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COMMENTARY

Utilizing a Discriminate-Generate-Operate-Demonstrate Framework for Instructional Design

Kristin Smith · Kerri Milyko · Tim Fuller · Molly Halligan

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Abstract Behavior analysts are frequently responsible for teaching concepts and operations. Whether teaching in academia, training employees within corporations, working with young learners, or serving disabled learners, behavior analysts primarily find themselves in an instructional position relaying information from themselves to others. They often design how this information is transmitted to the learner so that the person can operate upon the world proficiently with the new concept or operation. As a result, behavior-analytic instructional design has spent much time piecing together optimal ways of making instruction effective. Nevertheless, these instructional design practices are not widely disseminated or adapted to everyday clinical practice. Therefore, the current article proposes a comprehensive framework where a learner contacts different hierarchical instructional levels while establishing proficiency on each level before progressing toward the ultimate goal of the concept or operation. These levels include Discriminate, Generate, Operate, and Demonstrate. By progressing through this framework, the learner will apply and generalize the instructional concept or operation regardless of context and nuance.

Keywords Instructional Design · Curriculum generation · Effective instruction

K. Smith · T. Fuller
CentralReach, Fort Lauderdale, FL, USA

K. Milyko (✉)
The Learning Consultants, Sparks, NV, USA
e-mail: Kmilyko@gmail.com

M. Halligan
Las Vegas Autism Center, Las Vegas, NV, USA

Applied behavior analysis (ABA) has a rich tradition of applying the principles of behavior in service of meaningful change. Much of ABA's efforts have focused on the methods and measures used to showcase effective treatment (Chadwell et al., 2019). However, there are also several examples of approaches to instruction, including precision teaching (precise reading and math tools; Johnson & Layng, 1992), organizational behavior management (well-designed job aids and checklists; Choi & Johnson, 2022), and positive behavior support (assessment and family planning tools; Hieneman et al., 2022). Despite these exceptions, there remains ample opportunity for scholarship on what to teach, in what order, and to what extent. Behavior analysts could apply their expertise to the design of instructional and support materials that are systematic, measurable, and modifiable to the individual needs of a learner. The purpose of this manuscript is to design one such design.

Applying a Systematic Design Framework for Instruction

Our approach to instructional design provides a methodical and sequenced framework for creating

interventions for concept formation[1] and skill acquisition, or as Becker (1974) defines an operation. The framework operates with the presupposition that the instruction designed and delivered by the instructor (i.e., "teaching") is separate from the behavior of the learner (i.e., "learning"; Engelmann & Carnine, 1991) but acknowledges the interrelation between the two. This separation allows us to maintain learner behavior as the dependent variable and the designed instruction as the independent variable. As such, learner progress or lack of progress directly results from intervention design and delivery, retaining a core pillar of the behavior analytic perspective of the learner being "right" by ensuring our focus is on the conditions under which learning occurs (Skinner, 1968). To be clear, designing instruction is a separate activity from learners' performance outcomes (e.g., rate, duration, accuracy, application, generativity). This article aims to emphasize the opportunity to thoroughly explore the instructional design process as rigorously as behavior analysis has investigated performance outcomes.

When framing intervention design and delivery as our independent variable, predominantly responsible for learner progress, there are essential factors to consider. First, organize the delivery of the instruction around the skill's critical attributes, which are present across learning opportunities (Engelmann & Carnine, 1991). *Critical attributes* refer to the defining features of the skill or concept being taught. These attributes must be present for the learner to access reinforcement, and if one attribute is changed or omitted, the skill or concept completely changes. Therefore, each example of a skill or concept includes all critical attributes (Layng, 2019; Tiemann & Markle, 1991). For example, when teaching a learner to blow their nose, critical attributes include (1) material in the nose that should not be in there; (2) something to blow the material into placed up to the nose; and (3) a targeted nose blow. Incorporating these attributes enables a learner to blow their nose successful. Yet, omitting just one attribute yields a distinctly different response. For example, if a targeted blow is absent, the learner would only be pressing a tissue to their nose.

