University of Messina

ISSN 2612-4033

Journal of Clinical & Developmental Psychology

Journal homepage: http://cab.unime.it/journals/index.php/JCDP/index

Strategies to increase on-task behavior and the number of arithmetic facts in a group of adolescents with neurodevelopmental disorders

Iacomini S.[1]*, Vascelli L.[1], Artoni V.[1], Berardo F.[1]

[1] Tice Live and Learn, Piacenza, Italy

ABSTRACT

Background: In this research, we evaluated the effectiveness of an intervention, carried out through two studies, on the increase of on-task time in the context of a small group during the execution of arithmetic facts.
Methods: Four adolescents with neurodevelopmental disorders took part in the research. For the first study, we used an ABAB single-subject experimental design, and for the second one, a pre- and post-probe design. As dependent variables, in both studies, we measured the percentage of on-task behavior intervals, the number of correct arithmetic facts, and the total number of completed arithmetic facts during 10-minute sessions. In the first study, the implemented intervention was the use of a progressive variable interval reinforcement scheme. In the second study, the independent variable was an intervention package consisting of a self-monitoring procedure combined with an interdependent group contingency and public posting.
Results: The intervention was effective in increasing the emission of on-task behavior and the number of corrected and completed arithmetic facts by each participant.
Conclusions: the strategies described can provide learning and independence opportunities to students with neurodevelopmental disorders.

Keywords: *On-Task; Group; Neurodevelopmental Disorders; Self-Monitoring; Public Posting Arithmetic Facts.*

* *Corresponding author*: Silvia Iacomini, Tice Live and Learn, Piacenza, Italy
E-mail address: silvia.iacomini@gmail.com

https://doi.org/10.6092/2612-4033/0110-2425

Introduction

Class management is a fundamental component of effective instruction (Algozzine, Ysseldyke, & Elliott, 1997). Teachers must be able to involve students in academic tasks and use strategies to reduce inadequate classroom behaviors (Alberto & Troutman, 2009). The problem behaviors handling is very challenging and reduces the time dedicated to learning and educational activities. Often students who emit inappropriate behaviors disturb the class and interfere with the learning process (Rodrigo, Baker, & Rossi, 2013).

Students' ability to concentrate on their tasks also influences their school performance (Duncan & Magnuson, 2011). From the perspective of inclusive education, it is worth considering that, within a class group, there are students who have different characteristics and learning times. For this reason, some of them may experience frustration if the rhythm of learning in the classroom is too fast or too slow (Hitchock, Meyer, Rose, & Jackson, 2002). Others may present negative attitudes towards school, reduced self-esteem, and low levels of motivation (McGee, Ward, Gibbons, & Harlow, 2003). Effective instruction for a variety of students requires the use of different methodologies, curriculum materials, and assessments (Hitchcock et al., 2002). Students who actively participate in the planning and evaluation of their learning experiences are more likely to improve their school performance (Choate, 2000). This is particularly true for students with learning disabilities and emotional disorders, who can present difficulties in managing their behavior (Shimabukuro, Prater, Jenkins, & Edelen-Smith, 1999). The autonomy of students with disabilities in performing school activities is essential in a productive, inclusive environment (Choate, 2000; Friend & Bursuck, 2006; Gee, 2002). The school should therefore, be able to provide equal learning opportunities for all students. The biggest challenge for teachers in creating inclusive classes is to develop a broad repertoire of teaching strategies (Mitchell & Sutherland, 2020). These include multi-level teaching, based on flexibility, individualization and inclusion of all students, regardless of their skills (Johnson, 1999). Inclusive education also provides experience-based and student-centred learning and the development of self-determination. The school encourages students to express interest in curriculum content and learning strategies (Johnson, 1999). Other strategies can be the creation of multi-ethnic classrooms and heterogeneous groupings, cooperative learning activities and peer collaboration (Blenk & Fine, 1995).

Within the class, we can distinguish two types of behavior: on task and off task. On-task time (Romero & Barberà, 2011) indicates the amount of time spent in carrying out an activity and is a determining factor in a student's academic success (Usart, Romero, & Barberà, 2013). Off-task time is time spent on any activity other than learning tasks (Karweit & Slavin, 1982) and is associated with poor school performance. Some examples of off-task behaviors are talking to a companion, playing with other objects, or disturbing the class (Allday & Pakurar, 2007). For managing off-task behavior, and improving the climate within the classroom, behavior modification strategies, such as those based on the principle of positive reinforcement, can be implemented (Henderlong & Lepper, 2002). Positive reinforcement occurs when a behavior is immediately followed by the presentation of a stimulus and, as a consequence, similar behaviors occur more frequently in the future (Cooper, Heron, & Heward, 2007).

To promote a positive educational environment, many teachers employ differential reinforcement of alternative behaviors strategies (Christensen & Sanders, 1987) and token economy systems (Casarini, Artoni, Cascavilla, & Galanti, 2016; Celi & Fontana, 2001; Hackenberg, 2009) in which the student obtains reinforcement for desired behaviors. These types of interventions are relatively simple to implement if the behavior is easily observable and measurable. In many cases, however, it is more complex to measure certain on-task behaviors. For example, while it may be simple to observe that a student is not speaking, it is more difficult to discriminate whether the student is working on his own or is emitting off-task behavior, even if in silence (Hulac, Benson, Nesmith, & Shervey, 2016). To optimize student performance on a variety of tasks, educators can then implement interventions based on reinforcement schedules (Hulac et al., 2016; Lee & Belfiore, 1997).

Austin and Soeda (2008) demonstrated the effectiveness of using a fixed interval (FI) program to reduce off-task behavior in the classroom of two typically developing children of eight and nine years. During the implementation of the FI schedule, the teacher paid attention to the students every four minutes. The teacher reinforced the students' on-task behavior with verbal approvals and redirected their off-task behaviors. Moreover, he ignored the adequate or inadequate behaviors of the students that occurred between one interval and the next (i. e., extinction). The authors (Austin & Soeda, 2008) have suggested that extinction may have contributed to the effectiveness of the intervention. Another explanation for the decrease in off-task behavior could be the use of differential reinforcement. The teacher reinforced with approvals on-task behaviors and redirected off-task behaviors. Therefore, there was a stronger association between on-task behaviors and the approvals provided by the teacher. Riley, McKevitt, Shriver and Allen (2011) replicated and extended the results of the study by Austin and Soeda (2008). The authors also examined whether the FI reinforcement schedule was effective in reducing off-task behavior without using extinction between intervals. One of the disadvantages of using FI reinforcement schemes is that these patterns generate a post-reinforcement break whereby the individual's response rate decreases as soon as the person has received reinforcement (Lee & Belfiore, 1997; Hulac et al., 2016) and increases gradually before the next reinforcement (Cooper et al., 2007). Therefore, once reinforcement is no longer available, the student's behavior tends to decrease.

In a variable interval schedule of reinforcement (VI), it is reinforced the first response emitted after a variable time interval from the previous reinforcement (Cooper et al., 2007). In other words, access to reinforcer is negated until the end of the interval, regardless of the responses emitted. At school and in clinical settings, there is a wide range of possibilities for applying VI reinforcement programs to support students’ behavior.

Teachers can use a VI scheme to encourage and increase students' behaviors to sit straight in the chair and follow the teacher with gaze (Briesch, Hemphill, & Daniels, 2013). Alternatively, in a classroom situation where the teacher tries to use a group contingency to reduce peer-mediated behaviors (Hulac & Benson, 2010), the teacher can provide directions on a VI scheme to remind students of desired behaviors. This type of reinforcement program is also used to increase the on-task behavior of students who show difficulties in performing tasks assigned to them (Martens, Lochner, & Kelly, 1992). A VI reinforcement schedule can also be used, for example, to teach students to sit, to speak with an appropriate tone of voice, to keep their hands in place in the hallway and during the lessons, to sit in a correct posture, to organize materials appropriately and follow the teachers’ instructions (Hulac et al., 2016).

