A Clinical Model for Developing Executive Function Skills

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Abstract

The purpose of this article is to describe a therapeutic program developed by our clinic that (a) considers the core features of executive control which must be understood in order to effectively implement an executive function treatment model, (b) how we included those features into a treatment program that successfully teaches students to develop independent executive function skills, and (c) demonstrates how the model has been applied across the developmental age span.

Executive Function

Self-regulation is essential for task execution and involves three key components: (a) any action that allows students to stop and direct themselves, (b) how this action results in a change in their behavior, and (c) how this behavior changes the likelihood of future consequences or the attainment of a goal (Barkley, 2012). This mental process of stopping and self-directing behavior is termed mimetic ideational information processing. The individuals essentially "mime the idea" in their minds and can even imagine a "dry run" of their impending actions to mentally simulate several possible future scenarios. In effect, it is a mental "trial and error." Once this mental image is created, using nonverbal working memory, the individuals can then use "self-talk" to direct their actions. In other words, when we ask students to listen and follow directions, we are really asking them to momentarily stop (inhibit) their own actions and thoughts to consider the *what, where* and *when* of the desired future, to compare this future with previous experiences, and to determine the value: why is it important, necessary, or motivating?

Individuals with weak executive functioning (EF) skills exhibit reduced visual imagery to see the future, a weak ability to control and sustain this visual representation over time, limited self-directed talk, disinhibition, a limited or absent ability to pre-experience the emotion of the future, disorganized planning, weak initiation, and reduced sustained attention (Barkley, 2012; Barkley, Edwards, Laneri, Fletcher, & Metevia, 2001). The collective outcome is a reduced ability to plan, organize, and control their behaviors for task completion. Some students may also have difficulty clearly envisioning what their future selves might look like when carrying out a routine in a given context particularly if it is a novel situation, which can also trigger negative

emotional responses (Barkley, 2012). For example, a student who is anticipating his first visit to a Mexican restaurant may not form a mental image of what it might look like, and therefore could become anxious due to the novelty of the situation. The ability to access an episodic memory for the schema of "restaurant" would enable the student to predict the expected core features of an unfamiliar restaurant: hostess station, tables/booths, place settings, menu, kitchen, and décor. This ability to shift from the concrete to the abstract to form pattern perceptions — to abstract the quality of a concept and use this quality in a new context to identify how a future image is the same, but different, from a previous experience — is one of the keys to developing strong executive function skills (G. Caine & Caine, 2006).

According to Barkley (2012), in order to develop or rehabilitate EF skills, individuals "need to repeatedly practice: self-monitoring, self-stopping, seeing the future, saying the future, feeling the future, and playing with the future so as to effectively 'plan and go' toward that future." Temporal capacity describes how far into the future students can consider to envision their goals and how they will use their time to attain their goals. Thus, clocks, calendars, and schedules are only a tiny segment of how students experience time in their lives. There are many hidden dimensions of time, and the language of how time is used to meet an end goal is often complex and abstract. Students need to develop strategies for the comprehension and production of time as it pertains to time management, complex planning, self-regulation/pacing, and temporal reasoning. All of these skills are developed during the daily events of a student's life, such as managing homework, initiating and completing morning and nighttime routines, organizing the steps to "get out the door," and arriving to class on time with the requisite materials. When supporting students through these daily events, we have found our approach helps them to develop the core temporal awareness skills that increase their gradual independence.

A common area of concern for both parents and teachers, and one that our EF treatment model has been designed to address, is a student's ability to initiate and complete tasks in allotted time frames. Some students may exhibit a delayed initiation while others may appear to race through an assignment or task. Students with temporal sequential processing weaknesses present with a poor concept of time, struggle to process temporal prepositions, and are slow to learn how to tell analog time (Wren, 2013). When students visualize and mentally manipulate the temporal sequence of steps in order to meet an end goal, they gain a sense of pace that is necessary for completing the parts and whole of a task. It can be a challenge for them to interpret multi-step directions and to understand complex syntax with temporal markers (e.g., the direction "*Before* you *quickly* go upstairs *first* put your homework away and don't forget to hand it in *after* lunch.") Thus, it was important that the clinical model of executive function present the student with the ability to see and sense a unit of time, as well as the big picture of a task before they executed a multi-step procedure.