The second factor to consider when designing effective instruction is that it should be suitable numerous learners in diverse settings (Engelmann & Carnine, 1991). This is not to say that the instruction needs to be generic and, thus, ineffective. If a learner requires a nuanced way of learning, these should be considered individualized programming adjustments rather than the skill's original programming. The programming for a concept or operation should be appropriate for most learners who match the targeted population and setting (Markle, 1969), such as young autistic learners receiving one-on-one ABA services, middle-school learners with identified social deficits participating in a school-based social group, or adults with intellectual disabilities practicing daily living skills out in the community. Designing instruction in this manner is ultimately more efficient and systematic, and its effectiveness can be evaluated although still allowing for individualization.

The framework of instruction outlined herein predominantly focuses on developing systematic and comprehensive instruction. It contains four phases, or levels, of instruction: Discriminate (D), Generate (G), Operate (O), and Demonstrate (D) (D-G-O-D). Design across these levels is cumulative and progressive. Defining each level by its critical attributes clarifies differences between levels. Although these levels are constructs, they guide behavior analysts away from the idiosyncratic delivery of instruction and place emphasis on the design of such outcomes. The designer enhances complexity throughout each cumulative level when preparing instruction (Becker, 1974) by manipulating the critical or variable attributes in systematic ways. This framework allows for an opportunity to more holistically represent the design efforts used to produce meaningful outcomes. A pragmatic approach to these levels is not rigid or strict, but rather a collection of processes that aids in our design endeavors and their dissemination. Therefore, each level may be rigidly considered in sequenced but applied flexibly to allow versatile instruction when needed.

[1] Throughout this article, we use the term "concept" generally, referring to concepts and conceptual structures, as defined by Susan Markle (1970).

Levels of Instruction

When designers conceptualize instruction through the D-G-O-D framework, they intentionally design a skill to develop from the most foundational level (Discriminate) to the most complex level (Operate) and then explicitly program for the transfer of the skill in naturally occurring contexts and contingencies (Demonstrate). This framework guides designers through skill development and assumes they employ best practices regarding concept formation, mastery criteria, and the selection of instructional arrangements. As an example, to show true proficiency of a discriminative response between basic concepts in the Discriminate level of instruction, a designer must ensure that they program for the learner to respond accurately to that discrimination across a range of both close-in and far-out examples (Engelmann & Carnine, 1991; Johnson & Bulla, 2021; Tiemann & Markle, 1991).

The examples provided in the subsequent sections intentionally include skills in which the learner performs using verbal and non-verbal responses, highlighting the inherent versatility of this framework. It is the role of the instructional designer to determine which levels to apply for their learner, given the learner's behavioral repertoire and the critical attributes of the skill as performed in the learner's natural environment.

Prerequisites to D-G-O-D

To ensure success when entering this system of instruction, learners should have a well-established set of prerequisite skills specific to this framework. These prerequisites, often referred to as *tool* or *element skills* (Haughton, 1972; Johnson & Layng, 1996; Johnson et al., 2021), are important components of more advanced learning and participation with the environment. The development of prerequisite skills mitigates learners' frustration and expedites the acquisition of more complex skills (i.e., next-level skills; Johnson et al., 2021). For this conceptual framework, Discriminate-Generate-Operate-Demonstrate, prerequisite skills must be established in the learner's repertoire to proficiency, allowing the learner to participate in each level of instruction. Table 1 provides example prerequisite behaviors necessary for D-G-O-D, organized into three categories critical for all learning: learning readiness skills, basic motor skills, and verbal behavior elements (e.g., duplics and codics; Johnson & Layng, 1996; Twarek et al., 2010; Vargas, 1982).

Following best practices in instructional design, instructors must use processes such as element-compound analysis when identifying prerequisites specific to a skill, resulting in a series of skills slated for intervention beginning with elements (i.e., simple, single skills) and moving through compounds (i.e., more complex combinations of skills; Greer & Ross, 2008; Kubina, 2012). Specific to this framework, the instructor selects a skill and then maps out the skill in each level of instruction—from the skill's most basic form (i.e., Discriminate) to its most complex or refined form (i.e., Operate or Demonstrate). Figure 1 illustrates this evolution, including the identification of prerequisite skills.

