Taking the Guesswork out of Locating

Evidence-Based Mathematics Practices for Diverse Learners

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Approximately 5 to 7% of school-age students have a learning disability related to mathematics (Shalev, Auerbach, Manor, & Gross-Tsur, 2000), but the percentage of students who experience mathematics difficulty is much greater. For example, results from the 2015 National Assessment of Educational Progress (NAEP; National Center for Education Statistics, 2015) indicate 60% of fourth-grade students and 67% of eighth-grade student performed at or below a basic level of proficiency in mathematics. For students with disabilities, the percentage of students below a basic level of performance in mathematics was even greater, with 80% of fourth-grade students at or below basic levels of proficiency and 92% of eighth-grade students at or below basic, indicating lack of proficiency in mathematics. Yet, research documents that effective instruction can reduce the likelihood that a student will be identified as having a mathematics difficulty or disability (MD; e.g., Compton, Fuchs, Paulsen, Bryant, & Hamlett, 2005).

To provide appropriate mathematics instruction to any student, most educators are aware that they should use evidence-based practices (EBPs) supported by scientifically based research as mandated by federal legislation (Every Student Succeeds Act [ESSA], 2015). The use of EBPs is especially warranted for students with MD. First, EBPs are mandated for students with disabilities, as outlined by the Individuals with Disabilities Education Improvement Act (IDEIA, 2004) and emphasized by the Council for Exceptional Children (2014). Second, students with MD already perform below peers without disabilities (Wei, Lenz, & Blackorby, 2013), and the performance gap between students with and without MD tends to widen as students progress through elementary and secondary school (Morgan, Farkas, & Wu, 2009). EBPs provide educators with a starting point for providing effective instruction to students with MD as EBPs provide the likelihood of improving mathematics performance for *most* students with MD *most* of the time. This promise allows educators to have some level of confidence that the instruction may be effective and not wasteful of time.

In an article recently republished in 2014, Cook, Tankersley, Cook, and Landrum (original publication, 2008) describe practical considerations for EBPs in special education, including how to determine EBPs and why it is important for educators to use EBPs in the classroom. Similar considerations were provided by Cook and Cook (2013). The suggestions from this research team are correct and important, with a focus on all disability categories. Our paper specifically focuses on mathematics and students with mathematics difficulties or disabilities and extends the Cook et al. work by providing resources to find EBPs and make educational decisions about how to refine current instruction when EBPs are not available. The latter is especially necessary in mathematics as the collection of mathematics interventions identified as EBPs is quite small (i.e., compared to reading interventions), and the current collection of interventions does not include coverage on all mathematics content that students are expected to learn. In this manuscript, we briefly discuss what constitutes EBPs based on current educational policy and guiding documents. Then, we navigate the process for searching for and selecting EBPs in mathematics. We discuss the usage of evidence-based strategies as a method for intensification when evidence-based interventions (EBIs) are not available due to content or a lack of resources.

Impetus for Practices Supported by Scientifically Based Research

The widespread educational use of the term EBPs is rooted in legislation and the evidence-based movement in education to employ practices that have a strong and credible history of use resulting in improved student outcomes. ESSA (2015) explains that educators should employ instruction that has been proven to be effective based on scientific research. Eligibility to be scientifically based stems from use of empirical methods to collect and draw conclusions, rigorous data analysis, determined validity of data, and scrutiny of merit by way of objective, scientific review from experts in the field. While the language used in federal legislation emphasizes *scientifically based research* and provides a list of criteria for scientifically based research in the area of reading, the identification of what constitutes *scientifically based* is not easily identifiable in mathematics. In a similar way, the most recent reauthorization of the IDEIA (2004) stresses the necessity of *scientifically based literacy instruction,* yet the stress for the same in mathematics is absent. This is not surprising considering that the mathematics research base for students with MD is considerably less substantial than the literacy research base (Methe et al., 2011). Assuming we apply the phrase scientifically based research and instruction to mathematics, the criteria for standards still provide subjectivity in interpretation. For example, the procedures to obtain data for scientific research must be *rigorous*, however, *rigor* may be interpreted in various ways. Does *scientifically based research* need to meet all of the criteria set forth in legislation or just a proportion of them? Does rigor indicate one high-quality research study conducted under ideal conditions or multiple studies (Powell & Fuchs, 2015)? Additionally, the language used to communicate practices with scientific support varies (i.e., *evidence-based, empirical, research validated*) rely on the consumer (i.e., educator or parent) to distinguish between the meaning of terms and the quality of product.

Currently, the standards guiding the majority of mathematics curricula, textbooks, and assessments in the United States are the Common Core State Standards-Mathematics (CCSS-M;

National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). The CCSS-M state what students should understand and do to demonstrate an understanding of mathematics. The CCSS-M allow for educators and school district personnel to determine how to meet these standards via curriculum and instruction, but it is important that educators are equipped to implement practices that are efficient and effective. Consequently, teachers require direction for selecting and implementing EBPs in the era of the CCSS-M.

The translation to practice becomes even less clear for students with MD as the research base for mathematics grows in conjunction with the widespread understanding for the need to implement EBPs. Quality core instruction, including systematic, explicit instruction (Archer & Hughes, 2011) is generally efficient for most students; however, some students will need more targeted EBPs. Compounding the issue is that EBPs are not available for all learning and educational situations or for all types of students. For example, there is a body of scientifically based research supporting use of the cognitive strategies within a problem-solving intervention, *Solve It!* (e.g., Montague, Enders, & Dietz, 2011; Montague, Warger, & Morgan, 2000). Montague, Krawec, Enders, and Dietz (2014) share evidence to support *Solve It!* for use with middle school students with and without learning difficulties in a large urban area in the southern part of the United States. After reading this article, a middle school teacher at a rural school in the Midwest may wonder if this intervention would be appropriate for her students with learning disabilities. A special educator at an urban school on the west coast may wonder if this intervention is appropriate for her students with autism. Both educators ponder, "Can I assume that the success of this evidence-based intervention will translate across these differing characteristics and work for *my* students?"

