Educ. Treat. Child. (2020) 43:85–94
https://doi.org/10.1007/s43494-020-00007-1

ORIGINAL ARTICLE

# SRSD Fractions: Using Self-Regulated Strategy Development to Support Students' Conceptual and Procedural Fraction Knowledge

**Robin Parks Ennis** · **Mickey Losinski**

Published online: 14 February 2020


**Abstract** Fractions are a cornerstone skill for student success in higher-level mathematics and many practical skills. However, most students do not have proficient fraction conceptual or computational knowledge. Effective and efficient interventions are needed to remediate these skills, especially for students with or at-risk for disabilities. We present a curricular overview of a self-regulated strategy development (SRSD) framework, *SRSD Fractions*. *SRSD Fractions* addresses adding and subtracting fractions with unlike denominators, simplifying fractions, and converting fractions to mixed numbers. We summarize research on *SRSD Fractions* and lessons learned, including implications for future research and practice, especially for students with comorbid behavior and academic challenges.

**Keywords** Emotional and behavioral disorders · EBD · Fractions · Mathematics · Self-regulated strategy development · SRSD

R. P. Ennis (✉)
University of Alabama at Birmingham, EB122 1720 2nd Avenue South, Birmingham, AL 35294, USA
e-mail: rennis@uab.edu

M. Losinski
Kansas State University, 306 Bluemont Hall, Manhattan, KS 66506, USA
e-mail: mlosins@ksu.edu

## Introduction

Mathematics proficiency is a vital component of science, technology, engineering, and mathematics (STEM) education. However, on the most recent National Assessment of Educational Progress (NAEP 2015), 69% of 8th-grade students with disabilities performed below the basic level in mathematics. These outcomes are even more disheartening for individuals with disabilities. Researchers have found that students with emotional and behavioral disorders (EBD) struggle with mathematics achievement compared to their peers (e.g., Anderson et al. 2001; Trout et al. 2003). Often students with EBD have insufficient access to the general education curriculum in mathematics given their placement in more restrictive educational settings (Jackson and Neel 2006).

To build a student's ability to perform well in algebra, the National Mathematics Advisory Panel (NMAP 2008) describes the "critical foundations" (p. 20) of mathematics: number sense, fractions, geometry, and measurement. Fractions, the target of the *SRSD Fractions* intervention, refer to the segmentation of whole numbers represented by traditional fractions, decimals, and percentages as well as the ability to apply basic arithmetic models (NMAP 2008). In this article we discuss an overview of research-based fractions instruction, explore targeted strategy instruction, provide an overview of the *SRSD Fractions* framework, and highlight lessons learned and future directions.

## Fractions Instruction

In 2010, a team of researchers led by Robert Siegler developed the What Works Clearinghouse (WWC) practice guide on *Developing Effective Fractions Instruction for Kindergarten through 8th Grade*. Five recommendations were identified for promoting fluency in fractions, including (1) building on background knowledge of sharing and proportions to develop fraction concepts, (2) recognizing fractions are numbers that fall along a number line just like whole numbers, (3) understanding the validation for computations with fractions, (4) understanding various strategies for solving problems (e.g., rate, ratio, proportion), and (5) improving school personnel's knowledge of fractions and how best to teach them (Siegler et al. 2010). Researchers suggest that conceptual understanding of fractions (e.g., recognizing fractions on a number line, understanding the relationship between numerators and denominators, understanding fractions as division) is essential to success with fraction computation and in higher-level mathematics (Jordan et al. 2017; Woodward 2017). Because of the interconnectedness of conceptual and computational knowledge, measurement of fractions is a complex task, as computation and problem solving are nearly impossible to decouple (Fuchs et al. 2008). Researchers and teachers alike have accomplished this by assessing both process and outcomes related to fraction computation.

Recently, comprehensive literature reviews have been conducted on the evidence for mathematics instruction for students with emotional and behavioral disorders (EBD) and fractions interventions for students with disabilities. In the first review (Losinski et al. 2019a), 17 studies targeting a variety of mathematics skills (e.g., fractions, algebra, word problems) were found with only four of the studies meeting all quality indicators (Council for Exceptional Children [CEC] 2014) for evidence-based research, and effect-size calculations suggested large effects across all studies. The second, a meta-analysis of fraction interventions for students with or at-risk for mathematics disabilities (Ennis and Losinski 2019), resulted in 21 studies including 1804 students. Although only 10 of these studies met all CEC quality indicators, results from the review suggest positive results for explicit instruction, graduated instruction, and strategy instruction as well as mixed results for anchored instruction.

## Self-Regulated Strategy Development

Strategy instruction is one approach noted to improve students' fraction outcomes (e.g., Test and Ellis 2005; Zhang et al. 2016). One strategy approach, self-regulated strategy development (SRSD; Harris and Graham 1996) has been shown to be an effective method for remediating reading (e.g., Mason 2013) and writing (Ennis and Jolivette 2014a; Losinski et al. 2014) in students with disabilities and has shown promise in mathematics (Case et al. 1992; Cassel and Reid 1996; Cuenca-Carlino et al. 2016; Ennis and Losinski in press; Losinski et al. 2019b; Losinski et al. in press) for students with or at-risk for disabilities, including specific learning disabilities (SLD), EBD, autism, and attention deficit hyperactivity disorders (OHI-ADHD). SRSD targets a student's strengths and deficits through explicit instruction in the skills and strategies needed to accomplish a task.

