Identifying Evidence-Based Special Education Interventions From Single-Subject Research

Jennifer Freeman and George Sugai

Special educators are aware of the need to use evidence-based academic and behavioral interventions in their classrooms. Using research to guide decision making in the classroom—whether at the program, school, or district level—can help ensure students are effectively served. A second-grade resource room teacher, Mark, struggles with managing the behavior of several students who have trouble staying on task and completing work. Cindy, a middle school special education teacher, teaches a self-contained program and is looking for a way to teach writing skills to a seventh-grade student with a learning disability. How can Mark and Cindy find out about best practices, and read reviews or summaries of recent studies? Currently, there is no rigorous and comprehensive database to support educators. It also can be difficult for teachers, schools, and policy makers to interpret the results of research. Despite the limitations in currently available resources, there are ways for special education teachers and administrators to identify evidence-based practices that fit their specific contexts.

The most recent authorizations of the Individuals With Disabilities Education Act (IDEA, 2006) and the No Child Left Behind Act of 2001 (2006) provide a mandate for the use of evidence-based practices (EBPs) in the areas of academic and behavioral education (20 U.S.C. § 1414[b][6][B], 20 U.S.C. § 7801[37]). However, the lack of a clear understanding of what EBPs are and the difficulty finding EBPs that address the specific needs of students can be frustrating for many teachers and administrators. In response, educational researchers have attempted to evaluate the current research base and to define clear criteria for determining EBPs (Odom et al., 2005). However, the body of educational research in special education is extremely varied in both methodology and quality, often leaving special education teachers with the very difficult task of identifying and evaluating EBPs without clear criteria.

In order to address this issue, the U.S. Department of Education created the What Works Clearinghouse (WWC) as a resource for teachers. In addition, several other agencies, such as the Council for Exceptional Children (CEC), the American Psychological Association (APA), and the Promising Practices Network (PPN), also have attempted to bring together research results in a concise, user-friendly way for educators. Each organization has developed criteria for determining EBPs, and their web sites provide quick and easy access to EBPs for specific categories of students. However, differing criteria, a mismatch between current research practices and EBP standards, and limited access to specific research studies limit the usefulness of these resources for special

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education teachers. In particular, prior to 2010 the WWC prioritized randomized group design studies and excluded from consideration the results of studies using single-subject designs. This practice was particularly problematic for special educators due to the prevalence of single-subject designs in special education research (Horner et al., 2005).

In 2010, the WWC announced standards that included criteria for identifying EBPs through the use of single-subject research (Kratochwill et al., 2010), and both the CEC and APA have also developed standards. However, the WWC standards do not yet align with the current standard of practice in the field of special education. Consequently, few special education practices meet both WWC design and evidence standards.

Identifying Evidence-Based Practices

Table 1 provides a comparison of several web-based resources to assist special educators looking for EBPs. However, to benefit from these resources, educators must be critical consumers; the sites use varying criteria to evaluate the design standards and effects of single-subject research. In order to be able to evaluate practices based on single-subject research, educators must be fluent with the purpose and characteristics of single-subject research designs and the guidelines for evaluation and interpretation of that research.

Recognizing Well Designed Single-Subject Research

To judge the usefulness and strength of the results and implications from single-subject research, educators must understand the specific methods used, the strengths, and the limitations of single-subject research designs. Single-subject design studies are distinguished by several key characteristics:

- The individual case (individual or group of individuals), rather than a group, is the unit of analysis.
- The individual case serves as his or her own control.
- The researcher conducts frequent and repeated observations and measures outcomes over time to assess changes in level, trend, variability, and immediacy of the intervention effect across differing conditions (e.g., participants, settings).

Despite the strengths of single-subject research for special education (see box, "Strengths of Single-Subject Research"), determining what is and is not an EBP based on single-subject research can be difficult, because there is no standardized method for synthesizing results (Conroy, Dunlap, Clarke, & Alter, 2005; Mooney, Epstein, Reid & Nelson, 2003). Single-subject research designs identify causal relationships between an intervention and an observed effect in a specific setting and context and with a specific individual. Generalizable statements to larger populations of individuals are difficult to make from single-subject research.