Self-monitoring is another possible strategy to improve attentive skills, academic productivity, and decrease off-task behavior in the classroom (Cole, Marder, & McCann, 2000; Shapiro & Cole, 1994). Researchers have shown that students can use self-monitoring to regulate their behavior and increase autonomy (McDougall & Brady, 1998; Shapiro & Cole, 1994). Self-monitoring procedures can decrease dependence on external factors (e.g., teachers, parents, peers) involved in a behavioral change, facilitating the generalization to other settings and the maintenance of the acquired skills (McLaughlin, Krappman, & Welsh, 1985).

Several studies have demonstrated the effectiveness of self-monitoring strategies to increase students' on-task behaviors with ADHD (Graham-Day, Gardner, & Hsin, 2010), with Autistic Spectrum Disorders (Holifield, Goodman, Hazelkorn, & Heflin, 2010), Intellectual Disabilities (Prater, Joy, Chilman, Temple, & Miller, 1991; Dalton, Martella, & Marchand-Martella, 1999), emotional and behavioral disorders (Carr & Punzo, 1993), and young people at risk of school failure (Wood, Murdock, Cronin, Dawson, & Kirby, 1998).

In addition, some studies have shown that self-monitoring can directly affect academic skills. For example, the results of a study conducted by McDougall and Brady (1998) show that five fourth grade students with and without disabilities increased the performance-related fluency in the execution of arithmetic problems and the on-task time after learning two self-monitoring strategies (i.e., attention self-monitoring and productivity self-monitoring). When compared, both interventions seemed to improve school engagement and mathematical fluency. The term fluency is used to describe a rapid and accurate academic response (Haring & Eaton, 1978). Fluency is necessary to achieve the class's objectives in terms of skills and subjects. Concerning mathematical skills, a student who is able to complete arithmetic facts fluently will be more able to complete subsequent advanced mathematical tasks (Skinner, Fletcher, & Hennington, 1996). Students who are not fluent in performing arithmetic facts may experience frustration and will tend to avoid their math assignments as too difficult (Skinner, Pappas, & Davis, 2005). In addition, people with math facts deficits are more likely to be excluded from job opportunities that require mathematical skills (Sante, McLaughlin, & Weber, 2001). Fluency in the completion of arithmetic facts is also very important for the performance of everyday life activities, such as money management (Poncy, McCallum, & Schmitt, 2010; Spooner, Saunders, Root, & Brosh, 2017). To improve fluency in basic mathematical facts, some of the most common fluency buiding-techniques are used, such as precision teaching (Lindsley, 1992), effective exercise activities and feedback (Burns, 2005). For greater effectiveness, these techniques can be used in combination with other strategies (Farrell & Mc Dougall, 2008).

Despite the potential of self-monitoring to improve school performance, few studies investigated the effects of self-monitoring on the execution of mathematical exercises by students with intellectual and developmental disabilities (Agran, Cavin, Wehmeyer, & Palmer, 2006; Farrell & McDougall, 2008; Hughes, Copeland, Agran, Wehmeyer, & Rodi, 2002). Holifield, Goodman, Hazelkorn and Heflin (2010) examined the effects of self-monitoring, with verbal prompts, to help two children with second-grade autism to track their behavior. One of the limitations of the study was the time taken by the teacher to provide verbal prompts.

In recent years, researchers have used tactile prompts (e.g., MotivAider®) as an alternative to acoustic devices and verbal prompts, which can be more intrusive, stigmatizing, and adult-driven. The MotivAider® is an electronic device that can be easily programmed to vibrate based on a fixed or variable time interval.

Amato-Zech, Hoff, and Doepke (2006) studied the effects of using MotivAider® as a tactile stimulus to self-monitor on-task behavior in a class with students with special educational needs. Every three minutes, the MotivAider® vibrated, and the students recorded their behavior on an individual sheet. The results show that after the introduction of self-monitoring, students increased their on-task behavior. Similarly, Legge, DeBar, and Alber-Morgan (2010) examined the effects of self-monitoring using MotivAider® on the on-task behavior of three middle school students, two of whom with a diagnosis of autism and one with cerebral palsy. After each session, experimenters determined the accuracy of self-monitoring by comparing their data with those of the students.

Students could access to reinforcer if they were on-task for at least 80% of time. One of the limitations of the study was the lack of data on the accuracy of the mathematical tasks performed. Boswell, Knight and Spriggs (2013) studied the effect of self-monitoring with MotivAider® on the percentage of on-task behavior intervals of an 11-year-old child with moderate intellectual disability. The results show an increase in the percentage of on-task time during training, in the accuracy of monitoring their on-task behavior and in mathematical fluency.

In the school context, where teachers often have to teach huge classes, it would be advisable to implement group interventions to increase on-task behavior. These can be more productive, especially in terms of generalization (Heering & Wilder, 2006). When more than one student shares one ore more components of behavioral intervention, we use group contingencies (Turco & Elliot, 1990; Cooper et al., 2007). These strategies have the economic and practical advantage of minimizing the number of adults needed to manage students (Theodore, Bray, & Kehle, 2004). There are three types of group contingencies: independent, dependent, and interdependent. Independent contingencies include the use of the same target behavior, as well as the same criteria for having access to the reinforcer, which is the same for all students (Hulac & Benson, 2010). However, each student gains access to the reinforcer only by their behavior. Dependent group contingencies imply that the group can access the reinforcer contingently to the behavior of one or a few students (Kelshaw-Levering, Sterling-Turner, Henry, & Skinner, 2000). Finally, in the case of interdependent contingencies, a group of students has access to the reinforcer contingent upon the behavior of the entire group; for example, when the whole group meets the established criterion or when a mean group score is achieved (Cooper et al., 2007). In theory, interdependent contingencies seem to be more advantageous than dependent and independent contingencies, as they encourage students to achieve a common goal. Students are prone to help each other to increase the likelihood that everyone has access to the reinforcer (Kelshaw-Lewering et al., 2000).

As all members of the group must meet the criterion, individually and as a group, to achieve the reinforcer, problem behaviors within the class may decrease (Cashwell, Skinner, Dunn, & Lewis, 1998). Students who rarely receive reinforcement for their behavior may feel motivated to achieve a group goal (Skinner, Cashwell, & Dunn, 1996). Teachers may prefer these programs because they are useful in helping students work well together and meet teachers' expectations, and efficient in terms of reducing the number of adults needed to manage a group of students (Sharp & Skinner, 2004).

Another effective strategy in different contexts to achieve behavioral changes is public posting, used to provide feedback to students about their performance (O' Handley, 2014). Regardless of the setting, the information the person receives through the feedback creates motivational operations to increase the emission of a specific behavior in the future (Wright, 2016). Public posting also requires that other members of a group see each individual's performance levels. Posting can create an establishing operation that increases the value of the reinforcer for the subject. Therefore, the person is more likely to emit the behavior with which he or she has access to the reinforcer (Quinn, Miltenberger, Abreu, & Narozanick, 2017).

Some studies have examined the effects of public posting on academic achievements. Van Houten, Morrison, Jarvis and McDonald (1974) measured the number of words that primary school students were able to write in a ten-minute interval using public posting, timing, and feedback. The results showed that the number of words written by the students doubled during the training; when the public posting ended, the students' performance returned to baseline levels. Although some studies investigated the effects of public posting on academic performance, only a few focused on the effects of public posting on the classroom's behavior (Wright, 2016). Staub (1990) examined the use of public posting to reduce problem behavior in the corridor with 250 secondary school students. Again, the study demonstrated the effectiveness of public posting in promoting a behavioral change.