Building on behavioral and social cognitive theories, SRSD combines explicit instruction for strategy acquisition and self-regulation (i.e., goal setting, self-monitoring, self-instruction, self-reinforcement) into one cohesive framework (Mason et al. 2012). These self-regulation strategies are important for all students but are essential to students with challenging behaviors as students can use these skills to persevere when a task is difficult (Losinski et al. 2014). Goal setting involves setting goals to use the strategy or make performance improvements at each subsequent section. Self-monitoring involves determining whether or not a behavior has occurred and recording this occurrence (Menzies et al. 2009). This can be very helpful as students work through multistep tasks and need to keep track of steps completed and what step comes next. Finally, self-reinforcement involves celebrating one's progress toward goals. This can be done through positive self-talk or earning a reinforcer for meeting a goal (e.g., I will celebrate using the strategy on all problems by getting a drink of water from the water fountain). The components of self-regulation are embedded throughout all stages of instruction. Further, these self-regulation strategies are regularly used to support the academics, behavior, and social needs of students with EBD, making SRSD a logical strategy for this unique population (Ennis et al. 2014).

Instruction involves six strategy-acquisition stages: developing background knowledge, discussing the strategy, modeling the strategy, memorizing the strategy,

**Table 1** SRSD fractions stages

| Stage | Overview | Targeted SRSD Fractions Activities |
|---|---|---|
| Developing Background Knowledge | - Discuss relevant vocabulary necessary to complete fractions computation.<br>-Verify students possess necessary pre-skills to use the strategy.<br>-Establish classroom expectations to facilitate student success during the activity. | - Review the terms denominator, numerator, whole, least common multiple, greatest common factor.<br>-Verify students can both identify each part of a fraction and conceptually understand what each represents.<br>- Use visuals (e.g., number line) and manipulatives (e.g., fraction tiles) to demonstrate essential topics.<br>- Evaluate baseline/pretest math probes.<br>- Establish expectations such as: talk in a low voice to your table mates, raise your hand to solicit help from the teacher. |
| Discussing the Strategy | - Explain to students they will be learning a strategy to help them remember all steps.<br>-Discuss the benefits of learning a strategy, conveying enthusiasm.<br>-Sign a learning contract committing to work together to learn the strategy.<br>-Model the strategy – including selfstatements, goal setting, and selfmonitoring.<br>-Introduce lesson materials. | -Discuss what a strategy is and have students provide examples of other strategies they use and how they help them learn or do other things successfully.<br>-Review the mnemonic – linking to other memory devices they may already employ.<br>-When introducing the mnemonic review the FILMS analogy for the scale of a movie (or CUT - the director yells cut, EDIT – post-filming editing).<br>-Sign a contract with the students – for students with and at-risk for EBD, consider identifying a reinforcer to earn at the conclusion.<br>-Walk through each step, showing all of your work (e.g., listing factors/multiples, setting up new fractions).<br>-Model using the checklist, introducing other supports as needed. |
| Modeling the Strategy | - Model each step of fractions computation using think-aloud, selfinstructions, goal setting, selfmonitoring.<br>-Model the process of checking off each step on the strategy checklist. | -Self-instructions include both self-questioning ("Did I find the least common denominator?") and self-praise ("I used all my steps to solve the problem!").<br>-Use cue cards (or other supports) to involve students in each step while modeling.<br>-Set goals to use the strategy to improve or maintain performance from prior sessions. A suggested goal is to use the strategy to complete all 10 problems (or fewer if time allows for the completion of less problems).<br>-Prompt students to shade film reels (similar to writing rockets) for each problem on which they used the strategy. |
| Memorizing the Strategy | -Provide frequent opportunities to practice and memorize the steps.<br>-Facilitate students' memorization of both the steps and what they mean. | -Begin and end most lessons with opportunities to practice memorizing strategy steps through silent self-checks, partner quizzing, or written assessment. |
| Supporting the Strategy | Facilitate students' practice of the strategy steps by providing opportunities for collaborative practice and scaffolding. | -Provide opportunities for students to model the steps for one another (e.g., each student chooses a different problem to model).<br>-Provide individualized support as needed.<br>-Support students with accommodations as needed (e.g., a multiplication chart).<br>-Model different approaches to solving problems using the checklist, graphic organizer, cue cards. |
| Independent Performance | -Verify students can use the strategy independently and without prompting.<br>-Emphasize to students that they can use the strategy to complete problems outside of the small group setting (e.g., at home, on standardized tests). | -Encourage students to put away their materials and, if needed, list the strategy letters at the top of the page to serve as a prompt to complete all steps.<br>-Discuss activities such as cooking, measurement, algebra, geometry, chemistry, physics. |

guided practice, and independent performance (Harris and Graham 1996; see Table 1). Each stage is recursive with most lessons involving multiple stages. SRSD has improved academic outcomes for students while also improving their motivation and self-efficacy to perform academic tasks (e.g., Ennis and Jolivette 2014b). SRSD meets all the WWC practice recommendations for fractions instruction and can be implemented across instructional settings (i.e., class-wide, in small groups, or one-on-one; Harris et al. 2008). Therefore, SRSD can function as a universal Tier I, Tier II, or Tier III intervention.

