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**Research Article**

# Technology based self-monitoring for a student with EBD to improve academic engagement

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**ABSTRACT**

The current study evaluated the effect of technology-based self-management on disruptive behavior and academic engagement (AE) with a student with an emotional and behavioral disorder. A multiple baseline design across three general education settings was used to assess the effectiveness of the intervention, self-management using the CellF-Monitoring app. The use of technology based self-management resulted in an increase in AE across all three academic settings. Furthermore, students and teachers rated CellF-Monitoring app as highly social valid

**Keywords:** emotional behavior disorders, self-management, academic engagement, disruptive behavior, intervention

## INTRODUCTION

Students with emotional and behavioral disorders (EBDs) represent 5.45% of youth with disabilities in the United States (National Center for Education Statistics [NCES], 2022) and experience a host of negative short- and long-term outcomes. Specifically, students with EBD exhibit inappropriate behavior, academic problems, and poor interpersonal relationships (Landrum et al., 2003) that result in failing classes and dropping out of school at higher rates than their typically developing peers and students in other disability categories (Cipriano et al., 2018; Kern et al., 2023; Lloyd et al., 2019; Peltier et al., 2020; Smith et al., 2011). As such, they face adversity in home and school settings that involve conflicts with teachers, peers, parents, and siblings (Kauffman & Landrum, 2009; Menzies et al., 2009; Walker et al., 2004). Consequently, post high school outcomes are poor. For example, many youth with EBD do not engage in any educational activities after high school, and those that do earn fewer credits than students in any other disability category (Cipriano et al., 2018; Newman et al., 2011). Furthermore, students with EBD are more likely than their typically developing peers to experience unemployment, substance abuse, imprisonment, and divorce (Offerman et al., 2022). It is clear that interventions to interrupt this negative trajectory are needed in schools.

Opportunities for intervention are likely to exist within classrooms where students spend the majority of the academic day. Unfortunately, general education teachers often do not have the necessary preparation to serve students with an EBD (Mihalas et al., 2009) and are frequently not aware of evidence-based interventions. Nonetheless, recent statistics show that 43% of these students receive their education in general education classrooms for most of the day (Cook et al., 2017; NCES, 2015). Without the implementation

of effective interventions, schools are likely to resort to suspension or expulsion for students with EBD. Strategies are known to be ineffective for students with EBD (Gage et al., 2018). As such, the poor outcomes will continue.

One popular solution is the implementation of school-wide behavior interventions and support (SWPBIS), which is a positive means of decreasing disruptive behavior that negatively impacts learning, instructional time, and academic success (Bunch-Crump & Lo, 2017; Ling et al., 2011). SWPBIS is an empirically based framework comprising three levels of support designed to increase socially acceptable behaviors (Bunch-Crump & Lo, 2017; NCES, 2015). Within SWPBIS, students have been taught to attend to their own behavior (i.e., self-monitoring [SM]) at tier 1 and tier 2 resulting in positive behavioral changes across classroom settings as indicated by fewer discipline referrals (Bunch-Crump & Lo, 2017). Research has indicated that schools using SWPBIS are less likely to use exclusionary discipline practices (Cruz et al., 2021). In summary, implementing SM within a SWPIS system has the potential to be the positive support needed by students with EBD.

## Self-Monitoring

SM is a metacognitive strategy that emerged from the early writings of Bandura (1969, 1977). and is a commonly used strategy with students with EBD (Martella et al., 2013). When teachers implement SM, students are taught to be aware of a specific behavior, measure the extent to which that behavior occurs, and then document the occurrences (Bruhn et al., 2022; Mace et al., 2001; Reid et al., 2005; Rock, 2005). Decades of research have revealed positive outcomes when using SM, with students with EBD (Briesch & Chafouleas 2009; Bruhn et al., 2015; Mautone et al., 2005; Mooney et al., 2005; Ota & DuPaul, 2002; Vogelgesang et al., 2016; Webber et al., 1993). Specifically, in relation to students with EBD, SM has resulted in increases in positive behavior and decreases in negative behavior in specialized settings that implement specific programs. Although SM has been shown to be effective, some studies indicated that students are reluctant to engage with intervention (Harrison et al., 2020a). In an attempt to motivate students to use SM, a recent advancement takes advantage of technology (Vogelgesang et al., 2016).