Even when evidence is available regarding EBPs for a targeted population, application of

EBPs may be inconsistent, such that Stahmer and colleagues (2015) documented lack of fidelity of treatment for EBPs. Similarly, Kretlow and Helf (2013) discovered that few educators used curricula that had been rigorously evaluated for empirical support. Despite increased understanding of how students learn mathematics and growing bodies of research documenting effective mathematics instruction and intervention, there are still gaps in knowledge of mathematics EBPs.

Distinguishing Between Interventions and Strategies

In education, the term *evidence-based practice* is often used as an overarching term that may include different types of instructional practices, strategies, or interventions with validated research support. The Council for Exceptional Children (2014) uses EBP to describe practices or programs validated through the use of high-quality experimental group comparison designs or single-subject experimental designs. Because the term EBP does not distinguish between instruction, intervention, or strategy, it is important for educators to consider students' needs and the purpose of instruction when finding and selecting EBPs. Figure 1 provides a flow chart distinguishing and prioritizing uses of EBPs. Considering students with MD oftentimes have a history of failure in mathematics and need instruction that is provided in a smaller group setting, a strong core program is often not enough to meet their learning needs. For this reason, teachers must seek additional EBPs specifically targeted to student needs. For instance, a teacher may be implementing a core mathematics program with fidelity, and that program may have been selected because of its strong research base. That does not, however, mean that the core program will be effective enough for a student with MD, so the teacher may need to explore alternate instruction or interventions that is more intensive and aligned to student needs. Next, we discuss how to determine which type of intervention or strategy to select, based on the intensity of student need.

Evidence-Based Interventions

One type of EBP is an *evidence-based intervention* (EBI). An intervention is a complete program or package that includes multiple components for increasing the mathematics knowledge of students. These interventions may be grade-specific (i.e., fifth-grade standards) or content-specific (e.g., rational numbers). An EBI has been validated through high-quality experimental research that indicates the intervention improves mathematics performance. It would be ideal for educators to always have an EBI to use with students with MD. With an intervention, the preparation time for educators would be minimal, and the intervention would come with all necessary materials (e.g., lesson guides, technology, games, and assessments) for implementation. Specific directions for use would allow educators to implement the intervention with ease and ensure relatively high treatment fidelity, which measures the degree to which the intervention was implemented as intended. Additionally, educators could expect the outcomes of the intervention to be similar to those documented in the research if implemented in a similar manner with students with similar MD characteristics. As mathematics instruction is content specific, there are several mathematics concepts that have associated evidence-based interventions (e.g., *Fraction Face-Off!*; Fuchs et al., 2013); however, there are many mathematical content areas that do not have specific interventions with documented success. The gaps in research may be a result of lack of interventions, length of time for the vetting and peer-review process, or limited documentation of empirical success. In these situations, educators must rely on *evidence-based strategies* or *promising practices*.

Evidence-Based Strategies

As stated, ideally an EBI would be available for all instruction related to students with

MD. This is currently not the case, however, and this situation is likely slow to improve as conducting high-quality evaluations of interventions typically takes several years and financial support from grant agencies or foundations. When an EBI is unavailable, educators should turn to evidence-based strategies. We call these *strategies* because they are not a specific program or intervention, but rather a replicable process that has some documentation of improving the mathematics outcomes of students with MD. For example, taped problems is a fluency strategy that has a research base demonstrating improved addition and subtraction fact fluency (e.g., Aspiranti, Skinner, McCleary, & Cihak, 2011; Poncy, Skinner, & McCallum, 2012) or multiplication and division fluency (e.g., Bliss, Skinner, McCallum, Saecker, Rowland-Bryant, & Brown, 2010; McCallum & Schmitt, 2011). With taped problems, the educator provides a page with printed mathematics facts without an answer. The educator makes a recording by stating the fact then pausing for 1 to 5 seconds before stating the fact answer. Students listen to the recording and work on writing the fact answer before it is heard on the recording. Following instructions to make taped problems, educators can create their own taped problems materials to implement with students with MD. This is an evidence-based *strategy* because it has a research base; therefore, it is likely students with MD may demonstrate improved fact fluency after practicing facts using the strategy of taped problems. Educators, however, must be cognizant that this strategy may have been validated with other mathematics content (e.g., multiplication facts), with other disability groups (e.g., intellectual disability), or at other grade levels than the focus student, so there is no guarantee this strategy will transfer. We place evidence-based strategy under EBI because an intervention with an evidence base has the stronger potential to affect positive mathematics performance gains. When an intervention is not available, however, an evidence-based strategy is a strong route for an educator to explore.

Finding Evidence-Based Practices for Mathematics

For students with MD, EBIs provide the most effective content and are provided as part of complete or packaged programs. They are targeted for a specific skill or set of skills and have a documented history of success when implemented with fidelity. When an EBI package is not available or not feasible (e.g., too expensive), educators have to pursue an alternate route. We propose, rather than using an intervention that has not been empirically validated or create materials independently, that educators use evidence-based strategies. These strategies, similar to EBIs, have been validated by high-quality research with students with MD but may not be as specific to content or as comprehensive as an intervention. To locate both EBIs and evidence-based strategies, educators have several resources available. For ease of locating, we provide methods for identification of EBPs (which may include both interventions and strategies).