The use of SRSD with mathematics in the research literature, though supported by only a few investigations, holds promise. Studies have investigated word problems (Case et al. 1992; Cassel and Reid 1996) and algebraic concepts (Cuenca-Carlino et al. 2016). The purpose of this article is to explore a program designed to support students' fraction knowledge—conceptual and procedural. This program overview will discuss the components of *SRSD Fractions* and the existing research base.

*SRSD Fractions: A Curricular Overview*

To expand this evidence-based practice to fractions instruction, we developed a set of lessons (*SRSD Fractions*) to teach adding and subtracting fractions with unlike denominators using SRSD instruction with the mnemonic FILMS, to simplify fractions using the mnemonic CUT, and to transform fractions into mixed numbers using the mnemonic EDIT (Ennis and Losinski in press; Losinski et al. 2019b). These procedures support students' conceptual and procedural knowledge. All lessons are predicated on the analogy and theme of film (or movies as most students understand it) and this analogy is used to facilitate conceptual understanding.

FILMS

The FILMS (**F**ind the denominators, **I**dentify the multiples, **L**ocate the least common multiple, **M**ultiply to make new fractions, and **S**olve the problem) lessons mnemonic is used to guide students through the process of adding and subtracting fractions with unlike denominators. The FILMS analogy is used to help students understand fraction magnitude. For example, we discuss that a movie is the same on the movie theater screen as it is on a TV or iPad; the scale has simply changed as it does when we make new fractions using the least common denominator.

CUT

The second set of lessons, utilizing the mnemonic CUT (**C**alculate the factors, **U**nderline the greatest common factor [GCF], **T**ime to divide the numerator and denominator by the GCF) focus on simplifying fractions. There are five lessons in the CUT series. However, when the CUT lessons are taught immediately following FILMS, the CUT content is shared in brief form over a minimum of two lessons. The CUT lessons are delivered until mastery is achieved. Mastery is defined as students memorizing the strategy (based on a quiz delivered during the second lesson) and their ability to independently reduce fractions utilizing the strategy with correct answers on 80% or more of problems on lesson worksheets. Again, the film analogy is revisited to help students think about the order in which to use the strategies. For example, the director yells "cut" before conducting "edits." Therefore, we simplify fractions before converting fractions to mixed numbers.

EDIT

The final set of lessons focus on converting fractions to mixed numbers using the mnemonic EDIT (**E**xamine whether the numerator is greater than the denominator, **D**ivide the numerator by the denominator, **I**nsert the quotient as a whole number, **T**urn the remainder into your new numerator). There are five lessons in the EDIT series. However, when the EDIT lessons are taught immediately following FILMS and CUT, the EDIT content is shared in brief form over a minimum of two lessons. The EDIT lessons are delivered until mastery is achieved. Mastery is defined as students memorizing the strategy (based on a quiz delivered during the second lesson) and ability to independently convert fractions to mixed numbers utilizing the strategy with correct answers on 80% or more of problems on lesson worksheets. (Note: A complete five-lesson and brief two-lesson teaching sequences for CUT and EDIT are available online so that the strategies may be taught sequentially or in isolation.)

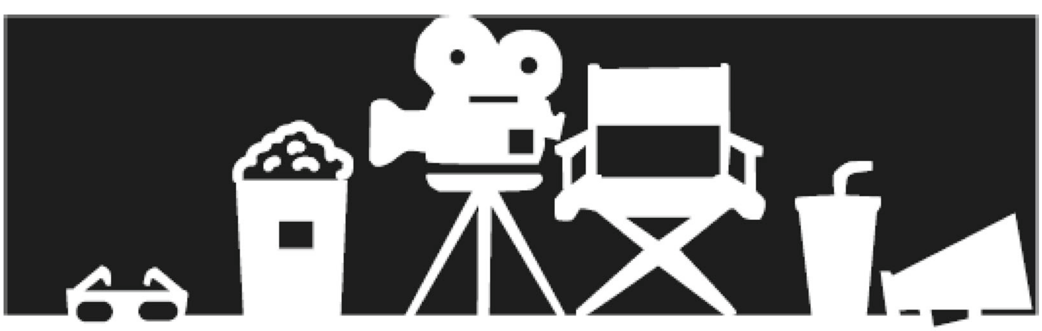
*Materials* We developed materials for all three strategies (located at https://srsdmath.com). At the beginning of the FILMS strategy, students complete a learning contract where students and the teacher commit to learning and using the strategy. This contract is developed and signed in the first lesson to solicit commitment and goal setting, an important skill for students with EBD in particular (Losinski et al. 2019 b). Students are also given a self-instruction worksheet that lists self-statements to use before, during, and after the three strategies. In addition, students are presented with a mnemonic chart, checklist, and cue cards for each of the three strategies. Finally, worksheets are given to students at the beginning of each intervention session to allow students to practice the targeted strategies. Each student has a folder to organize these mathematics materials, which are passed out daily during the intervention sessions.

*Intervention Components* The intervention, *SRSD Fractions* (FILMS, CUT, EDIT), focuses on adding and subtracting fractions with unlike denominators, simplifying fractions, and converting fractions to mixed numbers. FILMS, CUT, and EDIT follow the framework of SRSD outlined by Harris and Graham (1999): developing background knowledge, discussing the strategy, modeling the strategy, memorizing the strategy, supporting the strategy and independent performance. The strategies are taught utilizing all six strategy-acquisition stages of SRSD (until mastery is attained). *SRSD Fractions* lessons include activities to promote students' conceptual and procedural knowledge of fractions as research suggests a strong conceptual understanding of fractions is essential to fraction competency (Shin and Bryant 2015). See Figure 1 for an overview of each stage with specific activities used during *SRSD Fractions*.