This research aims to evaluate the effectiveness of an intervention, carried out through two studies, which includes the use of variable interval reinforcement schemes, self-monitoring strategies, an interdependent group contingency and public posting on the on-task time, the number of correct arithmetic facts and the total number of completed arithmetic facts, in a small group context.

Method

Participants

Four adolescents with neurodevelopmental disorders participated in this study. All the participants had a teacher or an educator as personal support during their whole school timetable. They all received individualized teaching based on Applied Behavior Analysis (ABA) from a minimum of 12 to a maximum of 22 hours a week in the afternoon. At the onset of the study all, the participants functioned at a writer-as-own reader level of verbal development (Greer & Ross, 2008).

Participant A was a 16-year-old-male with moderate intellectual disability (DSM-5; American Psychiatric Association [APA], 2013). He attended the third year of secondary school, for a total of 25 hours a week. He was selected for this study as he often emitted request avoidance behaviors during the completion of afternoon homework and individualized activities in the learning center's schedules.

Participant B was a 17-year-old-male with mild intellectual disability and Attention Deficit Hyperactivity Disorder (DSM-5; APA, 2013). He attended the first year of secondary school, for a total of 22 hours per week. He was selected for this study as he showed a limited ability to concentrate on carrying out the activities assigned to him and difficulties in regulating his behavior. He often reacted to requests with screams, swearing, and beating, especially in group settings.

Participant C was an 18-year-old male who had a diagnosis of Prader-Willi syndrome. He attended the fourth year of secondary school, for a total of 25 hours per week. The student was selected for this study as he was unable to complete the assigned arithmetic facts in the time devoted during the schedule of activities at the learning center.

Participant D was a 14-year-old male with autism spectrum disorder (DSM-5; APA, 2013). He attended the third year of secondary school for a total of 21 hours per week. The student was selected for this study as he often emitted request avoidance behaviors, during the completion of afternoon homework, and problem behaviors with peers when involved in a group setting, such as teasing other students.

Setting and materials

The study took place in a learning center in northern Italy. All the experimental phases were conducted in a room where students were engaged in individualized instructional programs and afternoon homework. The room contained two rectangular tables with four chairs.

The evaluation of the mathematical skills, which took place through a criterion assessment before starting the research, allowed the creation of personalized work materials for each participant. Thus, each student had at his disposal worksheets with a series of arithmetic facts to complete that he was able to carry out independently. During the self-monitoring training, the students also used a data sheet to record their behavior and a graph on which they recorder the corresponding data at the end of each work session. For data collection, the experimenter used a clipboard, a data collection sheet, a pencil, a timer, and a MotivAider®.

Procedure and Measures

In both studies, three dependent variables were measured. The first dependent variable was the percentage of on-task behavior intervals for each participant during 10-minute observation sessions. On-task behavior was defined in operational terms as the students sitting in the chair, looking at the worksheets, writing down the answers on the paper, using compensatory tools (i.e., the calculator) to carry out the exercises. All other behaviors, such as walking around the classroom, looking around or talking to other students, were considered off-task.

The second dependent variable was the number of arithmetic facts, selected for each participant based on their skill level, that was carried out correctly in each session. Finally, a third dependent variable was the total of the arithmetic facts completed by the students in each work session. The independent variable in the first study was a variable interval (VI) schedule of reinforcement. The first on task response emitted by the participants, once the interval elapsed, was reinforced by the experimenter with descriptive social praise. The mastery criterion was defined as a percentage of 100% of on-task behavior intervals for two consecutive sessions, except for Participant D, for which the criterion was 95% for two consecutive sessions. Each time the student mastered the criterion, the duration of the interval was increased from 60 seconds to 90 seconds and finally to 120 seconds. In the second study, the independent variable was an intervention package consisting of a self-monitoring procedure combined with an interdependent group contingency and public posting. Self-monitoring was implemented in 10-minute sessions using a 60" VI. The self-monitoring mastery criterion was set at 100% for two consecutive sessions for the Inter Observer Agreement (IOA), between the student's data and the data taken by the observer, established by the experimenter. At the end of each session, all the participants needed to achieve the percentage of the agreement previously established by the experimenter, to access the reinforcer. Eachstudent plotted this percentage at the end of the training. The graph was on a wall of the room so students could monitor their progress, and the other members of the group could also see this. *Experimental design*

An ABAB reversal design (Cooper et al., 2007) was used for the first study, where the behaviors defined as dependent variables were observed and measured both during the baseline phases, in which the independent variable was absent and in training phases, during which the independent variable was introduced. For the second study, a single-subject pre and post probe design (Cooper et al., 2007) was used to compare the percentage of on-task behavior intervals, the number of correct arithmetic facts, and the number of arithmetic facts completed before and after the training implementation.

Experiment 1

Before the introduction of training, the experimenter conducted 10-minute observations to measure behaviors defined as dependent variables. The experimenter placed the worksheets for each student at the location assigned to each one. Materials were structured in a manner that if the students completed the exercises before the 10 minutes elapsed, they would have more to do. Therefore, there was no fixed number of arithmetic facts to complete.

As all students sat at the tables, with their worksheets available, the experimenter provided them with individual indications on the exercises to be carried out, instructed them to complete the arithmetic facts assigned to them, and began the observation procedure. The experimenter set the MotivAider® to a fixed interval (FI) of 30 seconds and held the device with him. Each time the MotivAider® vibrated, the experimenter recorded on a data collection sheet whether the behavior of each student was on task or not, through a procedure of Momentary Time Sampling (MTS), which allows to measure whether a target behavior occurs at the moment corresponding to the end of a time interval (Cooper et al., 2007). At this stage, the experimenter did not provide any consequences for the students' behavior.

As in the baseline sessions, the teacher ensured that the students had the materials at their disposal and were well aware of how to proceed before starting the 10-minute training session.

The experimenter set the MotivAider® on a 60-second VI. When the MotivAider® vibrated, the experimenter recorded on the data collection sheet the student's behavior at that specific time, using the MTS, and reinforced with verbal approvals (e.g., "Good guys, you are working very well!") the first emission of on-task behavior. The experimenter did not redirect off-task behavior unless it directly disturbed other students. During the training, a second experimenter was at the students' disposal for any doubts or difficulties regarding the assigned exercises. At the end of each work session, the students had access to an activity that they had previously planned with the experimenter. Once reached the 100% mastery criterion for two consecutive sessions, a longer interval of 90 seconds and finally 120 seconds was introduced. For Participant D, the mastery criterion was set at 95% for two consecutive sessions only for the 60-second and 90-second VI schemes, as the 120-second VI condition was not implemented.

At the end of the training, baseline observations were conducted to compare the pattern of performance between the experimental phases, using the same methods described for the pre-probe observations. The independent variable was then reintroduced, at the end of the baseline measurements, with a 60 seconds VI reinforcement scheme.

Experiment 2

At the beginning of the second study, 10-minute pre-probe sessions were conducted in the modalities described for the previous study. Following this phase, self-monitoring training was introduced with 10-minute sessions. The participants were all seated at the same table, with their own maths worksheets at disposal. The experimenter gave each participant a self-recording sheet on which to record their behavior and then placed on the table the MotivAider ®, set to a 60 seconds VI. The experimenter then explained what self-monitoring consisted of and modeled how to record the data on the sheet. When the MotivAider® vibrated, students had to mark a "+" if working on assigned tasks at that moment and a "-" if they were doing something else, such as talking to another student. Participants were also informed that to access the break, they all needed to reach an inter-observers agreement of 60% or more comparing their data with those of the experimenter. The latter then gave practical examples to the students of how they were going to calculate the score. If all the students reached or exceeded this level, then they were allowed to have access to the chosen activity. Once the mastery criterion for this objective was achieved, for two consecutive sessions, a new one was set at 70% until an agreement level of 90% was obtained. During the training sessions, when the MotivAider® vibrated, the experimenter recorded on a data collection sheet the behavior of each participant, making sure that the students themselves recorded the data related to their behavior. At the end of each session, the experimenter calculated the percentage of agreements, comparing his data with those of the students on the self-recording sheet. An agreement occurred when both the experimenter and student recorded "+" or "-" at the end of the corresponding interval. If all the students achieved the level of the agreement previously established, they could have access to the reinforcer (i.e., the break). Participants reported on a graph the percentage of agreement obtained during self-monitoring. The graph was then hung on the wall of the room so that all participants could monitor their progress and other members of the group's progress. Moreover, as the training took place in a room where other individualized activities were carried out, the graphs were also viewable to other students attending the learning center.