## Technology Based Self-Monitoring

Although traditional SM interventions have been effective, there is growing interest in how technology can enhance the reach and impact of SM, particularly in more inclusive and varied settings. A significant advancement in this area is the use of technology-based SM tools, such as the I-Connect app and CellF-Monitoring app supporting students in SM across multiple settings beyond specialized classroom settings. The technologies offer flexibility and customization to meet individual student needs. The integration of technology into SM interventions presents new opportunities for supporting students with EBD. Although the research on technology-based SM is still developing, early findings indicate promising outcomes in increasing academic engagement (AE) and reducing disruptive behavior across settings. Additionally, educators can simultaneously rate student behavior (McCurdy & Cole, 2014; Peterson et al. 2006) to check accuracy, which helps students learn to recognize their own behavior (Young, 1991). During this process, students receive reinforcement (e.g., points) for accurate matches and appropriate behavior. Nonetheless, at times, students might be reluctant to engage in SM. One way to alleviate this reluctance is to use technology, which students find enjoyable and engaging (Bruhn et al., 2017; Kumm et al., 2021). We explored three apps prior to selecting CellF-Monitoring app for the current study.

### *I-Connect app*

One technology-based SM application is I-Connect. Wills and Mason (2014) conducted a study using the I-connect application with two male high school students with disruptive behavior in a general education science classroom with attention deficit hyperactivity disorder (ADHD) who struggled to maintain attention to task. Both participants demonstrated improvement in on-task behavior; however, only one participant achieved a sizeable immediate result from the baseline phase to the intervention phase. These results support findings from prior literature (Harris et al., 2005; Reid et al., 2005; Wills & Mason, 2014). The application delivered text prompts, such as ‘are you on task?’ to which students responded with either ‘yes’ or ‘no.’ Options for prompting included a vibration or a low chime, and all data were stored in a database. This

SM tool is unique in that it enables students to self-monitor across various settings, rather than being limited to a structured classroom environment.

### *Score It app*

Score It, another SM application, is integrated across all elements of the Read 180 program. The application supports students in tracking their progress in whole group, independent reading, and small group instruction (Bruhn et al., 2015). As one of the first technology-based applications studied for its influence on AE and behavior, Score It demonstrated promising results. Bruhn et al. (2015) used an ABAB design to evaluate the impact of SM on both AE and disruptive behavior. Their findings demonstrated that SM increased AE and reduced disruptive behavior.

### *CellF-Monitoring app*

The CellF-Monitoring app is another application that allows students to SM their own behavioral and academic progress. It is compatible with iOS-based devices and can be accessed through the iTunes APP store. This app prompts students to document their own behavior in response to questions, such as "are you on task?" Students indicate yes, they were on task or no they were not. Educators can set prompts at differing intervals based on student needs. Schardt et al. (2019) conducted a study using the CellF-Monitoring app. This study included four elementary age students who exhibited lower rates of on-task behavior but did not have a diagnosed disability. Two students completed the intervention during English/language arts, one during math, and one during writing. Researchers used an ABC multiple-baseline design (MBD) across participants. Student participants displayed higher rates of AE as indicated by the visual analysis of the immediacy of the effect, level, trend, and low incidents of data overlap. The device used in this study was iPad minis. The app allows for customizable intervals tailored to each student's needs. Students are prompted with either visual cues or a buzzing sound and asked, 'are you on-task?' They then respond by selecting 'yes' or 'no.' Similar to the I-Connect app, CellF-Monitoring app can be utilized across various settings, offering flexibility beyond structured environments.

## Purpose

While previous research has demonstrated that SM is an effective intervention for students with and without disabilities, including those with EBD, much of this research has been conducted in specialized classrooms (Briere et al., 2015; Bruhn et al., 2015; Kalis et al., 2007). Although SM is known to be effective in specialized settings, few studies have explored its effect in inclusive general education environments with students with EBD, even though 46% of students are educated in these settings (NCES, 2022). Knowledge of generalizability across settings is essential. At the time of this study, the only app that allowed for SM in general education settings was the CellF-Monitoring app. Other tools, such as Score It, were restricted to use within the Read 180 setting, and I-Connect was limited to Android devices. There was a pressing need to explore universal applications compatible with multiple operating systems and suitable for students who spend most of their day in general education classrooms rather than specialized environments.