## Evidence for SRSD Fractions

To date, four studies investigating the utility of SRSD fractions have been implemented. Two investigations have explored the utility of FILMS, CUT, and EDIT taught in succession (Ennis and Losinski 2019; Losinski et al. 2019b). Two have explored the utility of FILMS taught in isolation. To date, all interventions have been implemented by researchers or classroom teachers who were special education doctoral students.

One study used a single-case, multiple-baseline, across-schools design where three researchers were each responsible for implementing the intervention (Losinski et al. 2019b). Participants included 17 fifth-grade students with or at-risk for disabilities (e.g., EBD, OHI-ADHD, SLD) identified using the school-wide mathematics screener, FASTBridge Math (Christ 2017). Many students possessed behavioral risk factors (e.g., moderate or high-risk externalizing and/or internalizing behavior patterns) as measured by the Social, Academic, and Emotional Behavior Risk Screener-Student Rating Scale (SAEBRS; von der Embse et al. 2017). The intervention took place over nine (five FILMS, two CUT, two EDIT) sessions. Because they were introduced immediately following the conclusion of the FILMS lessons, CUT and EDIT were taught in a truncated fashion that was still inclusive of SRSD procedures. Outcomes suggested improved student performance on timed (2 min) fraction probes for 16 of the 17 participants as a result of participating in *SRSD Fractions*. Researchers were able to implement the intervention with high levels of treatment fidelity and students rated the intervention as acceptable on the Children's Intervention Rating Profile (CIRP; Witt and Elliott 1985). Results



**FILMS**

F ~ Find the denominator
I ~ Identify the multiples
L ~ Locate the least common multiple
M ~ Multiply to make new fractions
S ~ Solve the problem

**CUT**

C ~ Calculate the factors
U ~ Underline the GCF
T ~ Time to divide the numerator and denominator

**EDIT**

E ~ Examine whether the numerator is greater than the denominator
D ~ Divide the numerator by the denominator
I ~ Insert the quotient as a whole number
T ~ Turn the remainder into your new numerator

**Fig. 1** Strategies in SRSD fractions

suggested the limited amount of time (2 min) was constraining students' ability to demonstrate what they knew given the complex, multistep nature of the problems and that inappropriate behaviors may have affected student engagement and participation (e.g., off-task behavior, disruption, elopement).

Next, this study was replicated with two systematic modifications: (1) students were provided 4 min for fraction probes, and (2) we examined the behavioral risk and academic engagement of students (Ennis and Losinski 2019). A multiple-baseline, across-groups design was used with a researcher implementing the intervention. Participants included eight students with or at-risk for disabilities, identified using a school-wide mathematics screener (STAR Assessments; Renaissance Learning 2016) and a fractions unit test. Each group contained at least one student with moderate or high risk for internalizing and/or externalizing behavior patterns and at least one student without behavioral risk as measured by the school-wide behavior screener, the Student Risk Screening Scale-Internalizing/Externalizing (SRSS-IE; Lane et al. 2012). As with Losinski et al. (2019b), the intervention took place over nine sessions. Outcomes suggested a functional relation between the *SRSD Fractions* intervention package (FILMS, CUT, EDIT) and student performance on timed fraction probes for all eight participants. The researcher was able to implement the intervention with high levels of treatment fidelity and students rated the intervention as acceptable on the CIRP. Results suggested that the 4 min probe length was more appropriate, however, some students still only completed minimal problems. Results of academic engagement data were mixed. Two students with EBD displayed engagement at levels consistent with their peers, one was slightly less engaged, and one was slightly more engaged.

Next, we sought to investigate the effects of FILMS in isolation of the other strategies (Losinski et al. in press). In this investigation, a multiple-baseline, across-participants design was used with one researcher implementing *SRSD Fractions* with students one on one. Participants included three students with or at-risk for EBD and mathematics disabilities, as measured by the SAEBRS and FASTBridge Math. Outcomes suggested a functional relation between the *SRSD Fractions* FILMS intervention and student performance on timed fraction probes (4 min) for all three participants. The researcher was able to implement the intervention with high levels of treatment fidelity and students rated the intervention as acceptable on the CIRP.

Finally, Losinski and Ennis (2020) sought to replicate the effects of FILMS in isolation of the other strategies, similar to Losinski et al. (in press). In this investigation, a regression discontinuity design was used with one researcher implementing *SRSD Fractions* with 4th-grade students in an intervention group setting ($n = 16$). Participants included students with or at-risk for mathematics disabilities, as measured by school-wide systematic mathematics screening measures FASTBridge Math. Outcomes of this underpowered design ($n = 60$) showed a visual discontinuity at the cut-score, though due to low power a statistically significant effect was not noticed. However, when comparing gain scores for the treatment and control groups from pre- to posttest, the treatment group had significantly higher gain scores than did the control group ($t(1, 56) = 2.59$; $p = 0.01$). In addition, the researcher was able to implement the intervention with high levels of treatment fidelity and students rated the intervention as acceptable on the CIRP.