At the end of the intervention, post probes were conducted using the same procedure as for the pre probes.

Data Collection

In both studies, probes data were collected through systematic 10-minute observations. When all the students were sitting at the tables in the room, with their materials at their disposal, and after having indicated the assigned tasks, the experimenter activated the 10-minute timer and simultaneously turned on the MotivAider®, set to a fixed interval of 30 seconds. When the MotivAider® vibrated, the experimenter recorded each student's on-task behavior using a Momentary Time Sampling (MTS) procedure (Cooper et al., 2007). The behavior was recorded on the data collection sheet in the following way: the experimenter marked a "+" if the student's behavior was on-task, or a "-" if the behavior was off-task. At the end of each session, the percentage of on-task behavior was calculated and then reported on a graph. Also, the experimenter calculated the number of correct arithmetic facts and the total number of the student's arithmetic facts. At the end of the baseline sessions, the experimenter recorded on a graph the averages of the correct arithmetic facts and those completed per session. This data collection procedure was also used during all training sessions.

Inter-Observer Agreement (IOA) was calculated by having a second observer, who independently and simultaneously recorded the data. Agreements were divided by agreements plus disagreements then multiplied by 100 (Cooper et al., 2007). In the first study, the IOA was calculated for 75% of training sessions with 90% agreement and 70% of probe sessions with 90% agreement. In the second study, the IOA was determined for 30% of training sessions with 100% agreement and 50% of probe sessions with 100% agreement.

Results

Participant A's mean percentage of on-task behavior during the five baseline sessions occurred for 63.2% of the intervals (range= 53%-80%). In this phase, the student produced a mean of 14 correct and 19.2 completed arithmetic facts. In the first training phase, the student achieved the mastery criterion for the VI 60" reinforcement scheme in eight sessions, with a mean percentage of on-task intervals of 89.6% (range = 69%-100%); during the VI 60" schedule condition the student performed a mean of 20.5 correct and 28.6 completed arithmetic facts. With the introduction of the VI 90" scheme, the student achieved the criterion of mastery in four sessions, with a mean percentage of on-task intervals of 96.2% (range=85%-100%), a mean of 30.2 correct and 38.2 completed arithmetic facts were recorded. The student reached the criterion for the VI 120" scheme in seven sessions, with a mean percentage of on-task intervals of 96.5% (range=91% -100%); the means of corrected and completed arithmetic facts were 31.8 and 39.7 respectively. In the five baseline observations, conducted after the intervention, the student's mean percentage of on-task behavior occurred for 56,8% of the intervals (range = 19%-83%). At this stage, the means of correct and completed arithmetic facts were six and 16.2, respectively. Finally, during the VI 60" reinforcement schedule condition, a mean percentage of on-task intervals of 91.2% (range = 80% - 100%) was measured in four sessions. In this phase, the student produced a mean of 24.2 correct and 26.8 completed arithmetic facts.

Participant B's mean percentage of on-task behavior during the five baseline sessions, occurred for 65.2% of the intervals (range = 41%-77%). At this stage, the means of correct and completed arithmetic facts were 40.2 and 49.6, respectively. The student achieved the mastery criterion for the VI 60" reinforcement scheme in five sessions, with a mean percentage of on-task intervals of 92.6% (range = 81% -100%); the student performed a mean of 57.8 correct and a 70.6 completed arithmetic facts. The student achieved the criterion for the VI 90" scheme in five sessions, with a mean percentage of on-task intervals of 87.6% (range = 69% - 100%), a mean of 65.2 corrected and 75 completed arithmetic facts were recorded. With the introduction of the VI 120" scheme, the student achieved the criterion in two sessions, with a mean percentage of on-task intervals of 100%.

The means of correct and completed arithmetic facts were 72 and 81.5, respectively. In the six post-intervention baseline observations, the mean percentage of on-task behavior intervals was 60.5% (range = 31%-87%). During this phase, a mean of corrected of 30,8 and 41, 5 completed arithmetic facts were recorded. Finally, in the second phase of implementation of the intervention, the participant achieved the criterion of mastery in three sessions, with a mean percentage of on-task intervals of 86.6% (rang e= 60% - 100%). In this phase, the student produced a mean of 71 correct and 82.3 completed arithmetic facts.

Participant	Experimental phase	Mean percentage of on-task interval	Mean of correct arithmetic facts	Mean of completed arithmetic facts
Participant A	Baseline 1	63,2%	14	19,2
	VI 60”	89,6%	20,5	28,6
	VI 90”	96,2%	30,2	38,2
	VI 120”	96,5%	31,8	39,7
	Baseline 2	56,8%	6	16,2
	VI 60”	91,2%	24,2	26,8
Participant B	Baseline 1	65,2%	40,2	49,6
	VI 60”	92,6%	57,8	70,6
	VI 90”	87,6%	65,2	75
	VI 120”	100%	72	81,5
	Baseline 2	60,5%	30,8	41,5
	VI 60”	86,6%	71	82,3
Participant C	Baseline 1	78%	17,3	23,6
	VI 60”	88,8%	45,8	58,1
	VI 90”	100%	51	71
	VI 120”	96,2%	51,2	63
	Baseline 2	97,5%	29	41
	VI 60”	97,3%	40	60,3
Participant D	Baseline 1	50,8%	24	36,6
	VI 60”	89,7%	78	80,7
	VI 90”	82,4%	49	68,7
	Baseline 2	49%	32,8	48,6
	VI 60”	73,6%	79,6	86

Table 1. *Mean percentage of on-task intervals, mean of correct and completed arithmetic facts, during each experimental phase, for all participants.*

Participant C's mean percentage of on-task behavior during the six baseline sessions occurred for 78% of the intervals (range = 54%-100%). At this stage, the means of correct and completed arithmetic facts for each session were 17.3 and 23.6, respectively. In the first phase of implementation of the training, the student reached the criterion for the VI 60" scheme in seven sessions, with a mean percentage of on-task intervals of 88.8% (range = 60% - 100%); the student produced a mean of 45.8 correct and 58.1 completed arithmetic facts. During the VI 90" schedule condition, the student achieved the criterion in two sessions, with a mean percentage of on-task intervals of 100%; a mean of 51 corrected and 71 completed arithmetic facts were measured. In the VI 120" condition, the student met the criterion in four sessions, with a mean percentage of on-task intervals of 96.2% (range = 90% -100%). During this condition, the means of the correct arithmetic facts and those produced in total were 51,2 and 63, respectively. In the two post-intervention baseline observations, the mean percentage of on-task intervals recorded for the participant was 97.5% (range = 95%-100%). In this phase, the student produced a mean of 29 correct and 41 completed arithmetic facts. Finally, in the second phase of implementation of the intervention, the student achieved the criterion in three sessions, with a mean percentage of on-task behavior intervals of 97.3% (range = 92%-100%). During this phase, the student produced a mean of 40 correct and 60.3 total arithmetic facts.