Peer-Reviewed Journals

One source of EBPs is peer-reviewed publications. Through the peer-review process, experts in the field evaluate the rigor and quality of research. Research that has met the rigor determined by the journal, reviewers, and editors is then published and disseminated. These publications can be accessed through personal or group (e.g., library) subscriptions. A benefit to accessing research articles in a peer-reviewed journal is that the educator accesses the primary source and can be a critical consumer of the information at the primary level. Through many library search engines, educators can also search multiple journals for topics using relevant key terms. For example, if an educator wants to find examples of interventions to help students with learning disabilities solve addition word problems, he or she can search for interventions using key terms such as *word problem, addition,* and *learning disability*. Limitations to this resource include needing access to a library system that subscribes to the journals and only being able to access one article of evidence at a time. The exception to the latter limitation is access of a meta-analysis or systematic review of literature; both evaluate the efficacy or effectiveness of a type of intervention based on multiple research articles on that topic. Often, practitioner journals, which also undergo a peer-review process, provide summaries and applications for practice. Many articles from peer-reviewed journals are now available on-line and through websites such as academia.edu, googlescholar.com, or researchgate.com. Additionally, these and other websites may provide vetted information that does not have to be accessed through a library system.

Vetted Websites

Inputting search terms relating to MD into a search engine can produce too many results not applicable to the educator's purpose of the search. Thankfully, there are several websites with interventions that have been vetted (i.e., undergone a peer-review process). We highlight several of the most common to provide educators with a starting point for locating EBPs in mathematics. First, we discuss two websites that focus on general education instruction. Then, we provide information about three websites with specific information related to students with MD. See Table 1 for a list of websites with vetted intervention sources.

What Works Clearinghouse. Established in 2002, the What Works Clearinghouse (WWC; ies.ed.gov/ncee/wwc/) is an initiative of the Institute of Education Sciences (IES) and U.S. Department of Education. The aim of the WWC is to provide consumers with the resources they need to make "informed educational decisions" regarding educational programs. Raters from the WWC rate EBPs on the level of causal evidence associated with the intervention, and rate EBPs as having 'minimal,' 'moderate,' or 'strong evidence' for improving the mathematics outcomes of students. WWC provide briefs or *practice guides* that give overviews of recommendations for educators, *intervention reports* that summarize findings on an intervention, *single study reviews* that evaluate individual research studies, and *quick reviews* of research. For example, the WWC provides educators with a search tool to "Find What Works!" Educators can search by key words such as *math* and *programs with positive or potentially positive evidence* and a list of curriculum or interventions is generated. Many of the programs with positive evidence on the WWC are mathematics curricula (e.g., *Everyday Mathematics; Investigations in Number, Data, and Space*). However, it is often not reported if students with MD or other disabilities were included in the studies. Furthermore, the reports do not disaggregate findings to report on outcomes specifically for students with MD. These limitations in reporting make it difficult to determine if curricula meet the unique learning needs of students with MD. Additionally, the WWC only includes studies that are considered to be randomized controlled trials or quasi-experimental designs, as these are considered to be higher-quality designs,

Best Evidence Encyclopedia. The Best Evidence Encyclopedia (BEE; http://www.bestevidence.org) is maintained by Johns Hopkins University's Center for Data-Driven Reform in Education. The BEE organizes program reviews by levels (i.e., elementary and middle/high school) and shares evidence on three program categories relevant to this paper: mathematics curricula, computer-assisted instruction, and instructional process programs. Within each educational level, the evaluated programs are given a hierarchical rating of 'strong evidence of effectiveness,' 'moderate evidence of effectiveness,' and 'limited evidence of effectiveness.' The BEE also shares if programs have 'insufficient evidence' or 'no qualifying studies' to communicate evidence of effectiveness. This information is available in an easy-to-read table format and provides links to additional information, when available. The BEE also summarizes the information available and highlights key findings from the reviews. A strength of the BEE is that it provides transparent information on the methodology used to conduct the reviews, including inclusionary criteria, information on effect sizes, and other relevant information that allows readers to self-evaluate the rigor of evaluation.

Additionally, the BEE provides a separate section on effectiveness of technology. The BEE has a meta-analysis on educational technology to teach mathematics and shares the effect sizes for three categories of educational technology: computer-managed learning, comprehensive models, and supplemental computer-assisted technology. Similar to the WWC, the BEE primarily reports on general education programs and not specific interventions related to students with MD. Some programs rated by the BEE also have specific evidence for students with MD (e.g., Peer-Assisted Learning Strategies; PALS) and are cross listed on other sites, such as the Evidence-Based Interventions (EBI) Network and IRIS Center.

National Center on Intensive Intervention. Specific to students with MD, the National Center on Intensive Intervention (NCII; www.intensiveintervention.org) at American Institutes for Research provides a compilation of interventions for students with academic difficulties. By navigating the 'Tools Chart' related to academic interventions, educators can quickly identify mathematics interventions with an evidence base. The Tools Charts break down and evaluate (when appropriate) various elements of intervention research publications. For example, study qualities (i.e., participants, design, fidelity of implementation, measures targeted, measures broader) are evaluated as having 'convincing evidence,' 'partially convincing evidence,' 'unconvincing evidence,' and 'data unavailable.' Figure 2 shares a visual of the Tools Chart from the NCII. In separate tabs, the NCII also shares information about study results (number of outcome measures, mean effect size-targeted, mean effect size- broader, disaggregated data for demographic subgroups, and disaggregated data for <20th percentile) and intensity of the intervention (i.e., administration group size, duration of intervention, minimum interventionist requirements). The NCII also shares if there is additional research available on the intervention and if it was reviewed by the WWC. The advantage of the NCII is that the interventions are targeted for students with MD. By clicking on the title of the intervention in the table, readers can learn more about the intervention and how to obtain it and the cost of the program.

While the information for each intervention is spread across different tables and tabs, a link to a downloadable user's guide is provided. The user's guide provides suggestions to facilitate how to meaningfully use the tool chart on the website to make instructional decisions. In addition to the Tools Chart, the NCII provides information about implementation supports, instructional supports, and additional resources.

