promoting equity within the school and their communities (Bryan-Gooden et al., 2019; Mutegi, 2011).				
<b>Point Total:</b>				



## V. Decolonization

Attention paid to minimizing dominant discourse, deficit perspectives, and possible biases/micro aggressions so non dominant backgrounds have access and can participate as readily as those from dominant backgrounds (Aguilar Valdez, 2015, p. 2).

Equal learning opportunities are supported when the curriculum reflects the cultural norms, values and linguistic practices of all students (Moore et al., 2015).

	Strongly Disagree 0	Disagree 1	Agree 2	Strongly Agree 3
A. Curricular materials capitalize on linguistic resources, and family and community mathematical practices, to support students' mathematics learning (Aguirre et al., 2013).				
B. Curricular materials represent people of diverse backgrounds (e.g. race, sex, national origin, and religion) from an asset-based perspective, rather than the perceived deficiencies (Bryan-Gooden et al., 2019).				
C. Curricular materials promote or provoke critical questions about the status quo, surrounding what counts as mathematics and who can do mathematics.				
<b>Point Total:</b>				

## VI. Teacher Materials

All curriculum materials used to facilitate student learning.

	Strongly Disagree	Disagree	Agree	Strongly Agree
	0	1	2	3
A. Resources and guidance are provided to support teachers interrogating their own biases and examining how the similarities and differences between their culture and their students' cultures (Bryan-Gooden et al., 2019).				
B. Resources and guidance are provided on teaching students of diverse identities in culturally responsive ways (Bryan-Gooden et al., 2019).				
C. Resources and guidance on creating opportunities for students to contribute their prior knowledge and experience with a topic; not just respond to information provided during class (Bryan-Gooden et al., 2019, p.12).				
D. Resources and guidance are provided on leveraging opportunities to build authentic partnerships with students' families to enhance lessons (Bryan-Gooden et al., 2019).				
E. Resources and guidance are provided to customize and supplement the curriculum to reflect the cultures, languages, traditions, backgrounds, experiences, and interests of their students (Bryan-Gooden et al., 2019).				
<b>Point Total:</b>				



**66 pts.** The majority ( $\geq 75\%$ ) of the curricular materials support equitable and responsive mathematics learning. Learners have multiple avenues to engage in deep learning through connected procedures and concepts that involve complex mathematical thinking, explanations and justification of solutions (Aguirre & Zavala, 2013; Aguirre et al., 2013). Learners have opportunities to engage in inquiry-based, collaborative learning experiences. Curricular materials fully center learners by acknowledging and affirming their mathematics identities (Aguilar-Valdez, 2018). Tasks provide multiple entry points and learners can demonstrate knowledge in multiple ways (Aguirre, 2013) informed by student input and instructor's knowledge of students' differing learning styles (Aguilar-Valdez, 2015). Learners have multiple opportunities to “understand their world through math and combat injustices they notice” (Chao et al., 2014, p.2). The curricular materials present clear activities and content connecting mathematics to students' lived experiences (Bryan-Gooden et al., 2019) and all students of non-dominant backgrounds can access and feel included in the materials (Aguilar-Valdez, 2015).

The teaching materials include an “abundance of guidance on engaging cultural responsiveness meaningfully through the teaching approach... Culturally responsive guidance is clearly marked and presented as essential to effective teaching. Teachers are encouraged to consistently check their own biases and reflect on their practice” (Bryan-Gooden et al., 2019, 16).

**65-45 pts.** (74-50%) of the curricular materials support equitable and responsive mathematics learning. Learners have limited avenues to engage in deep learning that connects procedures and concepts and involves complex mathematics thinking, explanations and justification of solutions (Aguirre & Zavala, 2013; Aguirre et al., 2013). Learners have some opportunities to engage in inquiry-based, collaborative learning experiences. Curricular materials are mostly student-centered learners by acknowledging and affirming their mathematics identities (Aguilar-Valdez, 2018). Tasks provide less than three entry points and learners can demonstrate knowledge in multiple ways (Aguirre, 2013). Learners have several predetermined avenues to connect their learning to “understand their world through math and combat injustices they notice” (Chao et al., p.2). The curricular materials present several opportunities for teachers to connect



## Scoring and Analysis (cont.)

mathematics to students' lived experiences (Bryan-Gooden et al., 2019). Most students of non-dominant backgrounds can access and feel included in the materials (Aguilar-Valdez, 2015).

The teaching materials provide a lot of guidance on “engaging cultural responsiveness” (Bryan-Gooden et al., 2019, 16). Teachers are provided opportunities to reflect on their worldviews and how they engage with learners. Guidance is offered to supplement the curriculum, engage students in culturally responsive learning experiences, and make connections between learners and their lived experiences (Bryan-Gooden et al., 2019).

**44- 24 pts.** (49-25%) of the curricular materials support equitable and responsive mathematics learning. Most learning is recall and basic understanding with limited opportunities to engage in deep learning through connected procedures and concepts that involve complex mathematics thinking, explanations and justification of solutions (Aguirre et al., 2013; Aguirre & Zavala, 2013). Learners have limited opportunities to engage in inquiry-based, collaborative learning experiences. Curricular materials do not fully center learners by acknowledging and affirming their mathematics identities (Aguilar-Valdez, 2018). While students can work together, the curricular materials are predominately teacher-centered (Aguilar-Valdez, 2015). Tasks provide less than two entry points and learners are limited in the number of ways to demonstrate their knowledge (Aguirre, 2013). Learners have limited predetermined opportunities to "understand their world through math and combat injustices they notice" (Chao et al., 2014, p.2). The curricular materials present few opportunities for teachers to connect mathematics to students' lived experiences (Bryan-Gooden et al., 2019). Few students of non-dominant backgrounds can access and feel included in the materials (Aguilar-Valdez, 2015).