Systematic and repeated demonstration of the effect of the intervention is a key requirement for establishing a causal relationship between an intervention and an observed effect. In single-subject research these replications occur across individual students, settings, or conditions. Common single-subject designs include ABAB, alternating treatment, or multiple baseline designs. The goal is to control and account for internal threats to validity such as practice effects or an outside event that may affect the outcomes.

Table 1. Web Resources for Identifying Evidence-Based Practices

Features	Resource			
	What Works Clearinghouse http://ies.ed.gov/ncee/wwc/	Council for Exceptional Children http://www.cec.sped.org	American Psychological Association http://www.apa.org/education/k12/index.aspx	Promising Practices Network http://www.promisingpractices.net/
Design standards for SSR published and available	X	X	X	*group designs only*
Design standards matched to current research practices		X	X	
Evidence standards for SSR published and available	X	X	X	*group designs only*
Provides links to intervention descriptions	X	X		X
Provides links or references to research used for determinations	X	*only includes research commissioned by CEC*		
Fee required		X		

Note. SSR = single-subject research.

Traditionally, the effects of single-subject research are evaluated using **visual analysis**. Researchers graph and evaluate outcome data for changes in trend (direction), level (mean/median level), and variability (fluctuation) within and across phases. Because decision rules have not been sufficiently tested and established to guide visual analysis and interpretation of single-subject research data, inaccurate, inconsistent, or limited interpretations can result.

In addition to visual analysis, single-subject researchers often calculate an **effect size,** typically reported in standardized units that make comparisons of effect easier across studies and participants. The most prevalent reported effect size involves an examination of non-overlapping data points (54.65%) followed by a calculation of the standardized mean difference (18.6%; Maggin, 2011). There is currently no agreed-upon method for calculating an effect size in single-subject research, which makes it difficult to synthesize research results.

In sum, single-subject research designs have a number of strengths and useful characteristics that make them appealing to conducting studies that identify EBPs in special education. However, because of (a) a reliance on visual analysis procedures, (b) a lack of an effect size metric and methodology, and (c) a need for standardized criteria for effective implementation and interpretation, special educators also need guidance on how to systematically evaluate the existing research evidence base.

Evaluating and Interpreting Research

Given the significant but insufficient advances associated with using single-subject research methodologies to identify EBPs, teachers and administrators require additional guidance as they attempt to interpret research and judge practices that are examined with single-subject research methods. Table 2 lists six steps to guide decision making; Figure 1 illustrates how to evaluate and implement interventions.

1. Identify the Problem. The first step in the decision-making process is to have a specific, measurable, and complete identification of the problem or need. After determining whether the primary area of concern is academic, social, or both, assess

- The nature of the problem (frequency, duration, intensity, etc.).
- The context in which it is occurring (instructional curriculum, environmental conditions, etc.).
- Characteristics of the learner (disabilities, learning history, etc.).
- Other factors that might affect intervention responsiveness and effectiveness.

This specification would also include stating what a successful outcome would look like if an effective intervention could be identified. A variety of formal and informal assessment tools and procedures exist to structure this specification and identification step.

For Mark, the process of clearly identifying the problem included writing a clear description of each problem behavior, keeping a record of the frequency of these behaviors, as well as the time and the activity that was going on when the problem behaviors occurred. Cindy needed information about the specific part of the writing process that was proving difficult for her student. Using curriculum-based measurement tools, she was able to determine that her student needed specific instruction on spelling and grammar.

2. Identify Possible Interventions. After establishing an understanding of the problem, need, and context, the next step is to identify a list of intervention practices that might address the intended outcome. Although the utility and comprehensiveness of the WWC is not currently sufficient with respect to special education EBPs, it is an excellent starting place because of (a) high acceptability standards, (b) detailed procedural descriptions, (c) access to supporting research, and (d) thorough research reviews. An EBP selection made at the WWC is supported by high research standards and can be used with confidence by special educators; however, the number and/or range of choices might be limited.