Higher order thinking skills are also related to the skills of temporal sequential ordering. Many high-level cognitive functions are sequentially organized, such as understanding cause and effect, problem solving, and using conditional reasoning for inductive and deductive thinking when, in the moment, they are required to temporally organize their thoughts and actions in an online fashion to inhibit impulses, plan ahead, organize their actions, and complete academic/linguistic tasks requiring higher order thinking skills.

Given the above, it is not surprising that Barkley notes that, for a program to be effective to improve the development of EF skills, it is critical to "externally represent" or "remove gaps in time," to "externalize motivation," and to "intervene at the point of performance" (Barkley, 2012). Yet many of the current interventions to improve executive control are checklists/ contracts that focus the student's attention on the immediate or "now" of what they are doing. Although the past decade has led to progress in the research, development and documentation

of interventions to improve executive control, there remains a need for evidence-based, effective intervention strategies to improve EF.

Core Components of the Clinical Model of Executive Function

The purpose of the clinical intervention described in this article was to pilot a service delivery model for students that could be used across settings to develop executive function skills in children that captured Barkley's definition that EF is self-regulation to sustain actions across time towards a goal (Barkley, 2012). Thus, our clinical model is an intervention that combines mimetic ideational information processing, situational and intention awareness, elements of temporal sequential ordering and higher order thinking to promote efficient and accurate completion of tasks within allotted time frames.

The Model

The Get Ready*Do*Done Model (GDD) (Figure 1) is a pilot methodology designed to teach students to develop situational awareness, create forethought of an end result, and then integrate all the materials, time and actions to complete a future task. It is based on 6 key principles of executive functioning:

1. Students must develop the capacity to use situational awareness and intention awareness to imagine a hypothetical future[1].
2. Nonverbal working memory (a private, visual/mental representation of the future) must predate self-speech (verbal working memory).
3. "If… then…" conditional reasoning plans must be used to create "distance" between the current "space" and "time" to the future "space" and "time." As a result, students will "see themselves" as agents of the action for the future goal being contemplated, which will provide time for a student to demonstrate self-restraint and impulse control (Gawrilow, Gollwitzer, & Oettingen, 2011).
4. Students must develop the ability to see and sense the passage of time.
5. Students must develop the capacity to self-monitor and adjust performance towards task completion.

To implement the GDD model (Figure 1) a student is given Get Ready, Do, and Done mats (Figure 2).

[1]Situational Awareness (SA), as defined by authoritative expert on situational awareness Mica Endsley, is "the perception of elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future" (Endsley, 1995). Howard took Ensley's definition even further to show that, in order for individuals to successfully demonstrate SA, they must also be able to account for the intentions of the others that share the same situation" (Howard & Cambria, 2013). This is deemed Intentional Awareness (IA).