The teaching materials offer little guidance on engaging learners in "meaningful culturally responsive ways" (Bryan-Gooden et al., 2019, 16). The teacher materials provide guidance on supplementing curriculum, engaging students in culturally responsive learning experiences and making connections between learners and lived experiences (Bryan-Gooden et al., 2019).



## Scoring and Analysis (cont.)

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**23 - 0 pts.** (<25%) The majority of curricular materials ( $\geq 75\%$ ) do not support equitable and responsive mathematics learning. The majority of student learning centers around non-cohesive concepts that promote memorization and encourage students to follow prescribed steps to one correct solution (Aguirre, 2013). The majority of student learning does not allow for iniquity and collaboration. The learning is teacher-centered with only one way for students to express their understanding. (Aguilar-Valdez, 2015). The majority of math tasks are high sequence and promote individual progress (Aguirre, 2013). The curriculum is disconnected from students' lived experiences and provides little to no opportunities to “understand their world through math and combat injustices they notice” (Chao et al., 2014, p.2). Learners' prior mathematics knowledge is treated as irrelevant or problematic (Aguirre, 2013) and their mathematical contributions are limited with no connections to learners' cultural norms (Aguirre & Zavala, 2013).

The teacher materials offer little to no guidance on “engaging diverse learners or culturally responsive teaching. The guidance offered is on a superficial level and is positioned as additive. Teachers are not encouraged to reflect on their worldviews or practice” (Bryan-Gooden et al., 2019, 16). No guidance is provided to connect materials to student lived experiences (Bryan-Gooden et al., 2019).



## Key Terms

**Access:** All members of the educational community should have entrance into, involvement with, and full participation of resources, conversations, initiatives, and choices which are attentive to heritage and community practices (Paris, 2012).

**Authentic Intellectual Work (AIW):** Involves the application of knowledge and skills and not just routine use of facts and procedures. It also involves a careful study of a particular topic or problem that results in a product or presentation that has meaning beyond success in school (King et al., 2009).

**Culturally Responsive Teaching:** A pedagogy that “connects students’ cultural knowledge, prior experiences, and performance styles to academic knowledge and intellectual tools in ways that legitimize what students already know” (Kozleski, 2010, p.1).

**Culturally Sustaining:** “The term culturally sustaining...requires that [educators] support young people in sustaining the cultural and linguistic competence of their communities while simultaneously offering access to dominant cultural competence...[it] has as its explicit goal supporting multilingualism and multiculturalism in practice and perspective for students and teachers” (Paris, 2012, p. 95).

**Curriculum:** The total learning experience provided by a school. It includes the content of courses, the methods employed, and other aspects, like norms and values, which relate to the way a school is organized (Ahlstrom, 2003).

**Educational Equity:** When educational policies, practices, interactions, and resources, are representative of, constructed by, and responsive to all people such that each individual has access to, can meaningfully participate, and make progress in high-quality learning experiences that empowers them towards self-determination and reduces disparities in outcomes regardless of individual characteristics and cultural identities (Fraser, 2008; Great Lakes Equity Center, 2012).

**High Outcomes:** Occurs when solutions benefit all students towards self-determination and the ability to act as contributing citizens in a democratic society & global community (Waitoller & Kozleski, 2013).

*[Watermark Image description: Various mathematics numbers and symbols.]*



## Key Terms (cont.)

**Meaningful Participation:** Agency and voice are afforded to all members of a community, by intentionally centering members who have been historically on the margins including, but not limited to people living in under-resourced communities, people with dis/abilities, as well as racially, ethnically, and linguistically diverse individuals. Multiple perspectives are pursued and valued (Fraser, 1998).

**Representation:** Ensuring adequate presence of all when making decisions to examine patterns of underlying beliefs, practices, policies, structures and norms that may marginalize specific groups and limit opportunity (Chen et al., 2014; Mulligan & Kozleski, 2009).

**Socially Transformative STEM Curriculum:** Draws from critical pedagogists and positions learners (specifically learners of African descent) to become aware of racism, understand how racism is established and operates, and how to work against racism (Pitts Bannister et al., 2017).

*[Watermark Image description: Various mathematics numbers and symbols.]*





## About the Author

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**Dr. Crystal Morton** is an Associate Professor of Mathematics Education in the Department of Urban Teacher Education at IUPUI School of Education, where she serves as the Associate Dean of Research and Faculty Development. She also serves as Associate Director of Research for the Great Lakes Equity Center and board member for TechPoint Foundation for Youth, and is the founder and director of Girls STEM Institute.

Dr. Morton's scholarly work focuses on secondary mathematics education, emphasizing the role of informal STEM learning in fostering equitable and transformative mathematics teaching and learning experiences. She primarily examines the learning experiences--specifically mathematics learning experiences--of Black girls in grades 3-12.

As a former high school mathematics teacher, she is passionate about providing historically marginalized populations opportunities to become the next generation of STEM professionals, leaders and decision-makers.



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# IMPACT:

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