Participant D's mean percentage of on-task behavior during the six baseline sessions occurred for 50.8% of the intervals (range = 45%-64%). In this phase, the student produced a mean of 24.8 correct and 36.6 completed arithmetic facts. In the VI 60" condition, the student reached the criterion in four sessions, with a mean percentage of on-task intervals of 89.7 % (range = 80% - 95%). The means of the correct and completed arithmetic facts were 78 and 80.7, respectively. In the VI 90" condition, the student reached the criterion in seven sessions with a mean percentage of on-task intervals of 82.4% (range = 53% - 98%). During this condition, the student produced a mean of 49 correct and 68.7 completed arithmetic facts. In the five post-intervention baseline observations, the participant's mean percentage of on-task behavior occurred for 49% of the intervals (range = 22%-77%). During this phase, the student produced a mean of 32.8 corrected and a 48.6 completed arithmetic facts. Finally, in the second phase of the intervention, a mean percentage of on-task intervals of 73.6% (range, = 61%-88%) was recorded in five sessions. During this phase, the means of correct and total arithmetic facts were respectively 79.6 and 86.

Table 2 shows the results for Experiment 2. Participant A, in the two pre-probe sessions, emitted on-task behavior for a mean percentage of intervals of 72.5% (range = 60%-85%). In this phase, the means of the correct and completed arithmetic facts were 1.5 and 8.5, respectively. During the two post probe sessions, the student emitted a mean percentage of 95% on-task intervals (range = 90%-100%). The student produced a mean of 18.5 correct and 23 completed arithmetic facts.

Participant	**Experimental Phase**	**Mean percentage of on-task intervals**	**Mean of correct arithmetic facts**	**Mean of completed arithmetic facts**
Participant A	Pre Probe	72,5%	1,5	8,5
	Post Probe	95%	18,5	23
Participant B	Pre Probe	75%	21	29,5
	PostProbe	85%	48,5	62,5
Participant C	Pre Probe	100%	27,5	37,5
	Post Probe	100%	21,5	38,5

Table 2. *Mean percentage of on-task intervals and means of correct and completed arithmetic facts for each participant, during pre and post probe sessions.*

For Participant B, in the two pre-probe sessions, a mean percentage of on-task intervals of 75% (range = 70%-80%) was measured. During this phase, the student produced a mean of 21 correct and 29.5 completed arithmetic facts. In the two post probe sessions, a mean percentage of on-task intervals of 85% (range = 75%-95%) for each session was measured for the student. The means of the correct and completed arithmetic facts were 48.5 and 62.5, respectively.

Participant C, during the two pre-probe sessions, emitted on-task behavior for a percentage of intervals of 100%. During this phase, the student produced a mean of 27.5 correct and 37.5 completed arithmetic facts. In the two post probe sessions, a percentage of 100% on-task intervals was measured for the student. During this phase, the means of correct and completed arithmetic facts in total were 21.5 and 38.5, respectively.

Table 3 shows, for each participant, the mean percentages of on-task intervals and agreements with the teacher's data during the self-monitoring training, together with the means of the correct and the completed arithmetic facts.

Participant	Objective of % of agreements	mean% of on-task intervals	mean% of agreements	Mean of correct arithmetic facts	Mean of completed arithmetic facts
Participant A	60%	89,5%	79,5%	1	3,5
	70%	97%	82%	19,5	31
	80%	100%	97,5%	38,2	50,5
	90%	100%	100%	49,6	61,3
Participant B	60%	92%	85%	40	48,5
	70%	100%	93%	38	53,5
	80%	97%	100%	57,1	75,5
	90%	100%	100%	39	54
Participant C	60%	97%	92%	25	37,5
	70%	100%	100%	11,5	19
	80%	100%	100%	13,5	33
	90%	100%	100%	14,6	19

Table 3. *Mean percentage of on-task intervals, mean percentage of agreements with the experimenter's data and mean values of correct and completed arithmetic facts, during self-monitoring training.*

The table shows that all the participants have met the fixed criterion contingency, as their mean percentages of agreements were always higher than the fixed objective. In addition, the mean percentage of on-task intervals also seems to increase for all participants, as the goal of the fixed criterion contingency increases.

Discussion

The study aimed at assessing the effectiveness of an intervention on on-task behavior, in a group of adolescents with neurodevelopmental disorders, during the execution of arithmetic facts.

Overall, the results of the first study (Table 1) show for all participants, with the introduction of VI reinforcement schedules, an increase in the percentage of on-task behavior intervals, during both the first and the second training phase, compared to baseline conditions. Similarly, the number of correct and completed arithmetic facts increased in the intervention phases compared to baseline sessions.

Except for Participant C, the mean percentage of on-task intervals recorded in return to baseline sessions for Participants A, B, and D is lower than in the initial baseline measurements. This result could indicate that in the absence of the independent variable and, therefore, without the attention given by the teacher through reinforcement schedules, the students found reinforcement in the attention given by peers to the emission of off-task behaviors.

It is interesting to note that Participant C, with the introduction of VI reinforcement schemes in the first phase of training, progressively increased the number of correct and completed arithmetic facts. During the VI 120" condition, there is a slight decrease in the mean of total arithmetic facts per session and percentage of on-task intervals compared to the previous condition. An explanation could be that the longer duration of the interval in the reinforcement scheme led to a lower student response rate (Cooper et al., 2007). The student was included in the study as he took a long time to complete the assigned arithmetic facts. Therefore, the results of the study suggest that the VI reinforcement schemes were useful for increasing the overall number of completed arithmetic facts and that the student could be faster in carrying out the assigned materials.

Concerning Participant D, the decision to set the mastery criterion at 95% for two consecutive sessions, was dictated by the difficulties of concentration shown by the student in the context of small group and the frequent emission of off-task behaviors during the workgroup sessions. Moreover, the student's variable frequency of attendance at the learning center did not allow the implementation of continuous training. With the passage to VI 90" condition, there was a decrease in the means of correct and completed arithmetic facts for each session and the percentage of on-task behavior. One possible explanation could be that, by increasing the duration of the interval, the reinforcement provided by the teacher did not encourage the emission of on-task behavior, and that the student found more reinforcing the attention that the students were paying him during the emission of off-task behavior. Therefore, for Participant D, it was decided to terminate the first phase of training with the achievement of the criterion in the VI 90" condition.

Experiment 1 presents some limitations of a methodological nature. One of the main difficulties encountered was related to the measurement of on-task behavior. Particularly in the initial phase of the training, there were some difficulties in determining whether the student's behavior was on-task. For example, in some cases, it was difficult to discriminate whether the students were concentrated on completing the assigned arithmetic facts or whether they were responding randomly. A further limitation is that sessions were conducted on days when not always all four participants were present, due to the different weekly attendance at the learning center. This factor may have influenced, in some cases, the percentage of on-task time in the different sessions, as the presence or absence of one or more members of the group may have acted as a discriminatory stimulus for the other students' behavior. For example, in the presence of one of the group members emitting more disturbing behaviors, other members would also emit more off-task behaviors. The absence of this member may have influenced the percentage of on-task behavior in some training sessions, which was so much higher. Moreover, it was not possible to eliminate the influence of some external variables related to the setting, such as the presence of other students in the room. Finally, a temporal limit for Participants A and D was that of not having carried out further sessions, in the second phase of implementation of the intervention, to allow the achievement of the mastery criterion.