Evidence-Based Intervention (EBI) Network. The EBI Network (ebi.missouri.edu), housed through the University of Missouri, aims to provide guidance to educators as they select and implement academic and behavioral EBIs and evidence-based strategies in classroom settings. This website was initially launched in 2009 as a collaborative project by faculty and students at several universities. The EBI Network protocol was designed to examine the literature base for simple interventions that can be done in most classes with little resource commitment. These are interventions that a teacher or an intervention team can select and tryout with a target student or group of students demonstrating a common problem. Interventions included on the EBI Network are those which have a minimum of three published research articles supporting efficacy. Note, given that the focus of the EBI network is to work with children who have not responded to other interventions and standard curriculum, these research based interventions are only considered evidence based for a specific case when implemented with fidelity, appropriate target outcomes are measured, and the outcome data shows a positive effect.

In 2013, the project was expanded with the goal of developing a new section of the EBI Network devoted to mathematics interventions. Specifically, a framework was developed to present mathematics interventions that incorporate both a focus on content area (e.g., Counting & Cardinality or Operations & Algebraic Thinking) and the type of problem the child is having (acquisition, proficiency, or generalization). The interventions and strategies are organized in 'intervention briefs,' which provide an overview of what topics the intervention can be used to teach, a summary of when and how to implement the strategy, who the strategy may be appropriate for, and references to find more information through primary sources. The mathematics briefs share how the EBI or strategy has been researched to address topics in the CCSS-M. Additionally, the briefs share information relevant for educators implementing multi-tiered systems of support or response to intervention (RTI) frameworks. Figure 3 shares a screenshot of a mathematics brief. One of the unique features of the EBI Network is that both packaged EBI and evidence-based strategies are included. For example, in relation to mathematics, the EBI Network provides an overview of an EBI related to word problems (i.e., Pirate Math), but the EBI Network also provides an overview of evidence-based strategies in mathematics (e.g., keyword mnemonics; cover, copy, compare). Two example briefs are provided in Appendix A and B.

IRIS Center. The IRIS Center (iris.peabody.vanderbilt.edu/) is housed through Vanderbilt University in cooperation with Claremont Graduate University and offers resources and educational links regarding EBIs, evidence-based strategies, and promising practices. Dropdown menus allow the user to navigate the tools by topic or subtopic, including mathematics. See Figure 4 for a screenshot of IRIS Center Resources. Evidence-Based Practice Summaries provides access to external program reports. These research annotations are organized by categories. The mathematics summary provides a list of programs, a summary of descriptions and effectiveness, and a link to the original report (e.g., WWC). Within the IRIS Resource Locator, users can access case studies, information briefs, interviews, video vignettes, web resources, and STAR Legacy modules. Some of the information links users to external websites. For example, the web resources offer links to WWC, NCII, BEE, as well as other web sites. The interactive STAR Legacy modules are operated through the IRIS Center and provide information to help teachers select and implement EBPs and address such topics as fidelity of treatment and mathematics within an RTI framework. Information available on the website extends beyond EBPs and EBIs to share information on formative mathematics assessment. For someone who is new to the concept of EBPs or EBIs, there are modules and resources that explain the concept of an EBP and other considerations. There is abundant information on the site; however, information is not specific for students with MD, so any educator must purposefully search for information relevant to mathematics EBIs for students with MD.

Caveats

With today's never-ending search for an educational silver bullet, it would be remiss to discuss EBPs without also discussing practices that lack substantial research evidence. Some practices persist despite lack of supporting evidence or evidence that contradicts benefits (e.g., learning styles) but are readily available through search engines, which falsely validates the practice to the reader. Mostert (2010) refers to these practices as "fanciful" but which are ineffective or potentially even harmful interventions. Educators need to be critical consumers and not adopt practices which may have no positive impact on improving mathematics.

The role of critical consumer is particularly important in the area of social media. The free flow of information has many benefits but also poses cautionary tales. For example, crowd surfing may be a popular way to quickly survey friends and peers to gather a collective answer. Doing so often reinforces that the person posing the question or problem is not alone when dealing with this type of issue; however, this may result in various anecdotal responses that share conflicting conclusions. Well-intended sources of information from blogs, websites, and social media may provide interesting information to consider, but are often secondary or tertiary sources and provide no evidence supporting impact on student learning and lack the scrutiny of peer-review. Similarly, anecdotal stories about something working in for one person must be understood as a personal success story but not as EBPs. "Popular reviewed" and "peer reviewed" are separate entities that may overlap but should be appreciated and respected as what they are. In a world where educators are inundated with choices, being savvy, critical consumers of educational resources is paramount.

Student-Level Effectiveness

The current emphasis in education to use EBPs is that they have a history of success and likelihood for future mathematics achievement in similar conditions, with similar students. This does not ensure; however, that the intervention or strategy will work for every student at every time (Cook & Cook, 2013). There are a number of factors that can result in EBPs not working with a specific student (Burns, Riley-Tillman, & VanDerHayden, 2012). First, interventions are often not implemented with high levels of fidelity. Sometimes this is planned, as in the case of local modification. In other instances, low fidelity is simply due to lack of time or resources. Another factor impacting EBPs is difference at the setting or student level. Children and classrooms are complex, and it is typical for the target student or group to be somewhat different than those in the research studies supporting the EBP. Merely selecting and implementing an EBP without support from student level data is not recommended. While EBPs are a logical place to start, it is still important to collect information (i.e., data) on individual student progress, as even the most established EBPs cannot guarantee success for all students in all learning situations. There are many ways to collect formative data on student progress. For instance, short duration, technically adequate measures like Curriculum-Based Measurement (CBM; Foegen, Jiban, & Deno, 2007) can be utilized on a weekly basis. Graphed student data can be examined, comparing student growth to a set goal. If the student is not making the necessary progress, it is important to add to or change the intervention in a quick and meaningful fashion. In the end, the true documentation that an intervention is “evidence based” for a specific case occurs only when there is outcome data indicating a change in the target behavior. Additionally, any EBP should meet indicators for quality, including meeting minimum thresholds for context and setting, participants, intervention, description of practice, fidelity, internal validity, outcome measures, dependent variables, and data analysis (Cook et al., 2015).

