BRIGHT SPOTS IN MIDDLE YEARS MATH: LEARNING FROM THE FIELD

| August 2018 |

BACKGROUND

Middle Years Math R&D Program

The K-12 Education team is developing a Middle Years Math R&D program in recognition that by ninth grade, it is critical that students have developed the requisite skills to pursue higher-level math courses. Proficiency in math unlocks opportunities for students to pursue a wide range of post-secondary pathways and STEM careers. Our ultimate goal is to dramatically improve middle years math instruction, so that every black, Latino, and low-income student deeply knows, is able to use, and enjoys math by the time they are in high school.

“Bright Spots” Request for Information

In the spring of 2018, the K-12 Education team issued a Request for Information (RFI) aimed at identifying “Bright Spots” in the field of mathematics for both teaching and learning. The goal was to learn from our colleagues in the field who have already developed highly effective approaches in grades 3-12 to drive math achievement for black, Latino, and low-income students. Information learned from this RFI will directly inform the development of a focused research and development (R&D) program. This program will develop, test, and create mechanisms to support the use of a set of specific teaching and learning approaches that drive faster and deeper math learning in the middle years (approximately grades 3-9), enabling black, Latino, and low-income students to be fully prepared to be successful by 9th grade. As we move forward with the development of this program, we are inviting a small group of “breakthrough approaches” identified through this RFI to submit proposals for our initial round of funding. This group appear to have demonstrated significant impact on student learning outcomes with our target population, and we are interested in supporting them as an initial group to further develop and validate their models for the benefit of the field. We are also excited to continue to engage with the wider Middle Years Math community by sharing more about who responded to our RFI and what we learned about the work that is happening in the field.

STUDENT FOCUS

The K-12 Education team’s work is guided by a focus on elevating and intentionally incorporating student voices, particularly those of black, Latino, and low-income students, in order to inform user-centered design of future directed development projects in math. As such, we asked our RFI contributors to have a conversation with students about the joys and challenges of learning math. The responses we received highlight the critical importance of building
student agency through deeply engaging and relevant experiences. We are excited to share some of these direct student quotes with the field, in the hopes that it will help organizations think about how to further strengthen their approaches by collecting rich evidence of how students are learning and engaging with math, and thoughtfully using this data to promote:

- **Productive struggle and growth mindset:**
  “Mistakes don’t make me feel sad. They make me feel smart because if I get everything right, I already know that question. My brain cells are growing when I do a new thing. I remember mistakes and learn from them. They teach you. They stay in your head.” - 4th Grader

- **Relevance:**
  “I like math because I can use it in sports arguments. My family has never ending fights about basketball. I can know how good a player is by his percentages. It helps me win arguments against my uncle because I can tell him a number and numbers don’t lie. They are facts, so I like math because it makes me sounds smart. He then can just say what he thinks which is only an opinion.”
  - 8th Grader

- **Creativity:**
  “What helps me understand math is learning a bunch of ways to do something and then picking one or two that make the most sense to me. THIS IS WHY MATH IS SO AMAZING!”
  - 9th Grader

- **Deep conceptual understanding:**
  “If I’m struggling to understand a concept, I’ll find some examples and I’ll work my way through them one at a time until I feel comfortable, making sure that I’m understanding why I’m doing what I’m doing - why this formula works, why this one doesn’t; why I’m allowed to do this, why I’m not allowed to do that; why this type of equation merits this type of answer and that kind of equation merits that one. That way, I’ll be able to apply a sort of universal comprehension to any and all problems of that nature that I stumble upon in the future. I would recommend the same strategy to a friend in need.”
  - 10th Grader

To better guide our work, the Middle Years Math team has been diving deeply into two research papers that center on the perspectives of black and Latino youth on mathematics. If you’d like to explore and learn with us, these papers can be found here:

- **Counter Narratives: Examining the Mathematics and Racial Identities of Black Boys who are Successful with School Mathematics (2011, Berry, Thunder & McClain)**

- **(In)equitable Schooling and Mathematics of Marginalized Students: Through the Voices of Urban Latinas/os (2011, Gutiérrez, Willey & Khristy)**

**RESPONDENT ANALYTICS**

The Bright Spots in Middle Years Math RFI closed on May 18, 2018. We received:

- **106** total responses.
- **24%** of responses were from minority owned or led organizations and
- **47%** of respondents were prior Gates Foundation grantees.

The K-12 Education team was excited to learn about the incredible work happening in the field today. However, it is important to stress that 106 responses is a sample [not the complete landscape] of the most compelling approaches to teaching and learning in grades 3-12 math today. We will continue to look for additional Bright Spots as they emerge.
**Submissions By State**

Overall, 27 states and 4 countries were represented in the respondent pool. We recognize that not all states were represented equitably. 43% of all RFI respondents came from three states: California, Massachusetts, and New York.