Despite the limitations described above, as a result of the introduction of VI reinforcement schemes, all participants increased their on-task behavior. The training was easy to implement, and group activity resulted in being reinforcing and motivating for the students. Thus, this study seems to corroborate the results of previous research on the effectiveness of reinforcement schemes (Austin & Soeda, 2008; Riley, McKevitt, Shriver, & Allen, 2011) and, in particular, of VI schemes in the development of habitual behaviors that last for a prolonged time (Cooper et al., 2007; Hulac & Benson, 2010; Hulac et al., 2016; Lee & Belfiore, 1997; Martens et al., 1992). The choice of materials was determined by the fact that all participants presented difficulties in the execution of arithmetic facts. The worksheets were personalized according to the specific skills of each student so that everyone was able to perform the assigned arithmetic facts independently. If a student is not able to perform a given task in the absence of direct instructions, then VI schemes may not necessarily represent a functional strategy (Hulac et al., 2016). In these cases, it would be appropriate to provide the student with immediate feedback on the performance, along with more opportunities for practice. However, when working on fluency, VI schemes represent a useful strategy to be implemented to increase on-task behavior (Hulac et al., 2016). In this study, through the implementation of VI reinforcement schemes, participants accurately completed more arithmetic facts. The training could be a way to build mathematical fact fluency in students with neurodevelopmental disorders. The practical implications can be found in the importance of mathematical competences, even outside the academic field (Poncy et al., 2010). Indeed, those who can apply mathematical skills to a job, during leisure activities or everyday life situations can be more independent and experience a better quality of life (Spooner et al., 2017).

Future research may assess the effectiveness of these procedures during long observation periods. Also, it would be beneficial to identify the conditions necessary for the long-term maintenance of the effects obtained.

A further consideration is that the teacher's presence may have probably developed the properties of the discriminatory stimulus for the emission of appropriate group behavior (Marholin & Steinman, 1977). The literature (Duncan & Magnuson, 2011; Roberge, Rojas, & Baker, 2012) shows that the development of on-task behavior is a precursor to the improvement in students' academic performance. However, to ensure that on-task behavior is maintained even in the absence of the teacher, the discriminatory function should be transferred to other stimuli present in the group context (Marholin & Steinman, 1977).

To progressively reduce the stimulus control represented by the presence of the teacher and make the students more independent in carrying out the assigned activities, Experiment 2 was then conducted. The intervention included a self-monitoring procedure, combined with an interdependent group contingency, and public posting. Participant D did not take part in the study due to the termination of the attendance at the learning center.

The results (Table 2) show that, although the participants were already starting from very high percentages of on-task intervals in the pre probes, at the end of the training, they increased their on-task time, as well as the number of correct and completed arithmetic facts. For Participant C, the percentage of on-task intervals remained invariant from pre-probe to post-probe sessions, and the mean of the correct arithmetic facts decreases slightly. The student learned in the course of the two studies to increase his on-task behavior, but he was more accurate in executing arithmetic facts during the implementation of VI reinforcement schedules. More generally, the increase in the percentage of on-task intervals during post probes sessions may suggest that students learned to emit on-task behaviors even without the use of MotivAider®. This increase could be the result of reinforcement schemes not considered in the study. If the fact of scoring a "+" acted as a reinforcer, the increase in on-task time supports the principle that behaviors reinforced through intermittent reinforcement schemes tend to be more consistent and resistant to extinction (Cooper et al., 2007).

In line with previous research results (Amato-Zech, Hoff, & Doepke, 2006; Boswell et al., 2013; Legge, DeBar, & Alber-Morgan, 2010), the self-monitoring training was easy for students to implement and time-efficient. As the students themselves monitored and recorded their behavior, the intervention had the effect of gradually decreasing the control of the discriminatory stimulus provided by the teacher. During the training, the on-task behavior increased despite the absence of tangible reinforcements for this behavior. This result seems consistent with the theory that self-monitoring of appropriate behavior can assume motivational properties, reinforcing a behavioral change (Nelson & Hayes, 1981).

In the present study, public posting has had some practical implications. The graphs, on which students recorded the percentage of agreements, hung on the walls of the classroom, provided visual feedback on their performance and of other members of the group. Moreover, graphs were visible not only to the participants in the study but also to other students in the room. Public posting, together with the introduction of an interdependent group contingency, led to students being highly motivated and engaging in the emission of on-task behaviors, reaching or exceeding the expected agreement percentage from time to time. It would seem, therefore, that the students felt motivated to reach a group objective (Hulac & Benson, 2010). This could have led to an increase in the percentage of on-task time already during the training.

An interesting aspect is that during the training, other students with moderate intellectual disabilities and autism spectrum disorders were also included in the setting, as they showed difficulties in concentrating for even short periods and emitted request avoidance behaviors. When these students emitted off-task behaviors but did not receive attention from the other students who were engaged in completing the assigned materials, they decreased the emission of disturbing behaviors and returned to engage in their activities. This result could indicate a qualitative difference from the previous study: the students during the self-monitoring training seemed to be more concentrated in carrying out the assigned activities and less influenced by external factors, such as the presence of other students in the setting.

The results indicate that self-monitoring training could be used to improve mathematical performance of students with neurodevelopmental disorders, together with the implementation of other fluency-based strategies (Farrell & McDougall, 2008).

The limits of this second study were the lack of generalization to other settings and not having been able to reduce the teacher's intervention ultimately. Especially during the first training sessions, the teacher often had to give instructions to the students on how to record their behavior when the MotivAider® vibrated.

Despite the limitations, the results of this study are promising: a self-monitoring training with MotivAider® seems to be a practical and effective intervention to increase on-task behavior among students with neurodevelopmental disorders and behavioral difficulties. Further research is needed to examine whether in the long term students can control on-task behavior independently, without relying on external prompts, or whether the effects of self-monitoring disappear when the intervention is applied discontinuously. Future studies could assess the effects of a self-monitoring intervention with students with neurodevelopmental disorders in a school setting, or to assess the impact of this strategy on other academic skills and with students with different disabilities.

Conclusions

The inclusion of students with neurodevelopmental disorders in school is a challenge for teachers working in classrooms with students with different educational needs. The implementation of strategies to increase students' on-task time in carrying out academic activities, such as those described in this study, could therefore positively influence classroom management and provide more learning and independence opportunities for students with neurodevelopmental disorders.

***Acknowledgements, Grants and Funding*.** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Interest statement: none.

References

Agran, M., Cavin, M., Wehmeyer, M., & Palmer, S. (2006). Participation of students with moderate to severe disabilities in the general curriculum: The effects of the self-determined learning model of instruction. *Research & Practice for Persons with Severe Disabilities*, *31*, 230-241. https://doi.org/10.1177%2F154079690603100303

Alberto, P. A., & Troutman, A. C. (2009). *Applied behavior analysis for teachers*. Upper Saddle River, NJ: Pearson.

Algozzine, B., Ysseldyke, J., & Elliott, J. (1997). *Strategies and tactics for effective instruction*. Longmont, CO: Sopris West.

Allday, R. A., & Pakurar, K. (2007). Effects of teacher greetings on student on task behavior. *Journal of applied behavior analysis*, *40*(2), 317-320. https://dx.doi.org/10.1901%2Fjaba.2007.86-06

Amato-Zech, N. A., Hoff, K. E., & Doepke, K. J. (2006). Increasing on-task behavior in the classroom: Extension of self-monitoring strategies. *Psychology in the Schools*, *43*(2), 211-221. https://doi.org/10.1002/pits.20137

American Psychiatric Association (APA) (2013). DSM-5, *Manuale diagnostico e statistico dei disturbi mentali*, tr. italiana Raffaello Cortina, Milano, 2014.

Austin, J. L., & Soeda, J. M. (2008). Fixed-time teacher attention to decrease off-task behaviors of typically developing third graders. *Journal of Applied Behavior Analysis*, *41*(2), 279-283. https://dx.doi.org/10.1901%2Fjaba.2008.41-279

Boswell, M. A., Knight, V., & Spriggs, A. D. (2013). Self-monitoring of on-task behaviors using the MotivAider® by a middle school student with a moderate intellectual disability. *Rural Special Education Quarterly*, *32*(2), 23-30. https://doi.org/10.1177%2F875687051303200205

Blenk, K., & Fine, D. L. (1995). Making School Inclusion Work: A Guide to Everyday Practice. Cambridge, MA: Brookline.