As such, the purpose of the present study was to examine the effectiveness of technology-based SM on attention to task of an elementary student with EBD across reading, math, and writing. Three distinguishing factors of this study were:

(1) the participant was found eligible for special education services as a student with of EBD and received instruction in a general education classroom,

(2) the participant was taught to use technology-based self-SM, and

(3) the intervention was conducted across three content areas in the general education setting.

The following two research questions were answered:

1. To what extent does the use of the SM app, CellF-Monitoring app, improve on-task behavior of an elementary student with EBD?
2. To what extent was the CellF-Monitoring app acceptable to a general education elementary classroom teacher and the student with EBD?

# METHOD

## Sampling

We used purposive sampling to select participants based on specific characteristics with input from the school principal, someone knowledgeable about the population and the inclusion criteria (Patton, 2015). The criteria for the teacher participants were that he/she taught students with EBD in the general education setting and agreed to participate in the current study. As such, the principal invited two teachers.

## Teachers and Student

Two general education teachers participated. The first teacher, Mrs. Miller, was a white female with over 10 years of teaching experience. The second teacher, Mrs. Ball, was a white female teacher with less than five years of teaching experience. Mrs. Miller taught reading and writing in the morning and Mrs. Ball taught math in the afternoon to the same class of students including the participant in this study.

One student, Nathan (pseudonym). Nathan was a nine-year old white male in fourth grade who was twice exceptional and eligible for special education services under the category of EBD as verified through his individual education program. He was nominated for participation by the principal because of his eligibility of EBD, off-task behavior, and placement in a general education classroom for instruction in three content areas (i.e., reading, math, and writing). Nathan's teachers reported that they typically had to prompt him multiple times to begin assignments and continue to prompt him to stay on task, which was verified with baseline data collection (described below). Furthermore, although the work assigned to be completed independently was at Nathan's independent work level per the standardized testing for assessment of reading (Renaissance Learning, 2016) reading and math assessment as well as qualifying assessments for the gifted and talented program question understand examine solve think, he was frequently off-task, either putting his head down on his desk and going to sleep or getting out of his seat and exploring different parts of the classroom.

## Setting

The study was conducted in an elementary school in the mid-south region of the United States in two fourth-grade general education classrooms across three subject areas (math, writing, and reading). The school served approximately 690 students in third through fifth grade. The student population of the school was comprised of 73.1% White, 23.8% Black, and approximately 2% Hispanic, and 56.2% of students qualified for free and reduced lunch. Students sat at assigned desks arranged in row formation during instruction in all subjects. Both teachers maintained parallel expectations and utilized Class Dojo as a behavior management system. Class Dojo is a system in which teachers document student behavior related to classroom expectations via an app on their cell phones or through a website on their computers. When teachers document the occurrence of the behavior, students are awarded a "dojo" point. Both teachers projected the app onto a whiteboard so that the students could see when they were given a dojo or had a point deducted. Students were able to earn a small edible reinforcer when they reached a predetermined number of points. Furthermore, parents were able to log into class dojo on their mobile devices to see their child's daily behavioral progress. These procedures remained constant throughout each phase of the study.

## Measures

Data were collected for one dependent variable (i.e., AE) with CellF-Monitoring app, social validity with the school intervention rating form (SIRF), interobserver agreement (IOA) through direct observation, treatment fidelity with a checklist, and researcher field notes. Measures and descriptions to answer each research question can be found in **Table 1**. Definitions and examples of AE and disruptive behavior have been adopted from previous literature and are discussed below.