## Lessons Learned: Implications for Practice and Research

Through the exploration of the utility of *SRSD Fractions*, we hope to help bridge the research-to-practice gap by empowering teachers to use effective strategy instruction for mathematics within a multitiered system of support. Multitiered frameworks have been heralded as they use proactive and preventative strategies to meet the needs of at-risk students and reduce the number of unnecessary special education referrals (Fuchs and Fuchs 2006). To date, all *SRSD Fractions* investigations have been implemented as Tier 2, targeted interventions for students identified through systematic screening procedures (Lane et al. 2014) as needing additional support in the area of mathematics. SRSD has universal application and can be implemented as a universal strategy for all students in a classroom as a Tier 2 intervention for targeted students needing more support, and one-on-one for students needing individualized or Tier 3 supports; as such, SRSD has been effective for students in both general and special education (De La Paz 1999). However, unlike the broader teaching fashion demonstrated in the SRSD literature for reading and writing, (e.g., teaching strategies to promote reading of expository text; Sanders, Ennis, & Losinski, 2018b) the lessons detailed here are designed as more intensive interventions. In other words, it may not be appropriate to use all of the mnemonics developed for fear that students may become confused with which strategy to use. Rather, when a student has a known deficit with a particular concept, the SRSD method may be useful in addressing targeted need. That is not to say that *SRSD Fractions* couldn't/shouldn't be used as whole class instruction, but that it was designed as small-group instruction for those students struggling with a particular concept.

As schools move to multitiered models designed to be prescriptive in providing the ideal level of support to meet students' needs, evidence-based interventions are needed to remediate areas of weakness (Lane et al. 2014). Schools need affordable interventions that target students' specific areas of need. To that end, we are committed to providing *SRSD Fractions* online, free of charge, to facilitate its use by as many teachers and other school-based professionals as possible. Herein we highlight lessons learned from developing and conducting investigations using *SRSD Fractions* centered on the areas of conceptual knowledge, outcome measures, and supporting student behavior.

## Conceptual Knowledge

Siegler et al. (2012) note that conceptual knowledge is essential to success in performing fractions operations. That is why the *SRSD Fractions* lessons were designed to address both conceptual and procedural understanding of fractions, even if the mnemonic focuses on the procedural steps. The instruction of fractions often looks at conceptual knowledge separately where lessons on understanding numerators and denominators and what they represent are taught before teaching fractions operations. Although this is often a necessary prerequisite skill, it is not enough to only discuss fractions concepts separately from computation. Conceptual understanding of what a fraction represents, fraction magnitude, and how fractions fall along a number line need to continue to be embedded within procedural instruction (Woodward 2017). To add and subtract fractions with unlike denominators students need to understand what is represented by the numerator and denominator, how fractions fall along a number line to assist with estimation and checking work, and that when multiplied by a whole (e.g., $\frac{3}{3}$) the magnitude of a fraction changes but its value does not. Otherwise, the students do not have context to facilitate this conceptual understanding.

At present, the *SRSD Fractions* lessons contain language and suggestions for incorporating conceptual understandings. However, to date all interventions have been implemented by researchers or classroom teachers who were special education doctoral students. As we continue to explore this line of inquiry, logical next steps include making this more explicit with suggested activities embedded in *SRSD Fractions* lessons. Such activities include displaying fractions on a number line, using fraction manipulatives, and drawing visual representations of fractions. As teachers plan to use *SRSD Fractions*, they will be well-served by the meta-scripted nature of the lessons, which will allow them to take suggested language and make it their own to fit the needs of their students as well as their own approaches to teaching. Likewise, they can utilize available resources (e.g., fraction tiles, fractions manipulatives) to facilitate successful activities during stages for developing background knowledge, modeling the strategy, and supporting the strategy.

## Outcomes Measures

Measurement of mathematical computation is a complex task, with the skills of computation and problem solving being almost impossible to decouple (Fuchs et al. 2008). Adding and subtracting fractions with unlike denominators, which includes simplifying answers and converting fractions to mixed numbers when appropriate, involves multiple subskills and processes to arrive at the "correct" answer. This issue, coupled with a paucity of fraction assessments, makes measurement of fraction computation a difficult task. Our research team grappled with several issues, such as how to address a student arriving at the final correct answer but without using the least common denominator. Another issue we faced was related to students guessing to get the correct digits but not using an effective strategy to solve the problem (e.g., denominators are 2 and 3 of which 6 is the least common denominator but student just multiplied all denominators and happened to get the answer correct without computational understanding). Our current method of measurement for all *SRSD Fractions* studies involves the use of timed curriculum-based measures (CBM) and scoring digits correct. However, major limitations exist with this method as there are no standardized fraction CBM probes. As noted previously, we looked at providing students with two different lengths of time for assessment (Losinski et al. 2019b: 2 min; Ennis and Losinski 2019; Losinski and Ennis 2020;

Losinski et al. in press: 4 min) because previous research evaluating multistep problems have allowed as many as 7 min for timed probes (e.g., Foegen et al. 2008). However, even when 4 min probes were used, we observed that for some students these time constraints still affected their ability to complete more than one problem in the time allotted when using the multiple strategies (FILMS, CUT, EDIT). The multistep nature of the problems can certainly be attributed to this. However, a lack of computational automaticity for basic addition, subtraction, multiplication, and division operations could have contributed to this too. For example, Losinski et al. (2019c) found that the two participants who scored highest in baseline scored much higher on multiplication probe assessments. This suggests that the automaticity with multiplication could have contributed to their success in baseline. However, this fluency did not necessarily predict their responsiveness to the intervention.