Briesch, A. M., Hemphill, E., & Daniels, B. (2013). Check your SLANT: Adapting self-management for use as a class-wide intervention. *School Psychology Forum*, *7*, 29-39.

Burns, M. K. (2005). Using incremental rehearsal to increase fluency of single-digit multiplication facts with children identified as learning disabled in mathematics computation. *Education and Treatment of Children*, 237-249.

Cardoso-Leite, P., & Bavelier, D. (2014). Video game play, attention, and learning: how to shape the development of attention and influence learning?. *Current opinion in neurology*, *27*(2), 185-191. https://doi.org/10.1097/WCO.0000000000000077

Carr, S. C., & Punzo, R. P. (1993). The effects of self-monitoring of academic accuracy and productivity on the performance of students with behavioral disorders. *Behavioral Disorders*, *18*, 241-250. https://doi.org/10.1177%2F019874299301800401

Casarini, F., Artoni, V., Cascavilla, R., & Galanti, E. (2016). Token economy e peer-monitoring a scuola: aumentare la partecipazione e diminuire i comportamenti problematici in classe. *Difficoltà di apprendimento e didattica inclusiva*, *3*(3), 345-351.

Cashwell, C. S., Skinner, C. H., Dunn, M., & Lewis, J. C. (1998). Group reward programs: A humanistic approach. *The Journal of Humanistic Education and Development*, *37*(1), 47-53. https://doi.org/10.1002/j.2164-4683.1998.tb00405.x

Celi, F., Fontana, D. (2001). L'insegnamento positivo: ricerche psicoeducative in situazione reale sui comportamenti problematici. *Difficoltà di Apprendimento*, *7* (2), 215-228.

Choate, J. S. (2000). Successful inclusive teaching. *Proven ways to detect and*. Boston: Pearson Education.

Christensen, A. P., & Sanders, M. R. (1987). Habit reversal and differential reinforcement of other behaviour in the treatment of thumb-sucking: An analysis of generalization and side-effects. *Child Psychology & Psychiatry & Allied Disciplines*, *28*, 281-295 https://psycnet.apa.org/doi/10.1111/j.1469-7610.1987.tb00211.x

Cole, C.L., Marder, T., & McCann, L. (2000). Self-monitoring. In E.S. Shapiro & T.R. Kratochwill (Eds.), *Conducting school based assessments of child and adolescent behavior* (pp. 121–149). New York: Guilford Press.

Cooper, J.O., Heron, T.E., & Heward, W.L. (2007). *Applied Behavior Analysis.* Upper Saddle River, NJ: Prentice Hall.

Cowan, N. (1988). Evolving conceptions of memory storage, selective attention, and their mutual constraints within the human information-processing system. *Psychological bulletin*, *104*(2), 163. https://doi.org/10.1037/0033-2909.104.2.163

Dalton, T., Martella, R. C., & Marchand-Martella, N. E. (1999). The effects of a self-management program in reducing off-task behavior. *Journal of Behavioral Education, 9*, 157-176. https://doi.org/10.1023/A:1022183430622

DiGangi,S. A., Maag, J.W., & Rutherford, R.B.,Jr.(1 991). Self-graphing of on-task behavior: Enhancing the reactive effects of self-monitoring on on-task behavior and academic performance. *Learning Disability Quarterly*, *14*, 221-223. https://doi.org/10.2307%2F1510851

Duncan, G. J., & Magnuson, K. (2011). The nature and impact of early achievement skills, attention skills, and behavior problems. *Whither opportunity*, 47-70.

Farrell, A., & McDougall, D. (2008). Self-monitoring of pace to improve math fluency of high school students with disabilities. *Behavior Analysis in Practice*, *1*(2), 26-35. https://dx.doi.org/10.1007%2FBF03391725

Friend, M., & Bursuck, W. (2006). *Including students with special needs: A practical guide for classroom teachers.* Boston: Pearson Education.

Gee, K. (2002). Looking closely into the instructional approaches: Honoring and challenging all children and youth in inclusive schools. In W. Sailor, (Ed.), *Whole-school success and inclusive education: Building partnerships for learning, achievement, and accountability* (pp. 123–144). New York: Teachers College Press.

Graham-Day, K. J., Gardner, R., & Hsin, Y. (2010). Increasing on-task behavior of high school students with Attention Deficit Hyperactivity Disorder: Is it enough? *Education and Treatment of Children*, *33*, 205-221. https://psycnet.apa.org/doi/10.1353/etc.0.0096

Greer, R. D., & Ross, D. E. (2008). *Verbal Behavior Analysis: Inducing and Expanding New Verbal Capabilities in Children with Language Delays*. New York, NY: Allyn and Bacon.

Hackenberg, T. D. (2009). Token reinforcement: A review and analysis. *Journal of the Experimental Analysis of Behavior*, *91*, 257–286. https://dx.doi.org/10.1901%2Fjeab.2009.91-257

Haring, N. G., & Eaton, M. D. (1978). Systematic instructional procedures: An instructional hierarchy. *The fourth R: Research in the classroom*, 23-40. Columbus OH:Merrill.

Heering, P. W., & Wilder, D. A. (2006). The use of dependent group contingencies to increase on-task behavior in two general education classrooms. *Education and Treatment of Children*, 459-468.

Henderlong, J., & Lepper, M. R. (2002). The effects of praise on children's intrinsic motivation: A review and synthesis. *Psychological bulletin*, *128*(5), 774. https://psycnet.apa.org/doi/10.1037/0033-2909.128.5.774

Hitchcock, C., Meyer, A., Rose, D., & Jackson, R. (2002). Providing new access to the general curriculum: Universal design for learning. *Teaching exceptional children*, *35*(2), 8-17. https://doi.org/10.1177%2F004005990203500201

Holifield, C., Goodman, J., Hazelkorn, M., & Heflin, L. J. (2010). Using self-monitoring to increase attending to task and academic accuracy in children with autism. *Focus on Autism and Other Developmental Disabilities, 25*, 230-238. https://doi.org/10.1177%2F1088357610380137

Hughes, C., Copeland, S. R., Agran, M., Wehmeyer, M. L., & Rodi, M. S. (2002). Using self-monitoring to improve performance in general education high school classes. *Education and Training in Mental Retardation and Developmental Disabilities*, *37*, 262-272.

Hulac, D. M., & Benson, N. (2010). The use of group contingencies for preventing and managing disruptive behaviors. *Intervention in School and Clinic*, *45*, 257-262.

Hulac, D., Benson, N., Nesmith, M. C., & Wollersheim Shervey, S. (2016). Using variable interval reinforcement schedules to support students in the classroom: An introduction with illustrative examples. *Journal of Educational Research and Practice*, *6*(1), 6. https://doi.org/10.5590/JERAP.2016.06.1.06

Johnson, G. M. (1999). Inclusive education: Fundamental instructional strategies and considerations. *Preventing School Failure: Alternative Education for Children and Youth*, *43*(2), 72-78. https://doi.org/10.1080/10459889909603305

Karweit, N., & Slavin, R. E. (1982). Time-on-task: Issues of timing, sampling, and definition. *Journal of educational psychology*, *74*(6), 844. https://doi.org/10.1037/0022-0663.74.6.844

Kelshaw-Levering, K., Sterling-Turner, H. E., Henry, J. R., & Skinner, C. (2000). Randomized interdependent group contingencies: Group reinforcement with a twist. *Psychology in the Schools,37*, 523-533. https://doi.org/10.1002/1520-6807(200011)37:6%3C523::AID-PITS5%3E3.0.CO;2-W

Lee, D. L., & Belfiore, P. J. (1997). Enhancing classroom performance: A review of reinforcement schedules. *Journal of Behavioral Education*, *7*, 205–217. https://doi.org/10.1023/A:1022893125346