**Approach Types**

The majority of respondents self-categorized their approaches as curriculum (28%), professional development (27%), or research-based personalized learning (18%). While many approaches could actually fall under multiple categories, we assigned each organization to one approach category in this graph.
Bright Spots in Middle Years Math
Learnings from the Field
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Stage of Development

The majority of RFI respondents self-identified their breakthrough approach in the “growth” stage. For our team of RFI reviewers, the growth stage is defined as:

“Our approach is in use in a range of educational settings with teachers and students, you have validated its impact, and you are focused on expanding its reach.”

In reviewing RFI responses, our team felt that many of the approaches we saw might be better defined as early stage, for one or more of the following reasons:

- Some approaches had only been tested in a handful of controlled environments. More work may be needed to validate impact in multiple and varied educational contexts.

- Some approaches may serve our target population, but were not explicitly designed to meet the needs of black, Latino, and low-income students. More design work may be needed to incorporate these needs more intentionally.

- Some approaches are highly dependent on philanthropy and federal grant dollars. More work may be needed to develop more sustainable pricing structures.

Bright Spots Review Process

Of 106 RFI responses, 48 approaches were identified by the K-12 team as highly promising. These were approaches that:

- Actively considered our target populations (black, Latino, and low-income) in a meaningful way
- Had thoughtful and compelling design processes undertaken closely with schools
- Developed solutions in partnership with educators, researchers, and product developers

Of these 48 promising approaches, 23 were ultimately identified as demonstrating a compelling level of impact on student learning outcomes. These organizations set themselves apart by rigorously and continuously measuring impact as part of their DNA. While many approaches showed promise, most had not yet produced rigorous evidence of significant outcomes, indicating that they were still in the earlier stages of R&D.

Approaches By The Numbers

Of the 106 responses we received, nine key themes are important to highlight:

- 9 of our colleagues in the field are thinking deeply about how to replicate the success of 1:1 tutoring in new contexts, at greater scale, or via new delivery mechanisms such as intelligent tutoring systems, to drive significant gains in student learning.

- 5 organizations are working on approaches that explicitly highlight English Learners as a critical population requiring unique supports. We saw innovative interventions designed to reinforce math concepts through visual models, manipulatives, vocabulary, and research-informed instructional practices with the aim of meeting English Learner needs.
30 respondents are working on curriculum approaches that promote student engagement through relevancy. These approaches incorporate storytelling, real-world problem solving, interactive elements, and linkages between everyday concepts.

29 of our colleagues in the field are leveraging high-quality professional development experiences to support the instructional capacity of educators. This includes bringing teachers and experts together in communities of practices, PD-embedded curriculum, self-paced online courses, and experiencing math from the perspective of students.

30 respondents mentioned the critical importance of supporting continuous improvement processes for teacher teams. We saw innovative uses of continuous data analysis, cyclical observation and debrief, and just-in-time PD to address immediate student needs.

21 respondents are designing and implementing formative assessments in thoughtful ways as part of their approach. 6 of these organizations have produced personalized learning platforms that collect granular data as students interact with a task, using that data to inform follow-up interventions.

11 organizations are engaging directly and meaningfully with students through in-person after school and summer programs. These programs often utilize a cohort-based model - many over the course of multiple years - to accelerate academic growth, put students on a track to advanced math learning, and prevent summer learning loss.

26 of our colleagues in the field explicitly discussed how their approaches were rooted in learning science research. Organizations are thinking critically about how students learn and crafting curriculum, interfaces, instructional strategies, and data collection practices in response.

22 organizations actively considered how their approaches helped students to build growth mindsets and positive math identities. These approaches emphasized building student comfort with experimentation and productive struggle.

**KEY TAKEAWAYS**

As our team moves forward with the design and development of a Middle Years Math R&D program, we are guided by these key takeaways from the RFI process:

- **Co-Designing:** We are excited about approaches that start with a deep understanding of our target population and their needs, and work in partnership with educators and community stakeholders to design and continuously iterate upon solutions. Doing so helps ensure that approaches authentically meet student needs.

- **Equity:** We are starting to see more organizations recognize the need to better reflect the student population they aim to serve at both the organizational leadership and staff levels. There is more room for growth in this area. (The Gates Foundation is trying to grow here too). If your organization is interested in diversity, equity, and inclusion, the DEI Expert Hub may be of help on your DEI journey.

- **Sustainability Models:** Through this RFI process we uncovered many organizations that had developed their approach funded entirely by grant dollars (philanthropic and federal grants such as NSF and IES). When we asked respondents to give us a sense of their business model, many had not yet figured out an approach to supporting their programs after the grants end. This recognition is driving our team to think about what support we may want to build into future grants to ensure progress toward a viable business models being considered earlier in the stage of an R&D project.
Impact Measurement: In this RFI, our team outlined five impact measurements we considered as "breakthrough results". We shared with the field that these were just proxy measures and asked respondents if they had additional measures we should consider. We will be working with our math advisory group to further refine success metrics for middle years math, and view this as a critical task for the portfolio to be centered around the most meaningful impact measures. In the meantime, additional proxy measures suggested by the field included:

- Measurable improvements in teacher math knowledge using the Mathematical Knowledge for Teaching (MKT) assessment
- Proficiency in student ability to engage in verbal mathematical discourse about problem solving strategies and thought processes
- Measurable improvements in conceptual understanding, sustained over long periods of time
- Measurable improvements in social-emotional learning measures of student engagement and attitudes towards math, such as interest and passion for doing math, a willingness to do math voluntarily during free time, and a desire to understand math and identify real-world applications

Educator Needs: This spring our team had the opportunity to meet with 60 teachers at NCTM to better understand teacher needs and 24 teachers and principals at ISTE to share de-identified synopses of RFIs to hear reactions and questions from educators. A key theme that teachers told us was valuing “just-in-time” resources in order to grow their math knowledge and practice. When we analyzed teacher-facing approaches submitted through this RFI, very few had built a just-in-time delivery model. Many still rely on traditional, in-person PD. As our team moves forward with investments, we will be looking at when just-in-time delivery models can be effectively used.

Student Engagement: It was clear from many RFI responses that the efficacy of a product or program is also dependent on student enjoyment and buy-in. We saw many approaches that incorporate intentional elements to promote student engagement, through thoughtful user design, culturally relevant content, games and interactive activities, peer-based learning, etc. We also saw organizations designing experiences to change math mindsets by helping students to view challenges positively and understand the real-world importance of math. As we consider investments, our team will be looking at approaches that take this strong student-centered focus.

Community of Practice: A lot of organizations are dedicated to measuring the impact of their approaches, as well as continually improving those approaches. We are excited to see this and fundamentally believe the field could learn together much more quickly if we had structures in place for a community of practice. Moving forward in middle years math we plan to build a community of practice for our grantees who are working in similar areas to learn and grow with each other, and to connect to other existing communities of practice focused on R&D in K-12 mathematics. As we build this community of practice with our grantees, we will look to how we can build a larger community of practice with the field, so we can collectively learn and grow faster together.

WHERE WE AREヘADED

The K-12 Education team is now in the process of developing a focused R&D program aimed at dramatically improving middle years math instruction for black, Latino, and low-income students. We will identify common themes and cohorts within Bright Spots grantees, who will form communities
of practice in the co-development and validation process. We are also actively seeking an evaluation partner to work with grantees.

Our first cohort of grantees will focus on tutoring and peer-based learning. We will also explore other cohorts for investment in early 2019, in two of the following areas: professional development, after school/summer programs, or social-emotional learning.

In parallel to identifying which bright spot programs we plan to invest in, we will also be identifying leaders to facilitate our community of practice.

**Scope of Funded Activities**

Once we invite organizations to submit proposals, we will be working with each organization to identify which stage of R&D is appropriate for their breakthrough approach. We anticipate the majority of investments will fall within the develop and validate phases.

**EXPECTED OUTPUTS BY PHASE**

Research questions were informed by the Learning Assembly’s Evaluation Taxonomy.

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<th>Develop Phase</th>
<th>Validate Phase</th>
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<td><strong>Measurement</strong></td>
<td>Success metrics (including teaching and learning indicators) are defined for the controlled context.</td>
<td>Success metrics (including teaching and learning indicators) are defined for multiple contexts.</td>
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| **Design/Develop**   | Usable prototype is engineered in partnership with developer, educators, and researchers (co-designed). Prototype used in a controlled context. Research questions addressed:  
  • What is the user experience?  
  • How might the user experience of a breakthrough approach be improved?  
  • Does the design of a feature (in the breakthrough approach) achieve a specific learning outcome? | Document any shifts to design required for re-engineering for success in multiple contexts. Prototype used and evaluated in multiple contexts. Research questions addressed:  
  • Are any design shifts required for re-engineering for success in multiple contexts? |
| **Implementation**   | Research questions addressed:  
  • How is the breakthrough approach implemented in this controlled context? | Research questions addressed:  
  • How is the breakthrough approach implemented and adapted in specific contexts? |
| **Efficacy & Impact**| Usable prototype is tested in a controlled environment (rapid cycle piloting/trialing). Research questions addressed:  
  • Does a breakthrough approach produce the desired result when used as intended? | Test and adapt prototype in a range of contexts (rapid cycle piloting/trialing). Test and adapt prototype with larger populations (different student or teacher groups, different school configurations). Research questions addressed in an expanded contextual and impact analysis:  
  • Does a breakthrough approach produce the desired result when used as intended?  
  • Does a breakthrough approach work in the general population and what is the effect? |
SECONDARY ACTIVITIES FUNDED
The following are secondary activities we’ll invest in to support bright spot organizations, only if impact has been demonstrated/achieved.

- **Business Planning:** Build a plan for co-funder commitments.
- **Demand Signaling:** Measure and track interest (demand-side).
- **Supportive Narratives:** Develop and test supportive narratives.
- **Enabling Policy:** Assess policy implications and conduct policy landscape. Build a plan for policy shifts (if needed).

We are immensely grateful to our colleagues in the field who took the time and effort to offer responses to our Request for Information. If you are interested in learning more about this RFI or other opportunities, please refer to the Bright Spots in Middle Years Math page or the K-12 website.