*Figure 1. The Get Ready*Do*Done Model with Steps Labeled*

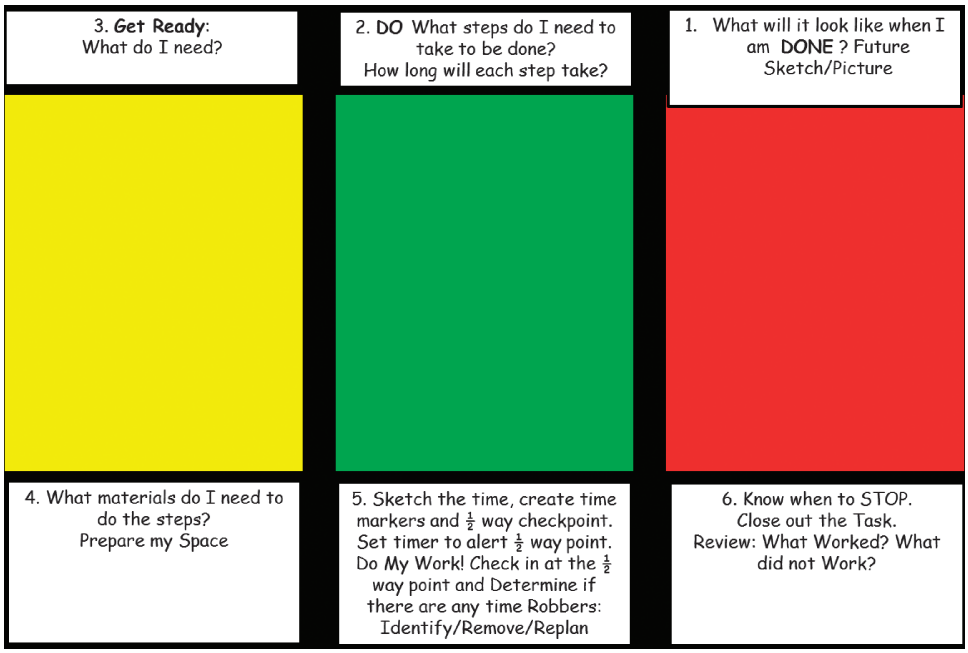
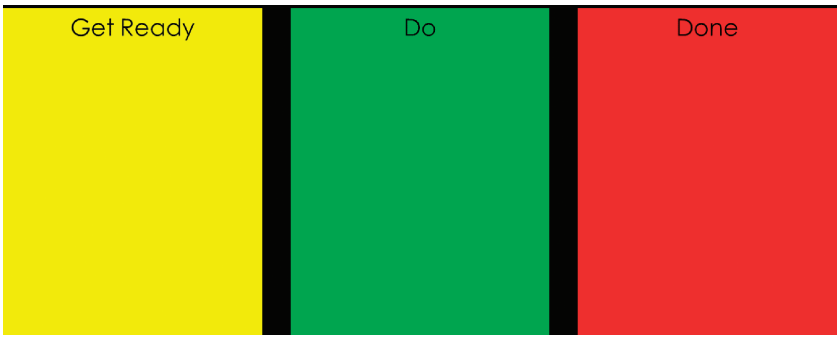


*Figure 2. Get Read*Do*Done Mats Without Steps Labeled*



The "Get Ready" mat is yellow, the "Do" mat is green, and the "Done" mat is red. The red "Done" mat signals students to imagine what something will look like in the end, and it also helps them visualize when to stop. The green "Do" mat signals students what to do, and it helps to remind the student to pre-plan what to do and then initiate or get them going on the task. The yellow "Get Ready" mat reminds students to slow down and to identify and gather the materials they need. The mats were preprinted and laminated or consisted of colored construction paper placed in plastic sleeve protectors. In this way, the students could use dry erase markers to write/draw on the protected mats and then erase as needed.

The GDD Model Stage 1: Task Planning

Done: What Will it Look Like? The process starts by asking students to put on their "future glasses," to start with the end in mind, and then imagine what they or the task will look like when they are all done. For some students, a pair of silly sunglasses are used and called

"future glasses" to serve as a physical mediator to facilitate and simplify the complex and abstract concept of forethought. Students are asked to sketch out this image, find a photo, or to verbally describe what it/they would look like. Using the visual image as a guide, the clinician coaches the students on how to break the image down from the whole, to the features, to the parts.

Do: What Steps Do I Need to Take to Get it Done? How Long Will Each Step Take? The students then use temporal sequencing skills to identify the steps required to match the future picture. The emphasis is placed on working backwards when planning and using an outcome to determine the relevant steps to achieve the visualized end result. Thus, when teaching the students the process of planning for task execution, it is important to choose therapy tasks that allow them to readily visualize or picture an outcome and, as such, eliminates the need for explicit instructions. In this way, students are responsible for looking at the pictured outcome and then using this visual to problem solve what steps are required to achieve their goals.

Students estimate the time needed for each step. It is important to note that when the time of a therapy session is limited, students can use dry erase markers on a clock (with a glass face) to sketch the total amount of time available and then fill in the time with the individual steps.

Get Ready: What Do I Need to Do? For each step, students use the future picture image and outlined set of steps to determine what materials are needed to complete the task. The planning for the maze project (Figure 3) and poster project (see Figure 4) are depicted below.