Although Mark and Cindy both began their search for EBPs at the WWC web site, neither was able to find an EBP that had been rated effective for the special education populations and problems they needed to address. They continued their search by looking at the CEC, APA, and PPN databases, and general Internet searches. Both teachers put together a short list of intervention ideas but needed to learn more about the evidence base behind them. Mark's list included interventions such as student self-monitoring (Briere & Simonsen, 2011; Reid, Trout, & Schwartz, 2005) and greeting students and providing a behavioral prompt prior to the start of class (Allday & Pakurar, 2007; Simonsen, Fairbanks, Briesch, Myers, & Sugai, 2008). Cindy was interested in the use of peer tutoring to improve her student's spelling and grammar (Burks, 2004).

Strengths of Single-Subject Research

Single-subject designs are ideal for the field of special education for several reasons (Horner et al., 2005). First, in special education the number of students with specific disabilities is relatively small, making large group design studies more difficult and often impractical. Second, in single-subject research designs, researchers are able to examine the specific conditions under which a particular student is responding to an intervention. Having specific information at the individual student level is critical in special education for the delivery of individualized intervention plans and evaluation of student outcomes. Finally, students with disabilities have a diverse range of learning characteristics, and single-subject research designs allow individual students to serve as their own controls.

3. Consider the Target Population. After increasing the specification of the problem or need, and identifying a list of possible interventions, consider the fit between the target population and the intervention:

- Was the intervention designed for a student or group of students that share the characteristics of the target population?
- How difficult might it be to generalize the findings from the research subjects to the target population of students?
- How similar/different is the research setting from the setting where the intervention will be implemented?
- Can the intervention be adapted to the characteristics (e.g., learning, cultural, linguistic) of the target population of students?

Mark explored the research related to both intervention practices and discovered that the research in both cases was conducted with middle school students. He decided that self-monitoring might not be a good match for his second-graders, but that greeting and prompting students at the beginning of a class period might be a good fit for his younger group. Cindy discovered that the research on peer tutoring was conducted with fifth-graders with learning disabilities, and decided this would be a good match for her seventh-grade student who was several years behind in writing skills.

4. Consider the Scope of the Decision. The size of the research base should match the level of the decision being considered. Large-scale decisions—such as adopting a new evidence-based intervention for an entire special education program—are more difficult to change and require more resources than individual-level interventions. Special education teachers have more freedom and opportunities to change with individual and small-group intervention decisions. With program- and schoolwide decisions, the stakes are higher, and educators must have the most and best empirical evidence to support their intervention decisions, which also might include group design studies, general education or other students, and program-level intervention evaluations. When making school- or program-level decisions, educators should consider:

- Does the design of the research study or studies demonstrate a clear relationship between the intervention and the effect?

Table 2. How to Identify Evidence-Based Practices From Single-Subject Research

Step	What To Do
1. Identify the problem	Clearly identify an area of academic or social need, using reliable and valid assessments.
2. Identify possible interventions	Identify a list of possible intervention practices related to the specific need and the research articles associated with those practices.
3. Consider the target population	Determine if the research studies were conducted with populations with similar characteristics to the target population.
4. Consider the scope of the decision	Match the size of the research base to the level of decision (classroom, school, or program level).
5. Consider the quality of the research design.	Assess the evidence of effect for the studies in the research literature base; design should allow for the determination of causal relationship between intervention and outcome(s).
6. Consider the effect of the intervention.	Assess the extent to which the observed effects can be attributed to the intervention.

- Has the effect of the intervention been demonstrated in a variety of settings wide enough with a variety of participants to support a range of practice uses?
- Is the total research evidence base sufficient enough to support high stakes decision making related to large numbers of students or severe problem need?

