Request for Information for Advanced Education Research & Development Programs

Draft Program Description: Program C

Measuring and Improving Executive Function

This document is part of the Request for Information for Advanced Education Research & Development Programs announced by the Chan Zuckerberg Initiative and the Bill & Melinda Gates Foundation. Full details on this RFI, including submission information, can be found at www.chanzuckerberg.com and k12education.gatesfoundation.org.

We are requesting information for innovative strategies to help address the above challenge within the US context (solutions from non-US contexts with applicability in the US are also welcome).

On the following pages, we are providing a concept description for the program to measure and improve executive function. This is, indeed, a *draft* description - because we intend, through this RFI, to refine this program idea, or add to it. We expect it will change, perhaps dramatically, based on your input.

Problem

Student success in academics and in future careers is associated with their ability to wrestle with multiple ideas at once, think flexibly, and regulate their actions and thoughts. These skills describe the basic executive functions (EFs) of working memory, cognitive flexibility, and inhibitory control. Strong childhood EFs predict higher socio-economic status, better physical health, and fewer drug-related problems and criminal convictions in adulthood.[1]

EFs have been shown to be measurable, malleable, and robustly associated with success across the lifespan.[2] Yet, there is much to be done to track and improve students' progress on EF development and connect it to real-world benefits, especially for those who are most at risk. For instance, we know EFs emerge in early childhood and build the foundations for more complex problem solving, reflection, planning, creativity, and task management, which students will need throughout life. We also know that psychological and physical stress can impede the development of these skills. Yet, we have not identified scalable, precise, and effective ways to track progress or kinds of interventions to improve EF in the general student population or to address stress-related EF challenges in children. In addition, we do not fully understand the connections between developmental trajectories of executive functions and real-world outcomes for different groups of children as they mature to adulthood. Finally, we lack the necessary targeted strategies and tools to intervene efficiently with adolescents who lag in EF development and may therefore be at risk of EF-related barriers to positive life outcomes in adulthood.

Programs and interventions that effectively harness and augment students' executive functions, especially students in adverse life situations, could potentially lead to dramatic improvement of mathematics and other academic achievement, college retention, and job and life success.

Assessing potential for impact

We will use the input from this RFI to inform the design of target outputs for a potential R&D program focused on developing, harnessing, and tracking progress of executive function in children and young adults. Some of the target outputs we may include are described below. However, we are also interested in new ideas and innovative approaches to measuring the potential efficacy and scalability of proposed projects. Please submit those as part of your response.

---

[1] Moffitt, T. E., Arseneault, L., Belsky, D., Dickson, N., Hancox, R. J., Harrington, H., ... & Sears, M. R. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences, 108*(7), 2693-2698.

[2] e.g., Diamond, A., & Ling, D. S. (2016). Conclusions about interventions, programs, and approaches for improving executive functions that appear justified and those that, despite much hype, do not. *Developmental Cognitive Neuroscience*, *18*, 34-48.

Chan, R. C., Shum, D., Toulopoulou, T., & Chen, E. Y. (2008). Assessment of executive functions: Review of instruments and identification of critical issues. *Archives of clinical neuropsychology*, *23*(2), 201-216.

- Detailed, developmentally appropriate multi-dimensional diagnostics to evaluate executive functioning in children and young adults, especially those with ongoing life stresses.
- Highly effective interventions that demonstrate transferable improvement in executive functioning in children and young adults.
- Delivery platforms for both diagnostics and interventions that allow for use by a range of users (e.g. parents, teachers, paraprofessionals, and students).
- Demonstration that improvements in executive functioning translate into significant gains in specific academic and non-academic real-world domains of functioning.
- Ease of integration by non-expert users of diagnostics and interventions into standard learning environments in PreK-12.
- Affordable cost to implement - below current market pricing for existing solutions and attainable at a variety of per-student funding levels.

Request for Information

We are requesting information about the current state-of-the-art approaches for the topic areas below and bold ideas for advancing these capabilities in 10 years by creating effective methods for evaluating and improving executive functioning. Submissions should address one or more topic areas.

Potential Topic Areas

Possible topic areas within this program may include, but are not limited to:

- Tracking progress of student executive function (PreK-12). Including but not limited to:
    - Advances in EF tracking techniques (for teachers and school leaders to use) to increase practicality within school constraints while maintaining validity and reliability of constructs (e.g., unobtrusive assessments of EF through real-time data; ecologically realistic, performance-based measures of student EF within classroom-relevant projects).
    - Focus on vulnerable student groups, including low-income students, students who have experienced high stress/high adversity, students with clinically defined learning and behavioral differences (e.g., ADHD, autism), etc.
- Student-facing interventions/programs/practices/tools to support EF development and use. Information may address:
    - Improvement strategies in or outside of school: Effective strategies in different demographic groups (e.g., PreK-12 age, ELL status, gender, clinical groups, etc.) that improve EF and impact/transfer/generalize to EF-related behaviors in real-world situations (e.g., social-emotional learning, mathematics, reading, writing, identity, and more).
    - Technology-enhanced programs in or outside of school: Games,

simulations, or other engaging content paired with teacher and family supports that improve EF and impact/transfer/generalize to EF-related behaviors (e.g., social-emotional learning, mathematics, reading, writing, identity, and more).

- Measures of educator EF and environmental EF supports. Including but not limited to scalable, valid and reliable, repeatable, pragmatic measures of
    - Educator's own EF within student learning contexts.
    - Adult capacity to support EF growth in students.
    - Environmental supports for EF that lead to pragmatic and real-world gains in educational contexts for educators.
    - Advances in measurement techniques for the above.
- Adult-facing interventions/programs/practices/tools that support their own and students' EF development and use. Information may address:
    - Techniques for adults to support student EF: Knowledge and effective strategies for teachers, school leaders, and other caregivers to support EF skills in students.
    - Supports for adult EF: Strategies/supports for teachers', school leaders', and other caregivers' EF development, which will ultimately impact their interactions with students.
    - Technology-enhanced programs for these.
- Critical field-building research topics. Including, but not limited to:
    - Multidimensional developmental trajectories: Understand relational structure between EF subcomponents and between EF and related academic and non-academic constructs, across time and development, for different demographic groups, that lead to real-world benefits.
    - EF precursor skills: Understand the early experiences that give rise to EF skills, such as autonomy, supportive teaching and caregiving.
    - Neuroscience connections: For example, neural underpinnings of EF intervention effects, neural developmental progressions, compensatory pathways vs. EF improvement in the brain.
    - Interactions between EF and other factors (e.g., stress, biology, motivation) toward academic and nonacademic outcomes/behaviors.
- Privacy. Identification of possible privacy implications and strategies for ensuring the privacy and security of student information.