Conclusion and Implications for Practice

Finding appropriate EBPs can be a daunting task. In addition to the daily demands and already high expectations placed on educators, finding EBPs can feel like one *more* thing to do. The purpose of selecting EBPs to use with students is to replace *do more* with *do more effectively*. Given instructional time constraints and classroom demands, selecting and implementing EBPs will contribute to a more effective use of planning and instructional time with better anticipated outcomes than one would expect when not implementing EBPs.

In an age where large quantities of information are readily available, navigating the location process for EBPs requires time and some savvy. By reading this article, educators learn to (a) clarify terminology used to describe scientifically based research as it applies to instructional practices and interventions or EBPs, (b) provide educators resources to locate relevant mathematics EBPs through sources that bridge the research to practice gap, and (c) provide resources for evidence-based strategies and promising practices when EBIs are not available.

References

Archer, A., & Hughes, C. (2011). *Explicit instruction: Effective and efficient teaching*. New York, NY: Guilford.

Aspiranti, K. B., Skinner, C. H., McCleary, D. F., & Cihak, D. F. (2011). Using taped-problems and rewards to increase addition-fact fluency in a first grade general education classroom. *Behavior Analysis in Practice, 4*(2), 25-33.

Bliss, S. L., Skinner, C. H., McCallum, E., Saecker, L. B., Rowland-Bryant, E., & Brown, K. S. (2010). A comparison of taped problems with and without a brief post-treatment assessment on multiplication fluency. *Journal of Behavioral Education, 19*, 156-168. doi:10.1007/s10864-010-9106-5

Burns, M. K., Riley-Tillman, T. C., & VanDerHeyden, A. M. (2012). *Advanced RTI applications, Volume 1: Intervention design and implementation.* New York, NY: Guilford.

Cook, B. G., Buysse, V., Klingner, J., Landrum, T. J., McWilliam, R. A., Tankersley, M., & Test D. W. (2015). CEC's standards for classifying the evidence base of practices in special education. *Remedial and Special Education, 36*, 220-234. doi:10.1177/0741932514557271

Cook, B. G., & Cook, S. C. (2013). Unraveling evidence-based practices in special education. *The Journal of Special Education, 47*, 71-82. doi:10.1177/0033466911420877

Cook, B. G., Tankersley, M., Cook, L., & Landrum, T. J. (2008). Evidence-based practices in special education: Some practical considerations. *Intervention in School and Clinic, 44*(2), 69-75. doi:10.1177/1053451208321452

Council for Exceptional Children (2014). *Council for Exceptional Children standards for* *evidence-based practices in special education.* Arlington, VA: Author.

Foegen, A., Jiban, C., & Deno, S. (2007). Progress monitoring measures in mathematics: A review of the literature. *The Journal of Special Education*, *41* (2), 121–139.

Fuchs, L. S., Compton, D. L., Fuchs, D., Paulsen, K., Bryant, J. D., & Hamlett, C. L. (2005). The prevention, identification, and cognitive determinants of math difficulty. *Journal of Educational Psychology, 97*, 493–513. doi:10.1037/0033-0663.97.3.493

Fuchs, L. S., Schumacher, R. F., Long, J., Namkung, J., Hamlett, C. L., Cirino, P. T., …Changas, P. (2013). Improving at-risk learners' understanding of fractions. *Journal of Educational Psychology, 105*, 683-700. doi:10.1037/a0032446

Kretlow, A. G., & Helf, S. S. (2013). Teacher implementation of evidence-based practices in Tier 1: A national survey. *Teacher Education and Special Education, 3*, 167-185. doi:10.1177/0888406413489838

McCallum, E., & Schmitt, A. J. (2011). The taped problems intervention: Increasing the math fact fluency of a student with an intellectual disability. *International Journal of Special Education, 26*, 276-284.

Methe, S. A., Hojnoski, R., Clarke, B., Owens, B. B., Lilley, P. K., Politylo, B. C., …Marcotte, A. M. (2011). Innovations and future directions for early numeracy curriculum-based measurement: Commentary on the special series. *Assessment for Effective Intervention, 36*, 200-209. doi:10.1188/1534508411414154

Montague, M., Enders, C., & Dietz, S. (2011). Effects of cognitive strategy instruction on math problem solving of middle school students with learning disabilities. *Learning Disability Quarterly, 34*, 262-272. doi:10.1177/0731948712463368

Montague, M., Krawec, J., Enders, C., & Dietz, S. (2014). The effects of cognitive strategy instruction on math problem solving of middle school students of varying ability. *Journal of Educational Psychology, 106*, 469-481. doi:10.1037/a0035176

Montague, M., Warger, C. & Morgan, T. H. (2000). Solve It! Strategy instruction to improve mathematical problem solving. *Learning Disabilities Research and Practice, 15*, 110-116. doi:10.1207/sldrp1502_7

Morgan, P. L., Farkas, G., & Wu, Q. (2009). Five-year growth trajectories of kindergarten children with learning difficulties in mathematics. *Journal of Learning Disabilities, 42*, 306-321. doi:10.1177/0022219408331037

Mostert, M. P., (2010). Asserting the fanciful over the empirical: Introduction to the special issue. *Exceptionality*, *18*, 1-5. doi:10.1080/09362830903462409

National Council of Teachers of Mathematics. (2014). *Principles to actions.* Reston, VA: Author.

National Center for Education Statistics. (2015). *2015 Mathematics & Reading Assessments*. Retrieved from: http://www.nationsreportcard.gov/reading_math_2015/#mathematics?grade=4

National Governors Association Center for Best Practices, Council of Chief State School Officers. (2010). *Common Core State Standards Mathematics*. Washington, DC: Authors.