Both Mark and Cindy were looking for intervention practices to use at the classroom level, so an individual study with positive results was an appropriate evidence base from which to start. Mark also was reassured to see the results of a literature review (Simonsen et al., 2008) that indicated that providing prompts to students prior to behavioral difficulties was an effective strategy. This finding allowed Mark to feel more confident that the results from the middle school study might generalize to his second graders.

5. Consider the Quality of the Research Design. Educators must focus their attention on the research designs and the evidence of effect for each of the studies in the research literature base. Examining design standards prior to evidence of effects is important because the value of the evidence of effects is directly linked to the quality of the design and integrity of the analysis.

- Are student characteristics described in sufficient detail to enable comparisons with target population?

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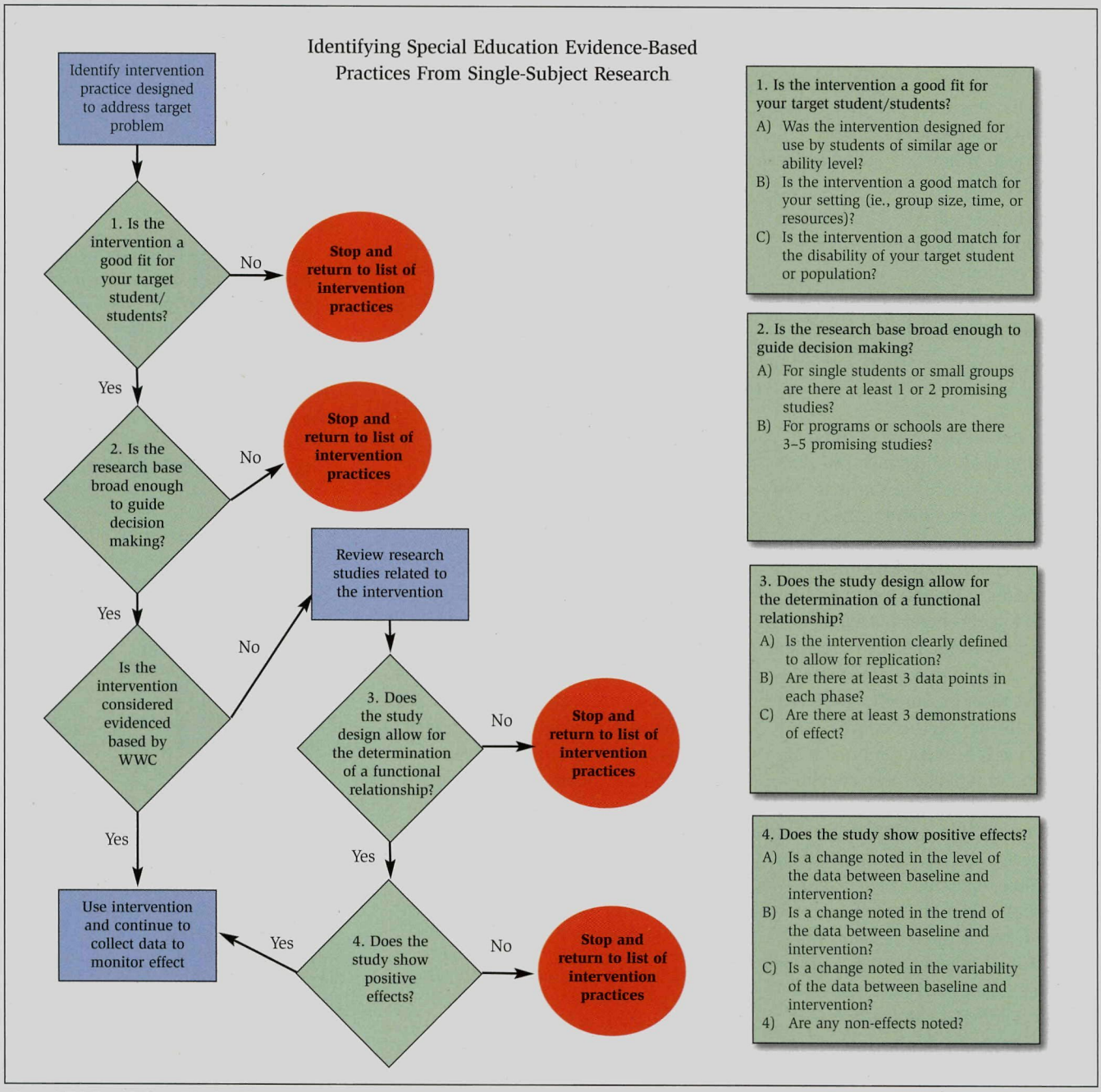
- Are descriptions of the setting and intervention specific and detailed?
- Are instructions and procedures for implementing a practice or intervention detailed enough to support direct replication?
- Are data collection procedures described in sufficient detail to enable data collection in the applied setting?