### *Academic engagement*

In the current study, Nathan was coded as academically engaged if he was

(a) independently and silently reading the assigned material as evidenced by visual attention to the text without shifting attention for more than five seconds at a time,

**Table 1.** Measures to answer research questions

| Research question | Data collection tool | Description |
|---|---|---|
| To what extent does the use of the SM app, CellF-Monitoring, improve on-task behavior of an elementary student with EBD? | CellF-Monitoring app | The CellF-Monitoring app, available on iOS devices, was accessed by the students on their iPads. The app prompted students to answer the question, 'Am I on-task?' at the end of each five-minute interval, with each academic block divided into ten such intervals |
| To what extent was the CellF-Monitoring application acceptable to a general education elementary classroom teacher and the student with EBD? | SIRF | SIRF was used to assess teachers' and students' perceptions regarding the acceptability and perceived effectiveness of the intervention. |

(b) independently working on a writing task as evidenced by visual attention, actively writing, and not shifting attention for more than five seconds, and

(c) engaging in group activities as demonstrated by visual attention to the speaker, task appropriate speaking, and writing information related to group work.

This definition was adapted from Harrison et al. (2019) and Kumm et al. (2021). Partial interval recording was conducted during behavioral observations throughout the study. First, the researchers documented student AE every five minutes across fifty minutes for a total of 10 opportunities. Second, the percentage of AE was calculated as the number of engaged intervals divided by number of opportunities (i.e., 10).

### *Social validity*

Social validity was measured with two (i.e., teacher and student) adapted versions of the SIRF (Kern & Gresham, 2002). The adapted teacher SIRF was an 11 question 7-point Likert type scale ranging from not at all (1 point) to very well (7 points) and was completed by the two teachers separately at the end of the study. We also included two open-ended questions:

1. What changes have you noticed in your student's classroom performance?
2. What were some of the barriers of the intervention (Kern & Gresham, 2002)?

Possible scores ranged from seven to 77 with higher scores indicating high social validity. After the last intervention session, the students and teachers completed this rating form and social validity was calculated. Means and standard deviations were calculated across both teachers. The student SIRF was a six-question 7-point Likert scale ranging from not at all (1 point) to very well (7 points) with space for additional comments. It was completed by the student at the end of the study. Possible scores ranged from seven to 42, with higher scores indicating high social validity.

### *Interobserver agreement*

Reliability was calculated through IOA as simple agreement (agreement/agreement + disagreement) between the researcher and a trained graduate assistant (Vannest et al., 2013). During the study, IOA was collected 27% of all sessions during baseline and 20% of sessions during the intervention phase. Average IOA was 90%.

### *Treatment fidelity*

Treatment fidelity was directly documented by the researcher each class period using a three-item checklist of intervention procedures developed prior to the study. Fidelity was 100% across observations.

### *Field notes*

Field notes were collected throughout the study to gather detailed information about the classroom environment. Notes were taken during each intervention session in conjunction with behavioral observations. Additionally, the notes documented initial interpretations of observed behaviors, which helped guide the subsequent analysis. These field notes provided valuable context for understanding variations in AE and complemented the quantitative data collected on both AE and social validity.

**Table 2.** Project phases

| Phases | Procedures |
|---|---|
| Recruitment | The researcher met with the teachers, parents, and the student, and obtained both consent and assent. |
| Baseline | On-task data were collected over five math sessions, seven writing sessions, and ten reading sessions. Data collection was staggered across each subject area to enhance generalizability. Stability was achieved before advancing to the next stage. |
| Training | A training phase for both the teachers and the student took place between the baseline and intervention phases. The teacher was instructed to continue regular classroom activities, with the researcher emphasizing the importance of maintaining typical procedures. The student's training was staggered across the general education settings |
| Intervention | Classroom procedures remained unchanged, with the only difference being the use of the CellF-Monitoring app. The intervention was staggered across math, writing, and reading. Using the app, the student self-monitored on-task behavior by selecting 'yes' or 'no' at the end of each five-minute interval |

## Procedures

We describe procedures in four phases (see **Table 2**), recruitment, baseline, teacher and student training, and intervention. For recruitment, the researcher began by meeting with the building principal, explaining the study and the inclusion criteria and asking him to nominate a student for participation. Next, the researcher met the student's two teachers, who consented to participate. Finally, the researcher met with the student's parents and the student and obtained consent and assent.