Poncy, B. C., Skinner, C. H., & McCallum, E. (2012). Comparison of class-wide taped problems and cover, copy, and compare for enhancing mathematics fluency. *Psychology in the Schools, 49*, 744-755. doi:10.1002/pits.21631

Powell, S. R., & Fuchs, L. S. (2015). Intensive intervention in mathematics. *Learning Disabilities Research and Practice, 30*, 182-192. doi:10.1111/ldrp.12087

Shalev, R. S., Auerbach, J., Manor, O., & Gross-Tsur, V. (2000). Developmental dyscalculia: Prevalence and prognosis. *European Child and Adolescent Psychiatry, 9*, 58–64. doi:10.1007/s007870070009

Stahmer, A. C., Reith, S., Lee, E., Reisinger, E. M., Mandell, D. S., & Connell, J. E. (2015). Training teachers to use evidence-based practices for autism: Examining procedural implementation fidelity. *Psychology in the Schools, 52*, 181-195.

Wei, X., Lenz, K., & Blackorby, J. (2013). Math growth trajectories of students with disabilities: Disability category, gender, racial, and SES differences. *Remedial and Special Education 34*, 154-165. doi:10.1177/0741932512448253.

Table 1
Vetted Websites for Mathematics Interventions

Name	Location	MD
What Works Clearinghouse	ies.ed.gov/ncee/wwc/findwhatworks.aspx	No interventions specific to students with MD
Best Evidence Encyclopedia	www.bestevidence.org/	No interventions specific to students with MD
National Center on Intensive Intervention	www.intensiveintervention.org/chart/instructional-intervention-tools	All interventions specific to students with MD
Evidence-Based Intervention Network	ebi.missouri.edu/?page_id=983	Some interventions specific to students with MD
The Iris Center	iris.peabody.vanderbilt.edu/ebp_summaries/	Some interventions specific to students with MD

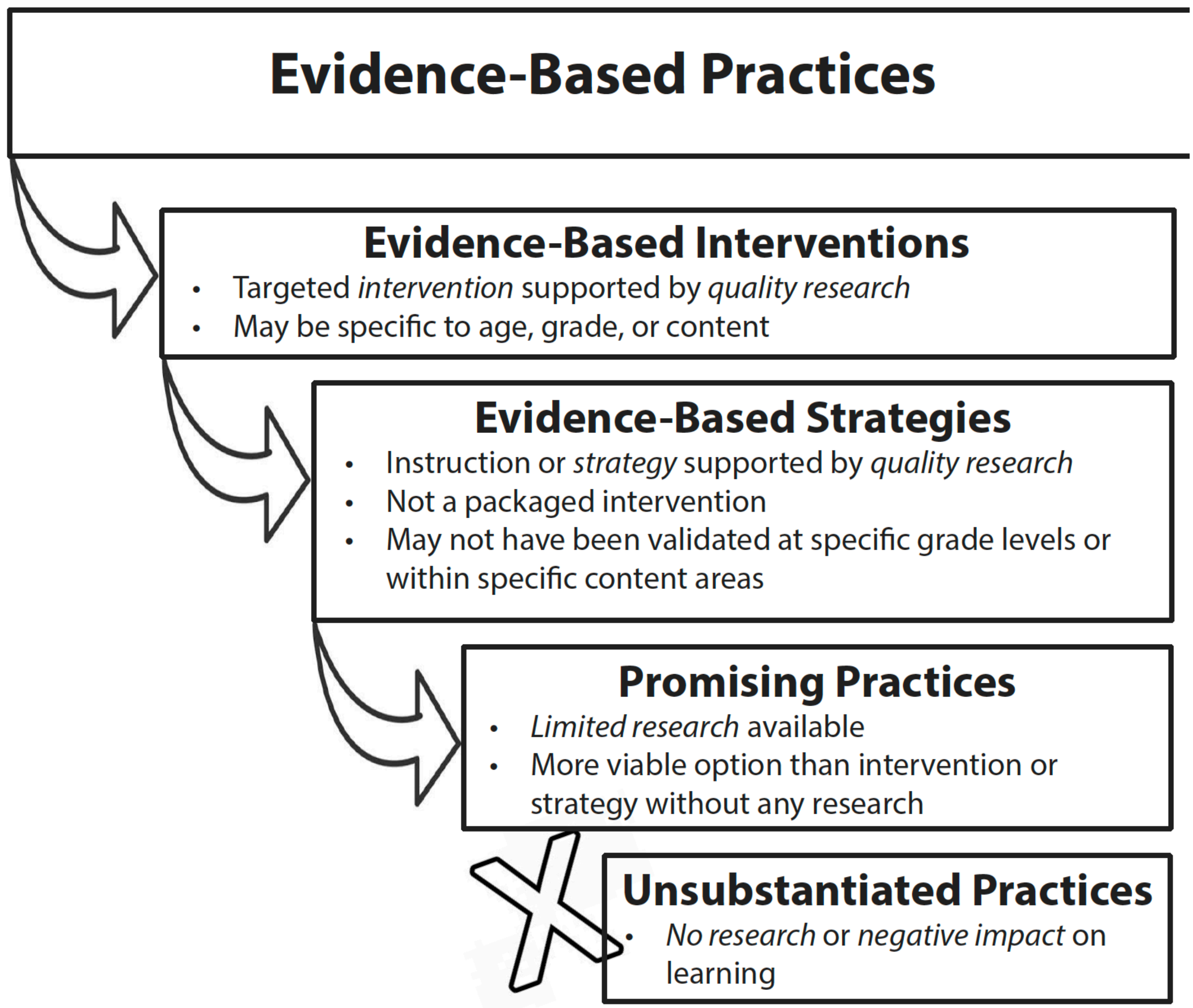


Figure 1. Flow chart to aid decision making for when to use different types of EBPs.