Figure 3. Task Planning for the Maze Project Using the GDD Model

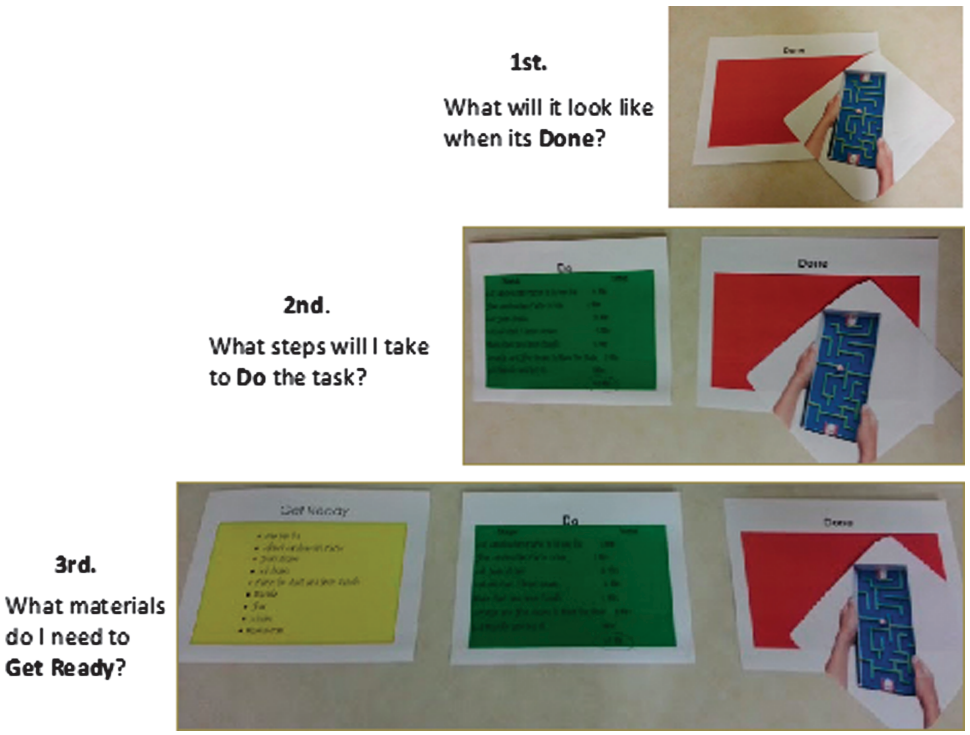
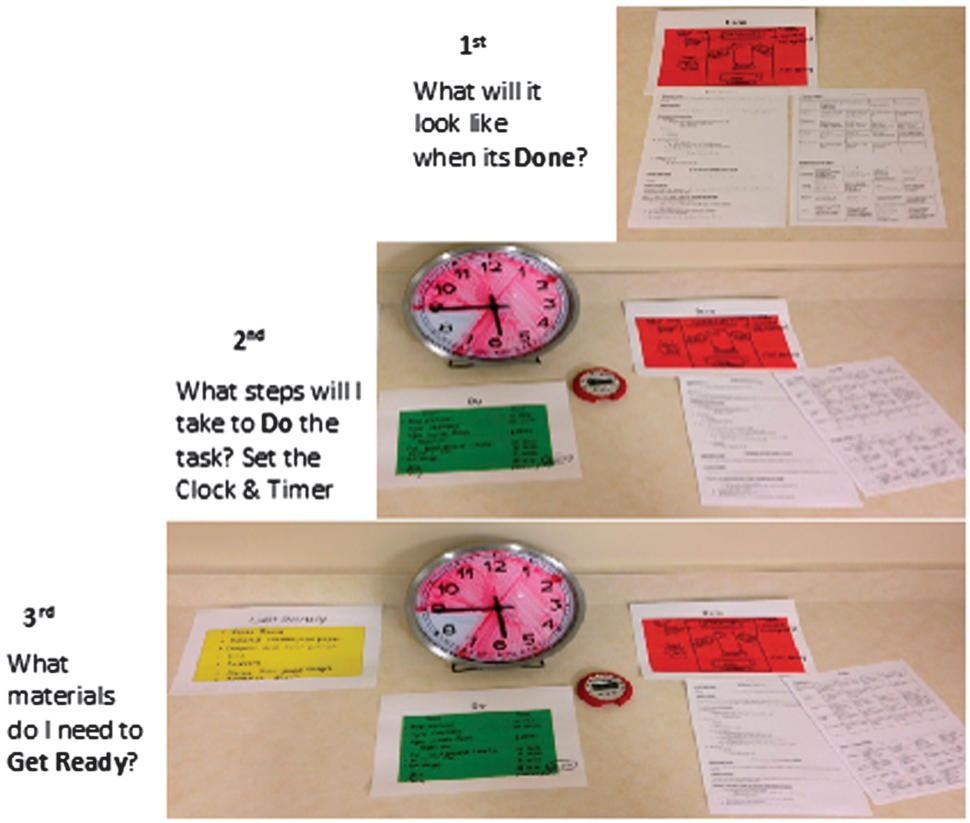