### *Baseline*

Baseline data were collected across three content areas, five sessions in math, seven sessions in writing, and ten sessions in reading, as intervention was staggered across content. Each session consisted of 10 five-minute intervals in each of the three classes for a total of 30 intervals in a day. During baseline, the teacher-maintained routines, procedures, and all teaching practices.

### *Self-monitoring using technology: Teacher and student training*

Training for the teacher and the student was conducted over two days between baseline and intervention phases. In the current study, the teachers' role was to continue class as usual as such, the researcher met with her for a one-time conference individually and explained the importance of continuing classroom procedures as usual. Additionally, the researcher explained and demonstrated the use of the CellF-Monitoring app.

Student training was staggered across settings. First, an individual conference was held with the students to discuss the importance of initiating and maintaining AE. During this conference, Nathan was told that he would be using technology that might help him remain engaged. The researcher and Nathan downloaded the app (i.e., CellF-Monitoring app) on an iPad and set a prompt every for 5 minutes and the length of each session as 50 minutes. Nathan was taught to ask himself if he was attending at any time during the five minutes when the app prompted. The researcher modelled and practiced using the iPad application. Attending and "not attending" behaviors were modelled and discussed. Nathan was taught to self-record on the app by hitting the yes or no when prompted. After two days of training, the student reported that he was comfortable with the application, so the intervention was implemented the following day.

### *Intervention*

During the intervention phase, typical classroom routines and procedures remained the same with the only change being Nathan's use of the CellF-Monitoring app with the iPad on Nathan's desk. The beginning of the intervention phase was staggered across general education settings (i.e., math, writing, and reading). The intervention lasted 12 class periods in math, eight class periods in writing, and six class periods in reading. Over the course of the intervention implementation, the intervention remained the same without being modified in any way. After each 5-minute interval, there was an audio cue (i.e., buzzing) and visual cue from the app asking Nathan if he was on-task. The student clicked 'yes or no' on the iPad to answer the question and continued working. The researcher calculated the percentage of engagement, at the conclusion of each class period.

### *Single case design and data analysis*

An MBD was used to evaluate the existence of a functional relation between the CellF-Monitoring iPad app and AE. MBD allows for comparison of treatment across three settings to measure change within individual behavior rather than comparing individual behavior to a control group (Parker et al., 2009). The percentage of AE was compared between the baseline phase and the intervention phase (i.e., SM, Parker et al., 2009). The primary method for evaluating the effects of the intervention was visual analysis following the what works clearinghouse procedures (Kratochwill et al., 2010).

In addition, three effect sizes (improvement rate different [IRD], nonoverlap of all pairs [NAP], and Tau-U) were calculated to quantify the magnitude of effect of the CellF-Monitoring app and engagement. IRD (Parker et al., 2009), NAP (Parker & Vannest, 2009), and Tau-U (Parker et al., 2011b) were used to quantify the effectiveness of the SM intervention. We elected to calculate three ES as the field has not determined the most accurate ES for single case design research. As such, we calculated three commonly accepted ES for comparison. All three were calculated between the baseline and intervention phase for each of the three settings and then combined. IRD (Parker et al., 2011b) is an estimate of the difference between baseline and intervention improvement rates. Results can be interpreted, as follows:

(a) less than .50 is considered very small and questionable,

(b) IRD equal to or between .50 to .70 is considered moderate, and

(c) larger IRD scores range from .70 to .75 and larger (Parker et al., 2009).

NAP is an estimate of the percentage of data improvement across phases (Parker et al., 2011b). To interpret NAP, a weak effect is 0 to .65, a moderate effect is .66 to .92, and large is .93 to 1.00. Tau-U either estimates trend, non-overlap between phases, or a combination of the two when baseline trend is positive (Parker et al., 2011b). To interpret Tau-U, a small effect is between 0 and .62, a moderate effect is between .63 and .93, and (c) a large effect size is .93 to 1.00. Calculations were completed using a single-case design online effect size calculator (www.singlecaseresearch.org, Vannest et al., 2011)

## RESULTS

### Academic Engagement

### *Visual analysis*

A potential functional relation was found between use of the CellF-Monitoring app and AE (see **Figure 1**). From the baseline phase to the intervention phase, an increase in level (mean difference = 51%) and an immediate effect of the intervention was evident across content areas (from 30% to 90% in math; 40% to 90% in writing; 50% to 100% in reading).