Legge, D. B., DeBar, R. M., & Alber-Morgan, S. R. (2010). The effects of self-monitoring with a MotivAider® on the on-task behavior of fifth and sixth graders with autism and other disabilities. *Journal of Behavior Assessment and Intervention in Children, 1*(1), 43-52. http://dx.doi.org/10.1037/h0100359

Lindsley, O. R. (1992). Precision teaching: Discoveries and effects. *Journal of Applied Behavior Analysis*, *25*(1), 51. https://doi.org/10.1901/jaba.1992.25-51

Marholin, D., & Steinman, W. M. (1977). Stimulus control in the classroom as a function of the behavior reinforced. *Journal of Applied Behavior Analysis*, *10*(3), 465-478. https://dx.doi.org/10.1901%2Fjaba.1977.10-465

Martens, B. K., Lochner, D. G., & Kelly, S. Q. (1992). The effects of variable-interval reinforcement on academic engagement: A demonstration of matching theory. *Journal of Applied Behavior Analysis*, *25*, 143–151. https://dx.doi.org/10.1901%2Fjaba.1992.25-143

McDougall, D., & Brady, M. P. (1998). Initiating and fading self-management interventions to increase math fluency in general education classes. *Exceptional Children*, *64*(2), 151-166. https://doi.org/10.1177%2F001440299806400201

McGee, C., Ward, R., Gibbons, J., & Harlow, A. (2003). *Transition to secondary school: A literature review. A Report to the Ministry of Education.* Hamilton: University of Waikato, New Zealand.

McLaughlin, T. F., Krappman, V. F., & Welsh, J. M. (1985). The effects of self-recording for on-task behavior of behaviorally disordered special education students. *Remedial and Special Education*, *6*(4), 42-45. https://doi.org/10.1177/074193258500600407

Mitchell, D., & Sutherland, D. (2020). What really works in special and inclusive education: Using evidence-based teaching strategies. London: Routledge.

Nelson, R.O., & Hayes, S. (1981). Theoretical explanations for reactivity in self-monitoring. *Behavior Modification*, *5*, 3–14. https://doi.org/10.1177%2F014544558151001

Nelson, J. R., Smith, D. J., Young, R. K., & Dodd, J. M. (1991). A review of self-management outcome research conducted with students who exhibit behavioral disorders. *Behavioral Disorders*, *16*(3), 169-179. https://doi.org/10.1177%2F019874299101600308

O'Handley, R. (2014). *The Effects of Contingent Public Praise Used Alone and in Combination with Public Posting on Appropriately Engaged Behavior in Secondary Classrooms*. (Master's Thesis) The University of Southern Mississippi, Hattiesburg, MS.

Poncy, B. C., McCallum, E., & Schmitt, A. J. (2010). A comparison of behavioral and constructivist interventions for increasing math-fact fluency in a second-grade classroom. *Psychology in the Schools*, *47*(9), 917-930. https://doi.org/10.1002/pits.20514

Prater, M. A., Joy, R., Chilman, B., Temple, J., & Miller, S. R. (1991). Self-monitoring of on-task behavior by adolescents with learning disabilities. *Learning Disability Quarterly*, *14*(3), 164-177. https://doi.org/10.2307/1510847

Quinn, M., Miltenberger, R., Abreu, A., & Narozanick, T. (2017). An Intervention Featuring Public Posting and Graphical Feedback to Enhance the Performance of Competitive Dancers. *Behavior analysis in practice*, *10*(1), 1-11. https://dx.doi.org/10.1007%2Fs40617-016-0164-6

Roberge, D., Rojas, A., & Baker, R. (2012). Does the length of time off-task matter? *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge* (pp. 234–237). New York: ACM.

Riley, J. L., McKevitt, B. C., Shriver, M. D., & Allen, K. D. (2011). Increasing on-task behavior using teacher attention delivered on a fixed-time schedule. *Journal of Behavioral Education*, *20*(3), 149. https://doi.org/10.1007/s10864-011-9132-y

Rodrigo, M. M. T., Baker, R. S. J. D., & Rossi, L. (2013). Student off-task behavior in computer-based learning in the Philippines: comparison to prior research in the USA. *Teachers College Record*, *115*(10), 1-27.

Romero, M., & Barbera, E. (2011). Quality of e-learners' time and learning performance beyond quantitative time-on-task. *The International Review of Research in Open and Distributed Learning*, *12*(5), 125-137. https://doi.org/10.19173/irrodl.v12i5.999

Sante, A. D., McLaughlin, T. F., & Weber, K. P. (2001). The Use and Evaluation of a Direct Instruction Flash Card Strategy on Multiplication Math Facts Mastery with Two Students with Developmental Disabilities and Attention Deficit Hyperactivity Disorder. *Journal of Precision Teaching & Celeration*.

Shapiro, E.S., & Cole, C. (1994). *Behavior change in the classroom: Self-management interventions*. New York: Guilford Press.

Shimabukuro, S. M., Prater, M. A., Jenkins, A., & Edelen-Smith, P. (1999). The effects of self-monitoring of academic performance on students with learning disabilities and ADD/ADHD. *Education and Treatment of Children*, 397-414.

Sharp, S. R., & Skinner, C. H. (2004). Using interdependent group contingencies with randomly selected criteria and paired reading to enhance class-wide reading performance. *Journal of Applied School Psychology*, *20*(2), 29-45. https://doi.org/10.1300/J370v20n02_03

Skinner, C. H., Cashwell, C. S., & Dunn, M. S. (1996). Independent and interdependent group contingencies: Smoothing the rough waters. *Special Services in the Schools*, *12*(1-2), 61-78. https://doi.org/10.1300/J008v12n01_04

Skinner, C. H. Fletcher, PA, & Henington, C. (1996). Increasing learning trial rates by increasing student response rates. *School Psychology Quarterly*, *11*, 313-325. https://doi.org/10.1037/h0088937

Skinner, C. H., Pappas, D. N., & Davis, K. A. (2005). Enhancing academic engagement: Providing opportunities for responding and influencing students to choose to respond. *Psychology in the Schools*, *42*(4), 389-403. https://doi.org/10.1002/pits.20065

Staub, R. W. (1990). The effects of publicly posted feedback on middle school students' disruptive hallway behavior. *Education & Treatment of Children*, *13*(3), 249.

Theodore, L. A., Bray, M. A., & Kehle, T. J. (2004). A comparative study of group contingencies and randomized reinforcers to reduce disruptive classroom behavior. *School Psychology Quarterly*, *19*(3), 253–271. https://doi.org/10.1521/scpq.19.3.253.40280

Turco, T. L., & Elliott, S. N. (1990). Acceptability and effectiveness of group contingencies for improving spelling achievement. *Journal of School Psychology*, *28*(1), 27-37. https://doi.org/10.1016/0022-4405(90)90034-5

Usart, M., Romero, M., & Barberà, E. (2013). Measuring students' Time Perspective and Time on Task in GBL activities. *ELearn Center Research Paper Series*, 40-51. Hattiesburg, US.

Van Houten, R., Morrison, E., Jarvis, R., & McDonald, M. (1974). The effects of explicit timing and feedback on compositional response rate in elementary school children. *Journal of Applied Behavior Analysis*, *7*(4), 547-555. https://dx.doi.org/10.1901%2Fjaba.1974.7-547

Wood, S. J., Murdock, J. Y., Cronin, M. E., Dawson, N. M., & Kirby, P. C. (1998). Effects of self-monitoring on on-task behaviors of at-risk middle school students. *Journal of Behavioral Education*, *8*, 263-279. https://doi.org/10.1023/A:1022891725732

Wright, S. J. (2016). *The effects of tootling combined with public posting in high school classrooms* (Unpublished master's thesis). University of Southern Mississippi, Hattiesburg, USA.