Figure 4. Poster Project: Task Planning Using the GDD Model

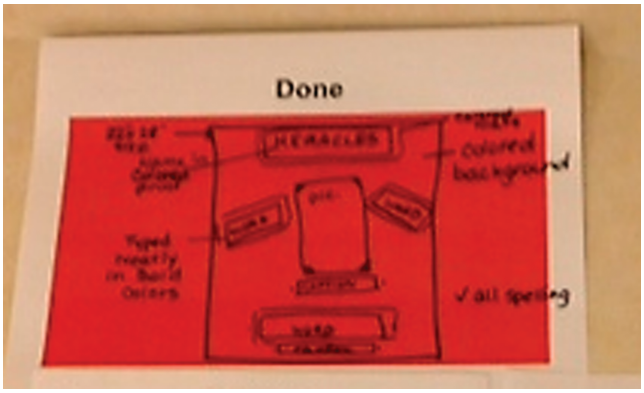


The maze project above included a picture model with the directions, so the picture was used in the "Done" mat. However, the poster assignment did not come with a picture model, which increased the complexity of planning for this task. The students needed to recall their previous experiences viewing and creating posters, and formulate an organized mental template of poster features based on those experiences. This mental template is used metacognitively to create a "future sketch" of the poster assignment. Thus, the student's mental imagery of the basic features of a poster, such as title, pictures, and captions are sketched as a template on the "Done" mat (see Figure 5 on the next page). The elements of the poster are represented as boxes and labeled. This "future sketch" is an external representation of the student's thinking that serves as the foundation for all the steps and materials that will be organized in moving toward that end result.

This is also a great time to pull in the directions and the rubric in order to complete the sketch by labeling all the components that the student will be graded on, as shown below. The completed sketch is then used to plan the specific steps and time for each step on the "Do" mat. It is beneficial for students to anticipate possible obstacles and use "if-then" thinking to consider solutions when engaging in the planning process. The time is then planned directly on the clock. Using a dry erase marker, a line is drawn from the center of the clock outwards to show when the task will begin and another line is drawn when the task is expected to end. A halfway checkpoint is marked on the clock, as well as on the "Do" mat to show which steps ought to be completed when halfway through the task. Continuing to work backwards, the

materials that are planned required to do each of the steps on the “Do” mat are then listed on the “Get Ready” mat. Other resources such as parents, teachers, and student partners may also be listed on the mat.

Figure 5. Task Planning for the Poster Project: Elements of the Poster Sketched on the Done Mat



The GDD Model Stage 2: Task Execution

Get Ready. Students are asked to gather the requisite materials that are outlined. It is important to note that in therapy and home-based sessions, students are *not given* the materials. In order to increase spatial awareness, students are required to determine or make smart guesses about where the materials are likely to be kept and found in the given space. They are then instructed to go and gather those materials independently.

Depending upon the skill level of the students, materials are provided in the following hierarchy:

1. *Essential materials:* The specific materials needed to achieve the goal are provided in the space but gathered by the student.
2. *Irrelevant materials:* The required materials are provided. However, irrelevant materials are also available, requiring the student to use conditional reasoning skills to determine if, when, and how a material would or would not be necessary to achieve the final product. For example, if a student were making the aforementioned maze, the straws, box lid, and construction paper would be provided. In addition, in the materials selection area, irrelevant materials would also be present, such as a small box, wooden dowels (could be used for the maze, but cannot be cut with scissors), ping pong ball (too large), paint, etc.
3. *Missing Materials:* To develop problem-solving skills in this third condition, requisite materials are not provided. Students are required to look at the provided materials and problem-solve a material that could be used in place of the missing item. For example, straws may not be provided. Popsicle sticks, dowels, and paper may be present instead. The student must then problem solve the benefits of the Popsicle sticks (wide and easy to glue, but tricky to cut to size) vs. dowels (narrow, but require a small saw to cut) vs. paper (can be rolled and taped to create a cylinder-shaped material similar to a straw and then easily cut to size).
4. A key vocabulary concept taught in the “missing materials” condition is the idea of “same” but “different.” Students are coached to identify the features of the required core materials and then determine which available materials are similar in feature.