However, considering all data points in the intervention phase, the slope was negative due to a series of unfortunate events between session 11 and session 12. First, Nathan was “defiant” in his reading class and was assigned to in school suspension where he continued to exhibit defiant behavior and was suspended for two days. Upon returning to school, he attended an “enrichment” course missing his math, writing, and reading classes. Data was not taken during these four days as he did not engage in independent work. On the day that he returned (session 12), his engagement was 100% across all courses. However, in the afternoon of session 14, the class had a Valentine’s Day party in his writing/reading class, followed by a three-day weekend. During this time, there was a significant, consistent decline in engagement across subjects and an overlap with baseline levels of engagement. After this decline, engagement increased across subjects (from 40% to 90% in math; 0 to 100% in writing, and 30 to 90% in reading.

Per IRD, in math, the increase in Nathan’s academically engaged time as a result of CellF-Monitoring app was considered large (IRD = .75). In writing and reading, Nathan’s increased engaged time was considered moderate (IRD = .63 and IRD = .67, respectively). PerNAP, in math, writing, and reading, the increase in academic engaged time was considered moderate (NAP = 0.91, NAP = 0.77, and NAP = 0.84, respectively). Per Tau-U, in math, the increase in engaged time was considered moderate (Tau-U = .82) and small for writing and reading (Tau-U = .59 and Tau-U = .53, respectively) (**Table 3**).

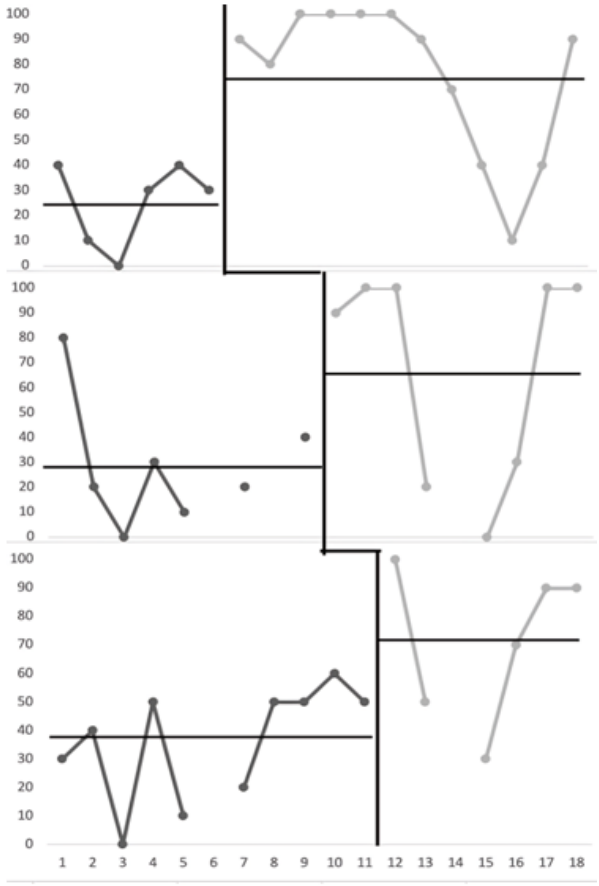


**Figure 1.** Multiple baseline design across content areas. Percentage of intervals of academic engagement (y-axis) for each data collection session (x-axis) for Nathan. (Source: Authors)

**Table 3.** Effect size for academic engagement using CellF-Monitoring app

| Content area | IRD | NAP | Tau-U |
|---|---|---|---|
| Math | .75 | .91 | .82 |
| Writing | .63 | .77 | .59 |
| Reading | .67 | .84 | .53 |

## Social Validity

The cumulative teacher's scores from the SIRF indicated high social validity of CellF-Monitoring app. Both teachers agreed that the intervention was a bit more than somewhat (5) reasonable and effective; required minimal time to carry out the intervention (6) and believed that the intervention was somewhat likely to result in permeant improvement (4) of the students' behavior (**Table 4**).