Additionally, evaluate the design to see if it allows for the determination of causal relationship between the intervention and the outcomes. Although the standards of the WWC are higher, the consensus in the research community is that studies must have at least three data points in each phase and allow for at least three demonstrations of effect in order to clearly show a functional relationship between the intervention and the outcome. The most common ways to demonstrate this functional relationship is using withdrawal/reversal (ABAB) designs or multiple-baseline designs (Hammond & Gast, 2010). In an ABAB design, educators should look for a clear baseline–intervention–baseline–intervention pattern. In a multiple-baseline design, demonstrations of effect can take place across settings or participants. Phase changes should occur at different points in time. Studies that are designed to allow for at least three demonstrations of effect can be used to determine the presence of a causal relationship between the intervention and the outcome. Educators should feel comfortable that the demonstrated effects are a direct result of the intervention, rather than some other variable or event.

The student characteristics and intervention descriptions were described explicitly for both Mark's prompting strategy and Cindy's peer-tutoring strategy and both teachers felt confi-

Figure 1. Evaluating and Implementing an Intervention



Note. WWC = What Works Clearinghouse.

dent that they could replicate the strategies in their classrooms. Next, Mark and Cindy evaluated the design of each of their studies. Mark's study was a clear multiple-baseline single-subject design. In each case there were at least three data points per phase and the design allowed for three demonstrations of effect. Mark felt confident that this study would allow him to determine if this intervention resulted in changes in the students' behavior. Cindy's study on peer tutoring was slightly different. It was an ABA design where baseline data was collected prior to and after the strategy implementation. Although the article reported at least three data points per phase, because the study design did not include a second intervention phase that would allow for a third demonstration of effect Cindy was not able to confidently determine if the reported results are a direct function of the intervention. Cindy could not consider peer tutoring an EBP based on this study.

6. Consider the Effect of the Intervention. In the final step, examine the effects of the intervention, in particular the extent to which the observed effects could be attributed to the intervention and whether the size of the effects is educationally important or relevant. As indicated, single-subject researchers rely on visual analysis procedures primarily and statistical tests

secondarily (Maggin, 2011) to judge the effects of the intervention. Consider:

- Are graphs prepared accurately, appropriately, and clearly?
- Are changes in level, trend, variability, and immediacy of effect described within and across phases adequately?
- Are changes aligned with the introduction of or manipulation of the intervention?
- Is the effect of intervention demonstrated sufficiently?
- Do statistical test results support the visual analysis descriptions?

Mark reviewed the results from the prompting study and concluded that for all three students in the study the prompting intervention resulted in clear and positive effects on the students' behavior. He decided to try the intervention in his classroom and monitor the effects for his students. Cindy reviewed the results of the peer-tutoring study and also determined that the effects for students were clear and positive for all the students although graphs were not provided, and she had to make these conclusions from individual data points and means reported in a table. Because the study design did not clearly allow for three demonstrations of effect, she was not confident that the results that were reported were a direct result of the peer-tutoring intervention. Because she was making an individual student-level decision and she felt that peer tutoring might be motivating for her student, Cindy decided to try the intervention while carefully monitoring her student's progress. In addition, she decided to return to the research to see if she could find a strategy with an evidence base she could be more confident about for her student.