As we explore further investigations to evaluate the efficacy of *SRSD Fractions*, future researchers should consider alternate ways to measure intervention outcomes. For example, investigations involving multistep problems using algebra have looked at using rubrics to assess student work (e.g., Foegen et al. 2016). In addition, assessing students on high-stake assessments, such as the NAEP fractions items, could provide meaningful insight on the generalization of these skills to other formats and in applied problems.

### Supporting Student Behavior

Students with academic risk factors often possess behavioral risk factors as well (e.g., Scott et al. 2001). To date, all *SRSD Fractions* investigations have involved, within the samples, students with or at-risk for EBD as well as academic concerns. Therefore, it is essential to consider ways to simultaneously address academics and behavior. Researchers have often recommended the use of low-intensity, research-based strategies during academic instruction, such as behavior-specific praise, choice making, high-probability request sequences, opportunities to respond, and precorrection (Landrum and Sweigart 2014; Lane et al. 2015). For example, teachers can use precorrection to clarify expectations prior to the beginning of the lesson. These strategies help empower teachers to support students' academic and behavioral needs simultaneously such as opportunities to respond (including response cards), self-monitoring, and token economies (Hirsch et al. 2018). For example, teachers can solicit frequent opportunities to respond from students during the modeling phases to keep students engaged in instruction. Teachers could link goal setting activities with an existing token economy system so that students earn tokens for SRSD and behavioral progress.

In addition, researchers have examined ways to incorporate low-intensity behavioral strategies into SRSD instruction. Ennis (2015) explored ways to simultaneously address behavior needs during SRSD writing instruction noting that the SRSD model lends itself to the implementation of multiple, research-based strategies, including choice making, high-probability request sequences, and opportunities to respond. For example, teachers can allow students to make a choice of writing prompt or choice of writing format (e.g., handwritten or typed) to increase their motivation to participation. Teachers can also use the stages of SRSD to build behavior momentum by making high-probability requests before asking students to complete tasks independently. Likewise, Sanders, Ennis, and Losinski (2018a) explored ways to support behavior during SRSD reading instruction using behavior-specific praise and opportunities to respond. For example, teachers can infuse behavior-specific praise when providing feedback to students to acknowledge their academic and behavioral efforts.

Finally, the self-regulation tasks addressed through SRSD instruction can generalize to self-regulation of behavior if skills are explicitly taught to students. SRSD includes self-evaluation, self-monitoring, self-reinforcement, self-graphing, and goal setting (Harris et al. 2008; Mason et al. 2012)—all essential skills for promoting self-control of behavior. This makes SRSD a natural fit for learners who struggle with both academic and behavioral needs. Many of these students are used to completing tasks and moving on without reviewing their work. Going through the process of goal setting and, in turn, self-monitoring progress toward meeting one's goals is an important life skill for students with EBD.

## Conclusion

Fraction proficiency is highly predictive of student success in higher-level mathematics skills (NMAP 2008).

To promote mathematics proficiency, there is a need for effective, efficient interventions to address students' conceptual and procedural knowledge of mathematics. *SRSD Fractions* is a curricular framework with promise for remediating the skills of adding and subtracting fractions with unlike denominators, simplifying fractions, and converting fractions to mixed numbers. Further, *SRSD Fractions* has proven efficacy for students with and at-risk for EBD. There is a clear and dire need for academic interventions to support this population as many struggle both academically and behaviorally; *SRSD Fractions* has the potential to fulfill this need.

## References


Anderson, J. A., Kutash, K., & Duchnowski, A. J. (2001). A comparison of the academic progress of students with EBD and students with LD. *Journal of Emotional & Behavioral Disorders, 9*(2), 106–115. https://doi.org/10.1177/106342660100900205.

Case, L. P., Harris, K. R., & Graham, S. (1992). Improving the mathematical problem-solving skills of students with learning disabilities: Self-regulated strategy development. *Journal of Special Education, 26*, 1–19. https://doi.org/10.1177/002246699202600101.

Cassel, J., & Reid, R. (1996). Use of a self-regulated strategy intervention to improve word problem-solving skills of students with mild disabilities. *Journal of Behavioral Education, 6*, 153–172. https://doi.org/10.1007/BF02110230.

Christ T. J. (2017). FastBridge learning. Retrieved September 6, 2017, from http://www.fastbridge.org.

Council for Exceptional Children (2014). *Council for Exceptional Children standards for evidence-based practices in special education.* Retrieved from https://www.cec.sped.org/~/media/Files/Standards/Evidence%20based%20Practices%20and%20Practice/EBP%20FINAL.pdf. Accessed Dec 2014.

Cuenca-Carlino, Y., Freeman-Green, S., Stephenson, G. W., & Hauth, C. (2016). Self-regulated strategy development instruction for teaching multi-step equations to middle school students struggling in math. *Journal of Special Education, 50*, 75–85. https://doi.org/10.1177/0022466915622021.