Differences were found between teachers on seven items. Differences were found between teachers on seven items: Mrs. Ball (math) found the intervention to be a bit more than somewhat socially valid; however, variation in her scores extenuated areas of acceptability and those of concern. She indicated that she understood the intervention very well, found the intervention very acceptable, was a bit more than somewhat willing to allow the student to use the intervention in her classroom, acknowledged some disadvantages, found the intervention to be minimally disruptive to her class, and liked the procedures. However, she was not willing to change her routine to allow students to use the CellF-Monitoring app in her classroom.

Mrs. Miller (reading/writing) found the intervention to be somewhat socially valid. understood the intervention a bit more than somewhat, was a bit more than somewhat willing to allow students to use the intervention in her classroom; found a bit more than some disadvantages, found the intervention a bit more than somewhat disruptive, and was a bit more than willing to change her routine to allow students to use the

**Table 4.** Item level social validity scores (SIRF)

| | Mrs. Ball: Math | Mrs. Miller: Reading/writing | Nathan: Student |
|---|---|---|---|
| Understood | 7 | 5 | 7 |
| Acceptable/like | 6 | 5 | 5 |
| Willing | 5 | 6 | * |
| Reasonable/easy | 5 | 5 | 7 |
| Disadvantages/did not like | 4 | 5 | 6 |
| Improvement | 4 | 4 | 7 |
| Time | 6 | 6 | * |
| Effective | 5 | 5 | * |
| Disruptive to class | 3 | 5 | * |
| Like Procedures | 7 | 5 | 5 |
| Uncomfortable | * | N/A | 7 |
| Willing to change routine | 2 | 5 | * |
| Total (mean/standard deviation) | 4.91 (3.20) | 5.09 (1.08) | 6.5 (.84) |

CellF-Monitoring app. Variation in scores per teacher can be seen in **Table 2**. Variation in scores per teacher can be seen in **Table 2**.

Along with the quantitative scores on the SIRF, the open-ended questions provided evidence that teachers perceived the CellF-Monitoring app as a useful intervention as noted by the increase in work productivity. Additionally, teachers stated that Nathan was truly reflective of his behavior which benefited the student behaviorally. In sum, both general education teachers indicated that the intervention was valuable in their classrooms due to the increase in work productivity and AE.

Nathan completed the student version of the SIRF (Kern & Gresham, 2002). Results (1 = not at all; 4 = somewhat; 7 = very well) indicated that he understood the SM intervention, and that CellF-Monitoring app was easy to implement. However, Nathan indicated that the intervention made him feel slightly uncomfortable, because although it. As it helped him remain engaged, there was not always enough desk space to hold the iPad as well as a Google Chromebook and a folder for the classes.

### Field Notes

The field notes were analyzed to identify recurring themes related to Nathan's AE. Two themes that emerged were classroom distractions and home-school interaction. Classroom distractions significantly impacted Nathan's ability to stay focused on instructional tasks. These distractions, often minor, played a critical role in diverting his attention. For instance, field notes documented Nathan repeatedly fidgeting with a pencil during independent reading time, leading to noticeable lapses in engagement. In addition to material distractions, peer-related distractions were frequently observed as contributing factors that shifted Nathan's focus away from his work.

The second theme, home-school interaction, also appeared to influence Nathan's classroom behavior. His schedule and routine varied depending on whether he was staying with his mom or his dad. For example, Nathan seemed more tired and off-task following weekends spent with his mom, while he appeared more rested and attentive after time with his dad. Together, these themes provide valuable insights into the factors that influenced Nathan's AE.

## DISCUSSION AND CONCLUSION

This study aimed to investigate the effect of CellF-Monitoring app on the AE of an elementary student with EBD across three general education content classes (i.e., math, writing, reading). Several findings are worthy of discussion. First, although engagement was variable within phases, the small to large effects (across effect types) for AE indicated an increase in time engaged in task that can be attributed to the CellF-Monitoring iPad app. This study supports years of research on SM that have produced positive results of increasing AE for students of all ages and with various disabilities applied in diverse school settings (Bruhn & Watt, 2012; Bedesem & Dieker, 2014; Graham-Day et al., 2010; Gulchak; 2008; Harrison et al., 2020b; Schardt et al., 2019; Wills & Mason, 2014). Findings here contribute to the diversity of settings where self-management can be considered helpful, as no prior study investigated the use of SM app, specifically CellF-Monitoring app, in

general education settings with a twice-exceptional student. As such, practitioners can consider SM a good intervention choice.