Discriminate

Discriminate is the most foundational yet critical level of instruction of the proposed framework. The instructor designs opportunities using examples and

Table 1 Prerequisites to D-G-O-D Framework

Learning Readiness	Basic Motor Skills	Duplics
Follows directions to come to table	Big 6 + 6 (motor tool skills)	Vocal imitation
Sits at table for specified duration of time	Balances	Motor imitation
Tolerates delays to reinforcement	Coordinated motor movements	
Works in distracting environments	Scans	
Listens to instruction		

These prerequisite skills are intended as a general list. When designing instruction for a specific skill, prerequisites specific to *that skill* must be identified. For example, instruction on blowing one's nose in their natural context is unlikely to necessitate the prerequisite skill of "Follows direction to come to table" but may instead require "Follows direction to come" (although the learner does not need to sit at the table to blow their nose, they may need to come closer to the instructor for coaching and/or prompting)

Elements → Compounds

Instructional Framework

Prerequisites to Instructional Framework

Discriminate	Generate	Operate	Demonstrate
Selection of item Learner sees a field of items Learner hears the name of the item Learner selects the item	Tacts noun Learner sees an item Learner tacts item	Learner answers yes/no questions about the name of items and correct incorrect ('no') answers Learner sees item Learner hears possible name of item Learner says yes/no Learner provides correct name of item	Tacts noun, in natural setting Learner sees stuffed giraffe animal at a toy store Learner says, "giraffe"
Learning Readiness: Remain in the instructional area Tolerate delays to reinforcement *Basic Motor Elements:* Scan field of items Reach Point or touch *Duplics:* Motor imitation	*Learning Readiness:* Remain in the instructional area Tolerate delays to reinforcement *Basic Motor Elements:* Look at target item *Duplics:* Vocal imitation	*Learning Readiness:* Remain in the instructional area Tolerate delays to reinforcement *Basic Motor Elements:* Look at target item *Duplics:* Vocal imitation	*Learning Readiness:* Remain in the instructional area Tolerate delays to reinforcement *Basic Motor Elements:* Look at target item *Duplics:* Vocal imitation

Fig. 1 Object Identification and Necessary Prerequisites Using D-G-O-D Framework

nonexamples for the learner to acquire discriminative relationships between examples and nonexamples (Becker, 1974). The learner then responds differentially and overtly to examples and nonexamples presented to them by the instructor (Engelmann & Carnine, 1991; Markle, 1969; Tiemann & Markle, 1991). The form of a learner's discrimination may vary depending on the skill (Becker, 1974). For example, a learner may engage in a discriminated response by matching to a sample, pointing to select examples or nonexamples, or answering with a verbal yes/no response (Johnson & Bulla, 2021).

Table 2 outlines three skills: *Object Identification, Answers Questions about the Appropriateness of Social Behavior at a Restaurant*, and *Organizes Materials*. In each of these examples, the learner displays overt discrimination. As described in Table 2, in *Object Identification*, the learner touches different representations of a concept (e.g., different cats). In *Answers Questions about Appropriateness of Social Behavior at a Restaurant*, the learner hears a context and scenario and then discriminates whether a behavior is appropriate or inappropriate specific to that context and scenario by saying yes or no. Finally, in *Organizes Materials*, the learner sees an array of examples (organized scenes) and nonexamples (unorganized scenes) and discriminates among these by pointing to all of the relevant images in alignment with the spoken instruction.