Do. Using a dry erase marker on a clock with a glass face, students sketch the total "pie" or amount of time they estimate they would need to achieve the future picture. This enables students to see the volume of time available. On the clock, students also use the dry erase marker to create time markers: a starting time, an ending time, and midpoint check in. The students also mark in their plans what steps they hope to have achieved at the halfway checkpoint. Prior to initiating the plan, students are asked to use a timer as a mediator to self-monitor the passage of time. Timers can be any tool that counts down a volume of time including egg timers, easy set timers, timers on smart phones, and computer and mobile apps. The students set the timer to count down the amount of time to the halfway point, as opposed to setting the timer for the total amount of time to be spent executing the plan. When the timer is activated at the halfway point, students then have the opportunity to check in and self-monitor their performance. At the checkpoint, students compare their actual performance to their plan. Students are asked to identify whether or not they had any "time robbers" that "stole" their time. They are then coached to "*identify* and *remove* time robbers and then *re-plan*" their actions, time, or plan to sustain their actions towards achieving their future goal. Examples of time robbers would be hunting around in the class/clinic for materials to do an assignment, spending too much time texting or surfing the Internet, not having a clear focus of what an assignment is asking for, etc. By checking in at the halfway point, students are given the opportunity to self-monitor their performance and time. If necessary, they can then self-correct to achieve their plan within the allotted time frame, or they can adjust their time plan and/or expectations toward a more realistic future goal.

Done. Because students start with the end in mind, they already have a future reference for knowing when to stop and recognize when they have achieved their outcome. When finished, students are instructed to stop and "close out" the task they are working on. This includes throwing out trash, putting away unused and gathered materials, and cleaning their workspace. Depending upon the nature of the project, students can record their completed work in an academic agenda and then place their project or assignment in the appropriate folder or storage space until it has to be graded or turned in. This "Done" phase is also used as a time for the student to review the task, and their actions, and to determine: (a) What worked: these steps could be repeated, and (b) What did not work? What changes could be made to the plan when doing a similar task in the future? The maze project (Figure 6) and poster project (Figure 7) are depicted in the two sets of photos below.

Figure 6. Maze Project: Task Execution Using the GDD Model

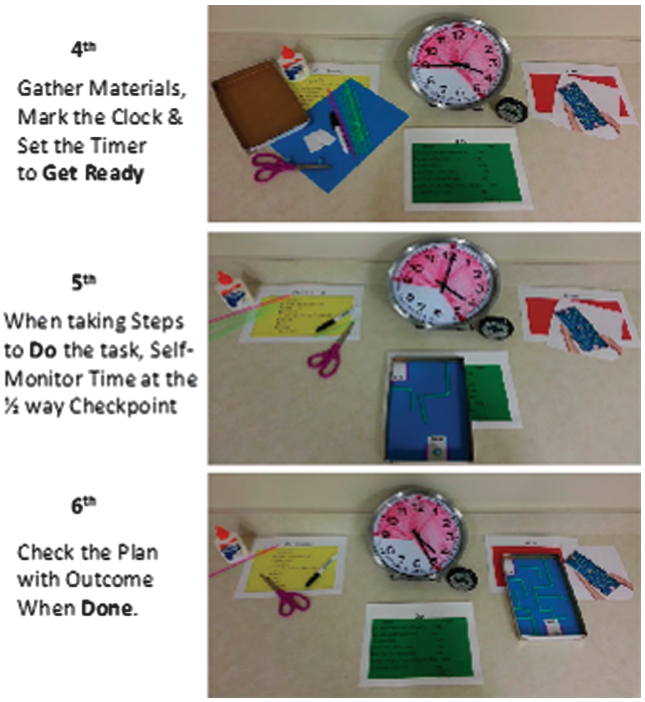
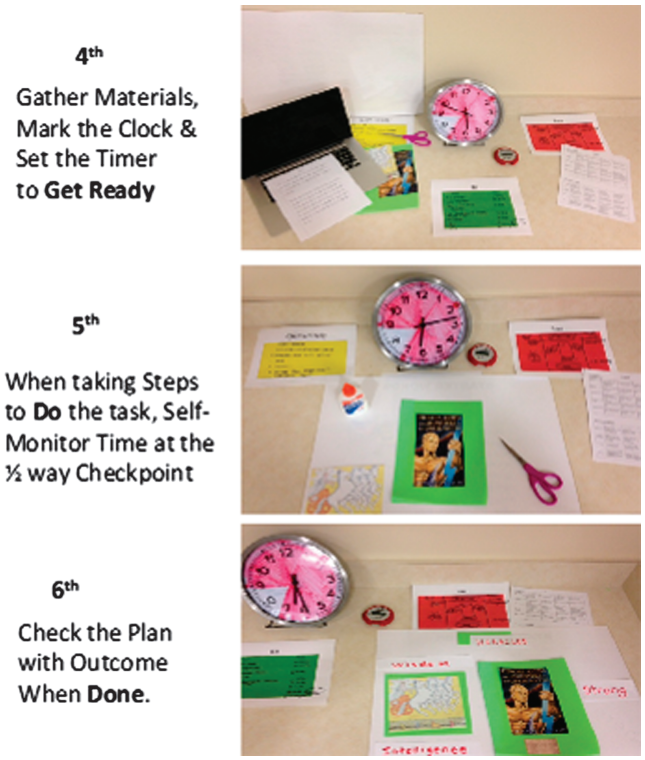