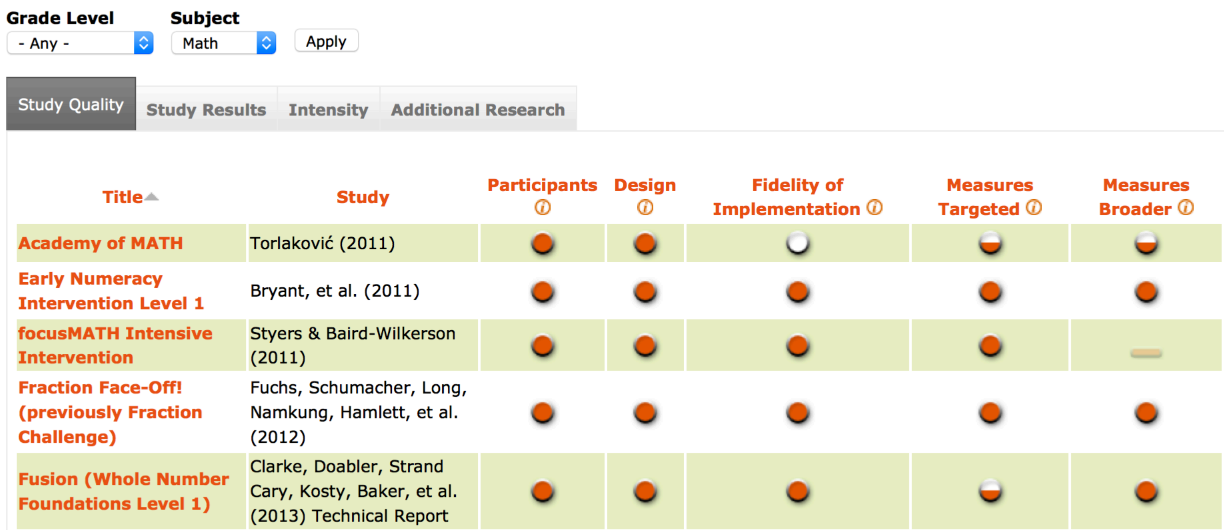
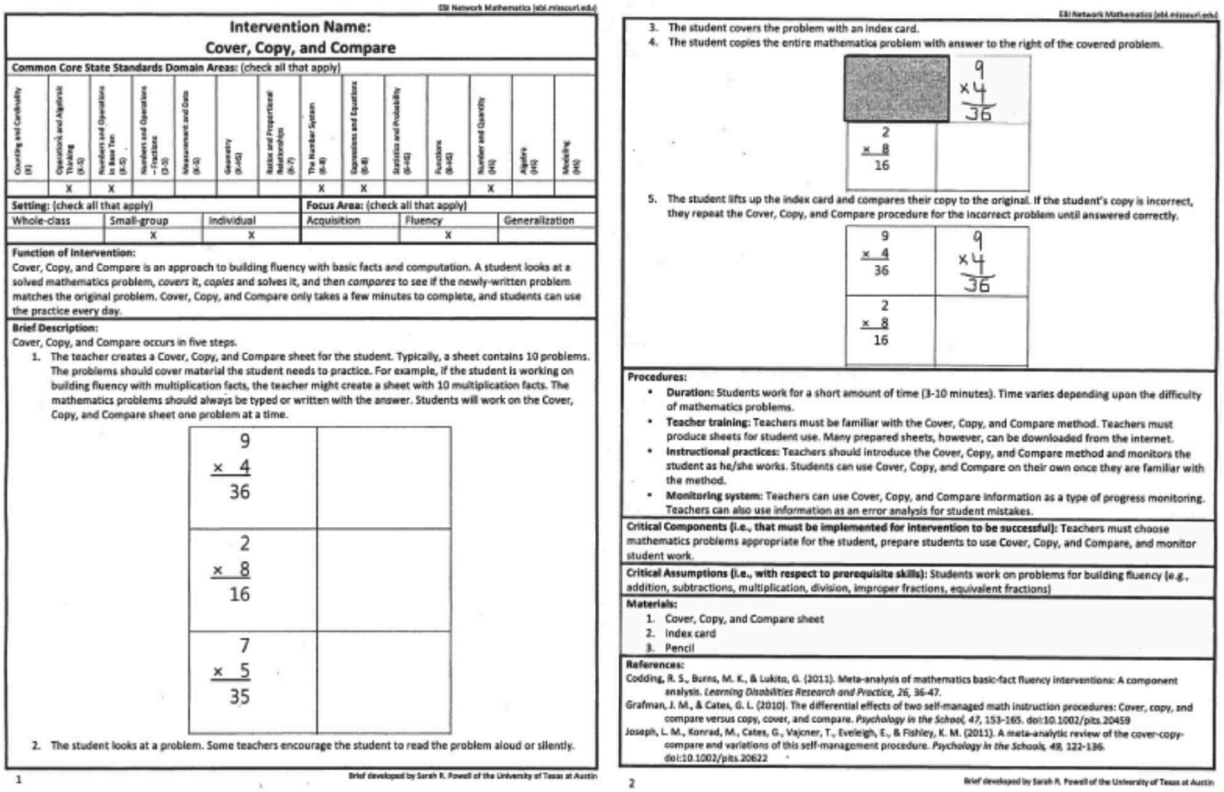


Figure 2. Screenshot of NCII Tools Chart for Mathematics Interventions.