The necessity of discriminative responses with more basic skills (e.g., identification of pictures or items) is often understood by instructors and incorporated into program design. It is, however, less often considered a part of instruction when a learner's skill repertoire becomes more sophisticated (Engelmann & Carnine, 1991). For example, just as a learner must

Table 2 Discriminate

Skill	Description of Discrimination	Example
Object Identification	Discrimination displayed by touching item that correlates to spoken label (example) (and refraining from touching items that do not correlate to the spoken label (non-example))	Field of six items is presented on the table S^D: Touch cat Learner response: Touches cat *(refrains from touching nonexamples of cat)*
Answers Questions About Appropriateness of Social Behavior at a Restaurant	Discrimination displayed by saying yes (to examples) or no (to nonexamples)	S^D: Instructor says, "When we are eating in a quiet restaurant, is it expected/appropriate to yell loudly at someone at another table?" Learner response: Says, "no" *(learner may say, sign, or use AAC to "say" no)*
Organizes Materials	Discrimination displayed by indicating whether a picture of an environment is organized or disorganized	Instructor places field of 6 pictures on the table, including both organized and disorganized environments.@S^D: Instructor says, "Touch all the ones that are organized."@ Learner response: Touches pictures of organized environments

Note. The learner's response demonstrating discrimination in *Organizes Materials* need not be vocal. The learner can indicate the discrimination by touching yes/no, giving a thumbs up/thumbs down, putting in a yes/no bin, etc. The learner does not need to vocalize "yes"/"no."

discriminate between examples and nonexamples of an item before labeling it (Johnson & Bulla, 2021), it is also critical for them to discriminate between examples and nonexamples of organized materials before physically organizing.

The need for discrimination is particularly true for learners requiring more systematic and repeated practice to acquire and generalize skills. As an example, if a learner cannot indicate whether a desk is organized or not, we cannot expect them to physically organize their desk upon hearing the direction, "Go organize your desk."

The critical attribute of this level of instruction is that the learner engages in overt discrimination and the response form and complexity are variable (Engelmann & Carnine, 1991; Johnson & Bulla, 2021). The designer's purpose in establishing discrimination is to establish the critical features of a concept or event (Becker, 1974; Gagné, 1985; Johnson & Bulla, 2021; Tiemann & Markle, 1991). As such, there can be significant variability in the topography of a discriminated response. In *Organizes Materials*, a learner may be asked to indicate "organized" or "not organized" by selecting pictures that represent organized or unorganized environments, saying organized/unorganized, or sorting organized and not organized into piles. The response form is specific to the learner and their baseline prerequisite skills and communication style; a learner does not need to speak to discriminate (Johnson & Bulla, 2021). This variance indicates different degrees of sophistication within the Discriminate level.

Generate

Within the *Generate* level of instruction, the instructor designs opportunities for the learner to create (or come up with) examples and nonexamples. These examples or nonexamples need not always be novel but must meet the critical attributes for a correct response (Layng, 2019). This requirement contrasts the Discriminate level in which the designer provided the examples and nonexamples. By its very nature, a learner must already have the skill to *discriminate between* before they *come up with*, as established discriminations are built upon in Generate (Layng, 2019).

When the learner generates, both the form and the sophistication of their responses are variable and dependent on the critical attributes of the behavior targeted for intervention. Put more simply, what Generate looks like for a learner and a skill depends on the skills currently in their behavioral repertoire. For example, a learner with limited language may provide a one-word tact, whereas a learner with a robust spoken repertoire may tact using a sentence.

Nevertheless, both responses are classified as Generate responses, so long as the learner independently provides the word or sentence.

Table 3 illustrates the respective Generate response for the skills addressed in the Discriminate level of instruction: *Object Identification*, *Answers Questions about the Appropriateness of Social Behavior at a Restaurant*, and *Organizes Materials*. For each of these skills, the learner's response moved from a Discriminate response to the learner giving their own example or nonexample. In *Organizes Materials*, the learner moved from discriminating between organized and unorganized environments to organizing an environment. As an alternative, in *a about Appropriateness of Social Behavior at a Restaurant*, the learner gives examples of socially appropriate and inappropriate behavior rather than saying if the behavior is or is not socially appropriate.

In an instructional setting, Generate responses may be used as a learner's terminal behavioral skill/objective. These skills, however, only serve as readily available components when the learner performs the composite skill generatively in everyday life (Johnson et al., 2021). For example, if a learner is to problem-solve in everyday life, they are more readily prepared to do so if they can generate multiple solutions to various problems.