Figure 7. Poster Project: Task Management Using the GDD Model



The last step includes comparing the actual final product with the plan. This student thought the poster was completed early and he was ready to stop and clean up. When he compared the actual poster with his plan, he realized that he was missing some details and he needed to continue working for several more minutes.

The GDD Model Used in the Clinic During a Social Skills Group

Table 1. GGD Model for Social Skills Group Session

3. What Materials do we need?	2. Sequence the Steps What steps do we need to take to be done? How long will each step take? How much time do we Have? How will time fill up?	1. Future Glasses: When group is over, what will we see that we have completed?
• IPad • Whiteboard • Dry Erase Markers	1. Review the Steps for How to Join a Group. (5 min.) 2. Create a Storyboard for the video. (5 min.) 3. Choose Roles (actors, director and recorder). (2-5 min.) 4. Rehearse action. (5 min.) 5. Video Action. (10 min.)	 We have recorded and are watching a video about how to, and how not to, join a group.
4. Gather Materials	5. Sketch the time, create time markers and ½ way checkpoint. Set timer to alert ½ way point. Check in at the ½ way point and Determine if there are any Time Robbers: Identify/Remove/Replan	6. Know when to Stop. Close out the Task. Review: What worked? What did not work?

Generalization to the Home Setting

To generalize the GDD Model to the home setting, parents are instructed in how the GDD model is implemented in the therapy session. They are then coached on how to support their children using the model at home. When a child needs to complete a task or craft project at home, the parent places on the work surface a piece each of yellow, green, and red construction paper. The parent then coaches the child to start planning with the end in mind by sketching a picture or finding a photo of the future outcome. A representative object could also be used. If, for example, a student were making a sandwich, a picture of a sandwich could be sketched or a photo printed and placed on the red "Done" mat. If the student were making a smoothie, an empty glass could be placed on the red "Done" mat to represent the future outcome (Figure 8).

Figure 8. GDD Model in Home Setting- Making a Smoothie

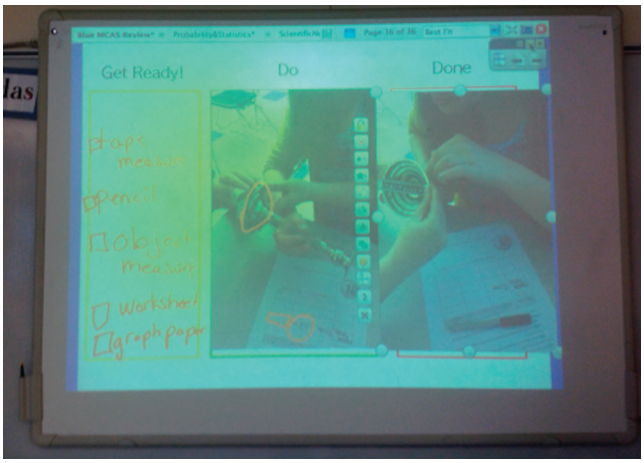
The child identifies the steps (Do) and materials (Get Ready) to achieve the future outcome and then gathers the necessary materials (Get Ready), sketches or verbalizes the available time, and then executes the steps of the task (Do). Finally, the child closes out the task (Done) by cleaning up the workspace and reviewing/comparing the planned vs. actual outcome.