De La Paz, S. (1999). Self-regulated strategy instruction in regular education settings: Improving outcomes for students with and without learning disabilities. *Learning Disabilities Research & Practice, 14*(2), 92–106.

Ennis, R. P. (2015). Simultaneously addressing academic and behavioral needs of students with and at-risk for E/BD using self-regulated strategy development. *Beyond Behavior, 24*, 3–9. https://doi.org/10.1177/107429561502400102.

Ennis, R. P., & Jolivette, K. (2014a). Existing research and future directions for self-regulated strategy development with students with and at-risk for E/BD. *Journal of Special Education, 48*, 32–45. https://doi.org/10.1177/0022466912454682.

Ennis, R. P., & Jolivette, K. (2014b). Using SRSD for persuasive writing to increase the writing and self-determination skills of student with E/BD in health class. *Behavioral Disorders, 40*, 26–36. https://doi.org/10.17988/0198-7429-40.1.26.

Ennis, R. P., & Losinski, M. (2019). Interventions to improve the fraction skills of students with disabilities: A meta-analysis. *Exceptional Children, 85*, 367–386. https://doi.org/10.1177/0014402918817504.

Ennis, R. P., & Losinski, M. L. (2019). Self-regulated strategy development for fractions: A replication study investigating FILMS, CUT, and EDIT with at-risk 5th graders. *Journal of Learning Disabilities, 52*, 399-412. https://doi.org/10.1177/0022219419859509

Ennis, R. P., Harris, K. R., Lane, K. L., & Mason, L. H. (2014). Lessons learned implementing self-regulated strategy development with students with emotional and behavioral disorders in alternative educational settings. *Behavioral Disorders, 40*, 68–77. https://doi.org/10.17988/0198-7429-40.1.68.

Foegen, A., Olson, J. R., & Impecoven-Lind, L. (2008). Developing progress monitoring measures for secondary mathematics: An illustration in algebra. *Assessment for Effective Intervention, 33*, 240–249. https://doi.org/10.1177/1534508407313489.

Foegen, A., Stecker, P. M., Genareo, V. R., Lyons, R., Olson, J. R., Simpson, A., et al. (2016). Using an online tool for learning about and implementing algebra progress monitoring. *Teaching Exceptional Children, 49*, 106–114. https://doi.org/10.1177/0040059916674327.

Fuchs, D., & Fuchs, L. S. (2006). Introduction to response to intervention: What, why, and how valid is it? *Reading Research Quarterly, 41*, 93–99. https://doi.org/10.1598/RRQ.41.1.4.

Fuchs, L. S., Fuchs, D., Hamlett, C. L., Lambert, W., Stuebing, K., & Fletcher, J. M. (2008). Problem solving and computation skill: Are they shared or distinct aspects of mathematical cognition? *Journal of Educational Psychology, 100*, 30–47. https://doi.org/10.1037/0022-0663.100.1.30.

Harris, K., & Graham, S. (1996). *Making the writing process work: Strategies for composition and self-regulation* (2nd ed.). Cambridge: Brookline Books.

Harris, K., & Graham, S. (1999). Programmatic intervention research: Illustrations from the evolution of self-regulated strategy development. *Learning Disability Quarterly, 22*, 251–262. https://doi.org/10.2307/1511259.

Harris, K. R., Graham, S., Mason, L. H., & Friedlander, B. (2008). *Powerful writing strategies for all students*. Baltimore: Brookes Publishing.

Hirsch, S. E., Ennis, R. P., & Driver, M. K. (2018). Three student engagement strategies to help elementary teachers work smarter, not harder in mathematics. *Beyond Behavior, 27*, 5–14. https://doi.org/10.1177/1074295617753113.

Jackson, H. G., & Neel, R. S. (2006). Observing mathematics: Do students with EBD have access to standards-based mathematics instruction? *Education & Treatment of Children*, *29*, 593–614.

Jordan, N. C., Resnick, I., Rodrigues, J., Hansen, N., & Dyson, N. (2017). Delaware longitudinal study of fraction learning: Implications for helping children with mathematics difficulties. *Journal of Learning Disabilities, 50*, 621–630. https://doi.org/10.1177/0022219416662033.

Landrum, T. J., & Sweigart, C. A. (2014). Simple, evidence-based interventions for classic problems of emotional and behavioral disorders. *Beyond Behavior, 23*(3), 3–9. https://doi.org/10.1177/107429561402300302.

Lane, K. L., Menzies, H. M., Oakes, W. P., Lambert, W., Cox, M. L., & Hankins, K. (2012). A validation of the student risk screening scale for internalizing and externalizing behaviors: Patterns in rural and urban elementary schools. *Behavioral Disorders, 37*, 244–270.

Lane, K. L., Oakes, W., Ennis, R. P., & Hirsch, S. E. (2014). Identifying students for secondary and tertiary prevention efforts: How do we determine which students have tier 2 and tier 3 needs? *Preventing School Failure, 58*, 171–182. https://doi.org/10.1080/1045988X.2014.895573.

Lane, K. L., Menzies, H. M., Ennis, R. P., & Oakes, W. P. (2015). *Supporting behavior for school success: A step-by-step guide to key strategies*. New York: Guilford.

Losinski, M., & Ennis, R. P. (2019). *Supporting students within a MTSS framework using SRSD Fractions: Results of a regression discontinuity design.* Manuscript submitted for publication.