Operate

The *Operate* level of instruction builds on the previous Discriminate and Generate levels. The instructor brings in contextual features designed to continue skill refinement by building conditional discriminations utilizing examples and nonexamples. This allows the learner opportunities to practice *when to* and *when not to* respond in a particular manner. Creating conditions under which the learner applies rules and procedures to previous discriminations further solidifies the concept or skill in their repertoire and provides opportunities for self-correction and adjustment (Gagné, 1985). As the definition of the word "operate" implies, this level of instruction focuses on when and how to adjust components of the stimuli to meet the criteria, rules, or standards of a concept (Gagné, 1985; Markle, 1969). More sophisticated levels of Operate can be responding under the condition of *when not to*, or an "explanation" response, explaining *when to* and *when not to*. Skills at the Operate level are akin to certain aspects of Skinner's (1974) analysis of understanding. They both involve conditional responding based on changes in the contingencies and contexts, an iteration of generative responding as described by Johnson et al. (2021).

Table 3 Generate

Skill	Description of Generate Response	Example
Object Identification	The learner comes up with the label of the item (tacts the item)	S^D: Instructor holds up a cup and asks the learner to label Learner response: Says, "Cup"
Answers Questions about Appropriateness of Social Behavior at a Restaurant	The learner comes up with their own examples of socially appropriate and socially inappropriate behavior at restaurants when given a context	S^D: Instructor says, "You are at Red Robin eating dinner. Tell me some things you can do that are not appropriate for that setting." Learner response: Says, "Look at a stranger's food and say it's gross, throw food at my brother, touch someone's food without asking, turn the volume up really high on my tablet."
Organizes Materials	The learner organizes a group of materials	Instructor presents the learner with a disorganized area S^D: Instructor asks the learner to organize the materials Learner response: Organizes the materials

Each of these Generate examples requires a learner to generate behavior (nondiscriminative) following the presentation of discriminative stimuli

Within the Operate level, the designer arranges for the learner to produce a two-part response that consists of (1) an overt discriminative response and then (2) operate using a generative response about the discriminative response (Johnson & Street, 2013; Johnson et al., 2021). The first part of this two-part response is sufficiently straightforward—the learner discriminates whether the stimulus is or is not an example of the concept based on the critical attributes (features) of the concept (Johnson & Bulla, 2021; Johnson et al., 2021). However, where this level of instruction becomes complex is in the subsequent generative response about the initial discrimination where the learner must address when to apply a concept, criterion, or skill.

For example, in Fig. 2, the instructor presents an opportunity for the learner to operate upon a contrived situation, such as "Is it appropriate to fart in a movie theatre?" In the first part of the learner's response, the learner discriminates with a functionally equivalent yes or no answer. The second part of their response is generative, adding detail to support (rationalize) their initial answer. Figure 2 outlines the two-part S^D provided by the instructor and the two-part response given by the learner. Note that the second sentence of the learner's response is a variable feature indicating a "fixing" to the answer. The learner only had to answer "why not" to meet this step's requirements. Other Operate steps could require the learner to also explain the "why not" or to provide what should be done instead to provide more sophisticated answers. The degree of response sophistication is dependent upon the skill and learner and serves as a variable attribute used at the discretion of the instructor. Further note that an affirmative response could be provided if a rational contextual generative response follows, such as, "Yes, as long as it is silent, and no one is sitting close to me." These sophisticated responses allow for rich and nuanced responses, encouraging a shift from memorization. They also contribute to establishing self-correction repertoires and provide the foundation for self-correction in the natural context (or as designed for in Demonstrate; Johnson et al., 2021).