Intervention Name:
Cover, Copy, and Compare

Common Core State Standards Domain Areas: (check all that apply)

Counting and Cardinality (K)	Operations and Algebraic Thinking (K-5)	Numbers and Operations in Base Ten (K-5)	Numbers and Operations – Fractions (3-5)	Measurement and Data (K-5)	Geometry (K-HS)	Ratios and Proportional Relationships (6-7)	The Number System (6-8)	Expressions and Equations (6-8)	Statistics and Probability (6-HS)	Functions (8-HS)	Number and Quantity (HS)	Algebra (HS)	Modeling (HS)
	X	X					X	X			X		

Setting: (check all that apply)			Focus Area: (check all that apply)		
Whole-class	Small-group	Individual	Acquisition	Fluency	Generalization
	X	X		X	

Function of Intervention:
Cover, Copy, and Compare is an approach to building fluency with basic facts and computation. A student looks at a solved mathematics problem, *covers* it, *copies* and solves it, and then *compares* to see if the newly-written problem matches the original problem. Cover, Copy, and Compare only takes a few minutes to complete, and students can use the practice every day.

Brief Description:
Cover, Copy, and Compare occurs in five steps.

1. The teacher creates a Cover, Copy, and Compare sheet for the student. Typically, a sheet contains 10 problems. The problems should cover material the student needs to practice. For example, if the student is working on building fluency with multiplication facts, the teacher might create a sheet with 10 multiplication facts. The mathematics problems should always be typed or written with the answer. Students will work on the Cover, Copy, and Compare sheet one problem at a time.

9 × 4 = 36	
2 × 8 = 16	
7 × 5 = 35	

2. The student looks at a problem. Some teachers encourage the student to read the problem aloud or silently.

3. The student covers the problem with an index card.
4. The student copies the entire mathematics problem with answer to the right of the covered problem.

(covered)	9 × 4 = 36
2 × 8 = 16	

5. The student lifts up the index card and compares their copy to the original. If the student's copy is incorrect, they repeat the Cover, Copy, and Compare procedure for the incorrect problem until answered correctly.

9 × 4 = 36	9 × 4 = 36
2 × 8 = 16	

Procedures:

- **Duration:** Students work for a short amount of time (3-10 minutes). Time varies depending upon the difficulty of mathematics problems.
- **Teacher training:** Teachers must be familiar with the Cover, Copy, and Compare method. Teachers must produce sheets for student use. Many prepared sheets, however, can be downloaded from the internet.
- **Instructional practices:** Teachers should introduce the Cover, Copy, and Compare method and monitors the student as he/she works. Students can use Cover, Copy, and Compare on their own once they are familiar with the method.
- **Monitoring system:** Teachers can use Cover, Copy, and Compare information as a type of progress monitoring. Teachers can also use information as an error analysis for student mistakes.

Critical Components (i.e., that must be implemented for intervention to be successful): Teachers must choose mathematics problems appropriate for the student, prepare students to use Cover, Copy, and Compare, and monitor student work.

Critical Assumptions (i.e., with respect to prerequisite skills): Students work on problems for building fluency (*e.g.*, addition, subtractions, multiplication, division, improper fractions, equivalent fractions)

Materials:

1. Cover, Copy, and Compare sheet
2. Index card
3. Pencil

References:
Codding, R. S., Burns, M. K., & Lukito, G. (2011). Meta-analysis of mathematics basic-fact fluency interventions: A component analysis. *Learning Disabilities Research and Practice, 26*, 36-47.
Grafman, J. M., & Cates, G. L. (2010). The differential effects of two self-managed math instruction procedures: Cover, copy, and compare versus copy, cover, and compare. *Psychology in the School, 47*, 153-165. doi:10.1002/pits.20459
Joseph, L. M., Konrad, M., Cates, G., Vajcner, T., Eveleigh, E., & Fishley, K. M. (2011). A meta-analytic review of the cover-copy-compare and variations of this self-management procedure. *Psychology in the Schools, 49*, 122-136. doi:10.1002/pits.20622

Figure 3. Example of EBI network for cover, copy, and compare.

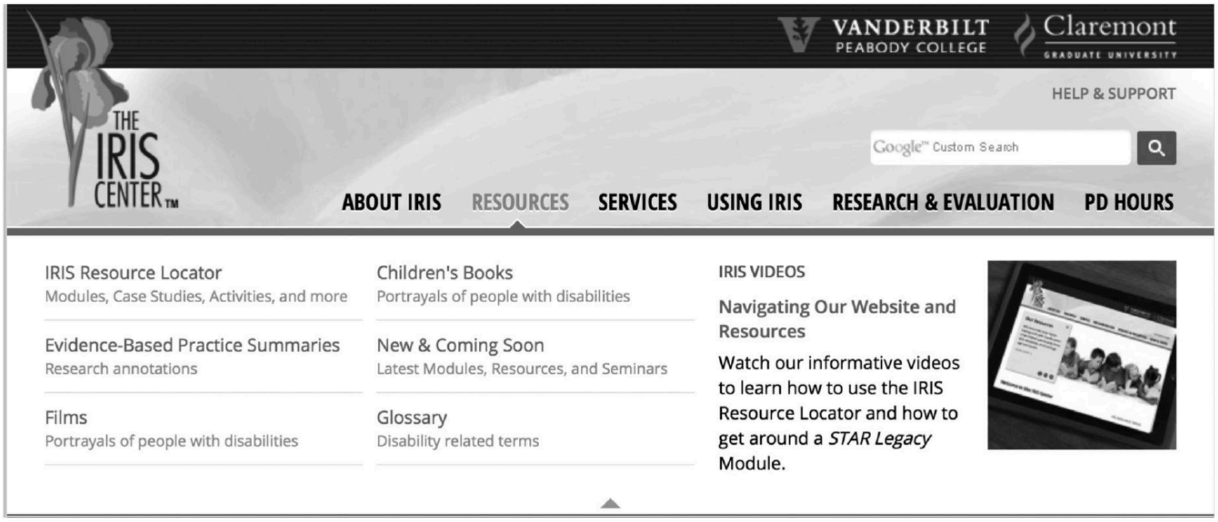


Figure 4. Screenshot of IRIS center resources.