Visual analysis indicated an increase in AE immediately following the introduction of the app and an overall increase in level across phases indicating a potential functional relation between the intervention and engagement; however, we would be remiss if we did not discuss the variability and overlap within and between phases. Events occurred during the study that were beyond the purpose of this intervention and the researcher's control. Nonetheless, it is important to acknowledge that events such as these are common in school and with students with EBD. Therefore, the findings indicate the importance of conducting research in schools, specifically in the general education setting, where students with EBD spend a majority of their time (NCES, 2022).

Furthermore, small differences were found across types of effect sizes. As we expected, results indicated that Tau-U was the most conservative of the three. This supports prior findings (e.g., Bowman-Perrot et al., 2013; Parker et al., 2011a; Soares et al., 2016). Additionally, this finding also speaks to Cohen's (1988) caution regarding the use of fixed effect size benchmarks. As benchmarks are somewhat arbitrary (Cohen, 1988), interpretation within the context of the prior literature adds strength to their meaning. In the case of self-management, findings here support a primarily moderate effect found by others (Harrison et al., 2019).

Including our findings within the literature is important as AE is crucial to a student's performance and is correlated with success (Harris et al., 2005; Otero & Haut, 2015). This is essential as independent seat work accounts for approximately 30% of the school day during general education classes but is a challenging time for students with EBD like Nathan (Denune et al., 2015; Rock & Thead, 2009). Using CellF-Monitoring app helped Nathan remain engaged during the independent work time. Prior to intervention, he was academically engaged for only 31% with the exception of one preferred activity in writing. After the introduction of the intervention, Nathan was engaged for 70% of the time.

In addition to being effective, the teachers and Nathan indicated that CellF-Monitoring app was an acceptable intervention to use in a general education classroom. The intervention was rated positively in all categories. In addition, the intervention was not distracting to the teachers or other students in the classroom. The teachers and Nathan participant found the intervention easy to implement as well as understand. However, Nathan, the participant indicated that the intervention made him feel somewhat uncomfortable due to having the iPad on his desk constantly and other required materials. He noted that he did not always have enough desk space because there was often a Google Chromebook and the mandatory binder on his desk. As the intervention was acceptable overall, we encourage researchers and intervention developers to streamline all applications to ensure they are compatible with devices frequently used in schools, such as Chromebooks.

## Limitations

Findings here suggest that the CellF-Monitoring app used in varying general education settings could increase a student's AE with EBD. However, this study was not without limitations. First, the present study was limited to one student with EBD. Although the study was valid as findings were measured across three academic settings, a larger sample would increase the reliability of the findings. However, it is not uncommon to find only one student with EBD in a general education setting; therefore, the ecological validity of this study is strong. Second, the study was conducted over a short period of time. Third, the study design was disrupted by a behavioral incident that led to Nathan being suspended from school, a three-day weekend, and an unstructured party.

Although there is a limitation to this study, such events occur in schools. Fourth, the present study did not include generalization or maintenance probes to measure the lasting effects of this application across general education settings.

## Future Research

Although technology-based self-management is in its early stages, the CellF-Monitoring app displayed positive findings across three general education settings. Further research investigating technology-based self-management will likely demonstrate positive findings. Future studies should include the use of

technology-based self-management interventions in general education settings with a continued emphasis on the inclusion of students with EBD (Hunt & Goetz, 1997; Lipsky & Gartner, 1996). Moreover, future research should investigate the lasting effects of self-management for students with EBD over an extended time. Future researchers should consider replication to explore CellF-Monitoring app as an evidence-based practice. To understand the long-term effects of the CellF-Monitoring app intervention, future research should include a generalization and maintenance phase.

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