Final Thoughts

Regardless of whether a strong or weak research database exists, special educators must be smart consumers. Regardless of their confidence in their EBP decisions, educators also must continuously monitor their intervention implementation fidelity and student responsiveness to the intervention. Implementation of every intervention can be "tweaked" to improve its effectiveness over time, and the responsiveness of every student can change over time and conditions.

Mark and Cindy were both able to make informed decisions about EBP for their classrooms despite the fact that the body of special education research is varied and clear standards for EBP are not yet clearly defined. Several organizations have attempted to compile intervention resources on a large scale; however, at this time none of these is mature enough to serve as a primary comprehensive and practical guide for special educators. Single-subject research designs and studies can be a valuable tool for guiding the selection of EBP, even though standards for evaluating interventions and outcomes based on single-subject research designs have not been established (Horner et al., 2005). Special educators can improve their identification of EBP by having solid background knowledge about the purpose, characteristics, and requirements of single-subject research designs; and a systematic process to guide their evaluation of single-subject research design, quality, and demonstrations of meaningful effects.

References

Allday, R. A., & Pakurar, K. (2007). Effects of teacher greetings on student on-task behavior. *Journal of Applied Behavior Analysis, 40*, 317–320. http://dx.doi.org/10.1901/jaba.2007.86-06

Briere, D. E., III, & Simonsen, B. (2011). Self-monitoring interventions for at-risk middle school students: The importance of considering function. *Behavioral Disorders, 36*, 129–140.

Burks, M. (2004). Effects of classwide peer tutoring on the number of words spelled correctly by students with LD. *Intervention in School & Clinic*, 39, 301–384. http://dx.doi.org/10.1177/10534512040390050701

Conroy, M. A., Dunlap, G., Clarke, S., & Alter, P. J. (2005). A descriptive analysis of positive behavioral intervention research with young children with challenging behavior. *Topics in Early Childhood Special Education, 25*, 157–166. http://dx.doi.org/10.1177/02711214050250030301

Hammond, D., & Gast, D. L. (2010). Descriptive analysis of single-subject research designs: 1983–2007. *Education and Training in Autism and Developmental Disabilities, 45*, 187–202.

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children, 71*, 165–179.

Individuals With Disabilities Education Act, 20 U.S.C. § 4301 *et seq.* (2006).

Kratochwill, T. R., Hitchcock, J. J., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D., & Shadish,W.R. (2010, June). *Single-case design technical documentation: Version 1.0 (Pilot)*. Washington, DC: Institute of Education Sciences, What Works Clearinghouse. Retrieved from http://ies.ed.gov/ncee/WWC/documentsum.aspx?sid=229

Maggin, D. (2011, February 14). *Identifying evidence through synthesis of single-subject research* [PowerPoint slides]. University of Connecticut, Storrs.

Mooney, P., Epstein, M. H., Reid, R., & Nelson, J. R. (2003). Status of and trends in academic intervention research for students with emotional disturbance. *Remedial and Special Education, 24*, 273–287. http://dx.doi.org/10.1177/07419325030240050301

No Child Left Behind Act of 2001, 20 U.S.C. § 6301 *et seq.* (2006).

Odom, S. L., Brantlinger, E., Gersten, R., Horner, R. H., Thompson, B., & Harris, K. R. (2005). Research in special education: Scientific methods and evidence-based practices. *Exceptional Children*, 71, 137–148.

Reid, R., Trout, A. L., & Schwartz, M. (2005). Self-regulation interventions for children with attention deficit/hyperactivity disorder. *Exceptional Children, 71*, 361–377.

Simonsen, B., Fairbanks, S., Briesch, A., Myers, D., & Sugai, G. (2008). Evidence-based practices in classroom management: Considerations for research to practice. *Education and Treatment of Children, 31*, 351–380. http://dx.doi.org/10.1353/etc.0.0007

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