Get Ready*Do*Done at School. The GDD model has also been successfully adapted to the school setting. Teachers are instructed on how to use the model, but implement it only when students need to focus on and complete an in-class assignment or task. Kindergartners were learning the sound/letter correspondence for the letter "M," so the students participated in a craft project and made a moose out of construction paper (Figure 9).

Figure 9. GDD Model in the Classroom

In a seventh grade special education classroom, co-taught by a speech-language pathologist (SLP), the class needed to complete a worksheet on calculating radius. The GDD model was presented on an active board as a ready reference for the students, and they successfully executed the task within the allotted time frame (Figure 10).

Figure 10. GDD Model in the Classroom—Calculating Circumference, Diameter, and Radius of a Circle



Preliminary Results

Performance results and efficacy of our clinical model are just beginning to be examined. Although our findings cannot be judged by standardized measures, descriptive analysis by clinicians, parents, and teachers suggests that the students who utilized the GDD model demonstrated an increase in task independence and an ability to plan, sense the passage of time, self-monitor, and self-evaluate performance. Students using the GDD model report and demonstrate a confidence in their ability to complete tasks efficiently, a greater feeling of autonomy, and a deeper appreciation for planning and monitoring time.

The GDD model offers clinicians a clinical tool with which to teach the process of task execution. As clinicians who, on the service delivery grid of an individualized education plan (IEP), are asked to consult with classroom teachers or to co-teach in the classroom, SLPs can now use this model as a useful tool to help teachers translate their curricular demands into an executive function intervention that will increase students' planning skills and time spent on-task. For teachers with large class sizes and an increased number of students on IEP's whose goals must be met, the GDD model will likely decrease the amount of one-to-one support a child with poor planning typically requires. For example, teachers using the GDD model report that students more readily initiate, ask fewer questions about what they are being asked to do, complete tasks with greater independence, and quantitatively spend more time on-task.

For clinicians with large caseloads, who typically have limited time with students (often only one hour or less per week, per student), the GDD model helps them to prioritize their interventions. They can now address specific communication goals, while at the same time teach an executive control process that increases a student's ability to attend, follow directions, understand what is being presented, sense the passage of time, and self-monitor.

Summary

For SLPs to teach EF skills in the clinical, school, and home settings, it is critical to understand EF as a self-regulatory process that requires students to demonstrate situational awareness, and then activate nonverbal (visual forethought) and verbal working memory (self-directed talk) in order to achieve a predicted outcome. Preliminary observations, descriptions, and findings suggest that our GDD model is a promising clinical intervention that can be implemented to foster independent task completion within allotted time frames. This model

scaffolds for students a method of self-regulation that helps them develop an appreciation for the *complexity* of tasks, while at the same time giving them an understanding of the *simplicity* of task execution when visualizing an outcome and then breaking that forethought into manageable parts.

Based on teacher and clinician feedback in school, therapy, and home settings where this model has been implemented, students have demonstrated a notable increase in self-esteem and autonomy using the GDD model. Programs and methods to develop EF skills are critical, not only when technology is swiftly changing the way students think and behave, but also at a time when the American educational system is increasingly stressing standards-based test performance. Opportunities have plummeted for imaginary play, trial by error learning, and allocated time to do tasks that allow for the students to "plan-execute-review-try again." Paul Pintrich, an educational leader and legacy of research on self-regulated learning, defined self-regulation as "an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation and behavior, guided and constrained by their goals and the contextual features in the environment" (Pintrich, 2000). As research has shown that a student's academic skills and abilities do not always account for achievement, integrating explicit instruction in self-regulation and motivation into the core curriculum may mean the difference between mere performance and actual learning. If EF truly is self-regulation, then using the GDD model in the clinic, school, and home settings shows great promise of clinical utility in developing the core EF skills for lifelong achievement in planning, time management, organization, motivation, and metacognition.

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