Losinski, M., Cuenca-Carlino, Y., Zablocki, M., & Teagarden, J. (2014). Examining the efficacy of self-regulated strategy development for students with emotional or behavioral disorders: A meta-analysis. *Behavioral Disorders, 40*, 52–67. https://doi.org/10.17988/0198-7429-40.1.52.

Losinski, M., Ennis, R. P., Sanders, S. A., & Nelson, J. (2019a). Examining the evidence-base of mathematics interventions for students with emotional disturbances: A meta-analysis. *Journal of Special Education, 52*, 228–241. https://doi.org/10.1177/0022466918796200.

Losinski, M. L., Ennis, R. P., Sanders, S., & Wiseman, N. (2019b). An investigation of self-regulated strategy development to teach addition and subtraction of fractions with unlike denominators to students with or at-risk for disabilities. *Exceptional Children, 85*, 291–308. https://doi.org/10.1177/0014402918813980.

Losinski, M., Ennis, R. P., & Shaw, A. (in press). Using SRSD to improve the fraction computations of students with and at-risk for EBD. *Behavioral Disorders.*

Mason, L. H. (2013). Teaching students who struggle with learning to think before, while, and after reading: Effects of self-regulated strategy development instruction. *Reading & Writing Quarterly, 29*, 124–144. https://doi.org/10.1080/10573569.2013.758561.

Mason, L. H., Reid, R., & Hagaman, J. L. (2012). *Building comprehension in adolescents: Powerful strategies for improving reading and writing in content areas*. Baltimore: Brookes Publishing.

Menzies, H., Lane, K. L., & Lee, J. M. (2009). Self-monitoring strategies for use in the classroom: A promising practice to support productive behavior for students with emotional or behavioral disorders. *Beyond Behavior, 18*, 27–35.

National Assessment of Educational Progress (NAEP). (2015) *Mathematics assessments various years, 2005–2015*. Retrieved from https://www.nationsreportcard.gov/reading_math_g12_2015/#mathematics. Accessed Dec 2016.

National Mathematics Advisory Panel (NMAP). (2008). *Reports of the task groups and subcommittees*. Washington: Author.

Renaissance Learning. (2016). *STAR 360 assessments*. Wisconsin Rapids: Author.

Sanders, S., Ennis, R. P., & Losinski, M. (2018a). Academic and behavioral strategies to enhance the understanding of expository text for students with and at-risk for EBD. *Beyond Behavior, 27*, 65–73. https://doi.org/10.1177/1074295618780975.

Sanders, S. A., Ennis, R. P., & Losinski, M. (2018b). Effects of TWA on science text comprehension of students with E/BD in a special-day school. *Education & Treatment of Children, 41*(4), 483–505. https://doi.org/10.1353/etc.2018.0026.

Scott, T. M., Nelson, C. M., & Liaupsin, C. J. (2001). Effective instruction: The forgotten component in preventing school violence. Education and Treatment of Children, 24, 309–322.

Shin, M., & Bryant, D. P. (2015). Fraction interventions for students struggling to learn mathematics: A research synthesis. *Remedial & Special Education, 36*(6), 374–387. https://doi.org/10.1177/0741932515572910.

Siegler, R., Carpenter, T., Fennell, F., Geary, D., Lewis, J., Okamoto, Y., . . . Wray, J. (2010). *Developing effective fractions instruction for kindergarten through 8th grade: A practice guide* (NCEE #2010–4039). Washington: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from whatworks.ed.gov/publications/practiceguides. Accessed Aug 2016.

Siegler, R. S., Duncan, G. J., Davis-Kean, P. E., Duckworth, K., Claessens, A., Engel, M., Susperreguy, M. I., & Chen, M. (2012). Early predictors of high school mathematics achievement. *Psychological Science, 23*, 691–697. https://doi.org/10.1177/0956797612440101.

Test, D. W., & Ellis, M. F. (2005). The effects of LAP fractions on addition and subtraction of fractions with students with mild disabilities. *Education & Treatment of Children, 28*, 11–24.

Trout, A. L., Nordness, P. D., Pierce, C. D., & Epstein, M. H. (2003). Research on the academic status of children with emotional and behavioral disorders: A review of the literature from 1961 to 2000. *Journal of Emotional and Behavioral Disorders, 11*(4), 198–210. https://doi.org/10.1177/10634266030110040201.

von der Embse, N. P., Iaccarino, S., Mankin, A., Kilgus, S. P., & Magen, E. (2017). Development and validation of the social, academic, and emotional behavior risk screener–student rating scale. *Assessment for Effective Intervention, 42*(3), 186–192. https://doi.org/10.1177/1534508416679410.

Witt, J. C., & Elliott, S. N. (1985). Acceptability of classroom intervention strategies. In T. R. Kratochwill (Ed.), *Advances in school psychology* (Vol. 4, pp. 251–288). Mahwah: Lawrence Erlbaum Associates.

Woodward, J. (2017). The concept of magnitude and what it tells us about how struggling students learn fractions. *Journal of Learning Disabilities, 50*, 640–643. https://doi.org/10.1177/0022219416659445.

Zhang, D., Stecker, P., Huckabee, S., & Miller, R. (2016). Strategic development for middle school students struggling with fractions: Assessment and intervention. *Journal of Learning Disabilities, 49*, 515–531. https://doi.org/10.1177/0022219414562281.