Table 4 includes examples of different complexities of Operate responses for three skills: *Object Identification*, *Answers Questions about the Appropriateness of Social Behavior at a Restaurant*, and

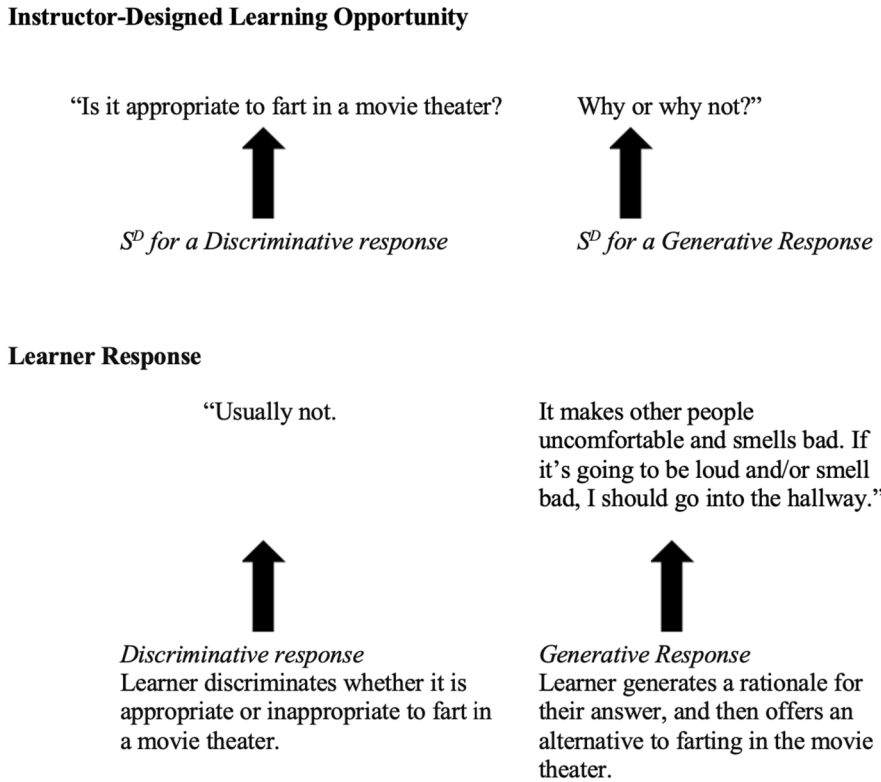

Fig. 2 Operate: Designed Learning Opportunities and Learner Response

Table 4 Operate

Skill	Instructional Cue	Sample Operate Response 1	Sample Operate Response 2
Object Identification	The learner sees a picture or item	See picture/item and hear a label and then say if the label is the name of the picture/item, correct incorrect labels	
	Instructor holds up a picture of a motorcycle and says, "This is a dog."	*Learner says: No. Motorcycle*	
Answers Questions about Appropriateness of Social Behavior at a Restaurant	The learner hears a restaurant, information about that restaurant, and behavior	Hears the situation and behavior and then says if that behavior is appropriate or inappropriate and corrects nonexamples by giving an alternative appropriate behavior	Hear the situation and behavior and say if the behavior is appropriate or inappropriate and why
	Instructor says: You are at a quiet sushi restaurant. You realize you need to burp so you burp loudly	*Learner says: Inappropriate. I could cover my mouth with my napkin or go to the bathroom to burp instead*	*Learner says: Inappropriate. Burping loudly in a restaurant is considered bad manners. Especially when it quiet and everyone can hear*
Organizes Materials	The learner sees an example or nonexample of materials	The learner discriminates whether the space is organized and "fixes" unorganized spaces	The learner discriminates whether a space is organized and then points to the disorganized areas
	The instructor arranges a disorganized environment and presents it to the learner	*The learner identifies the environment as disorganized (discriminated response) and then organizes it*	*The learner identifies if the environment is disorganized (discriminated response) and then points to the areas and items that are disorganized*

Each of these Operate examples requires the learner to determine the parameters of discrimination mastered in the previous level and behave in a way that implements these perimeters. The learner's response demonstrating discrimination in *Organizes Materials* need not be vocal. The learner can indicate the discrimination by touching yes/no, giving a thumbs up/thumbs down, putting in a yes/no bin, etc. The learner does not need to vocalize "yes"/"no."

Organizes Materials (two of these skills have variations to indicate progression of response complexity). These examples illustrate how instruction at the Operate level significantly enhances concept and skill formation and increases the sophistication of the learner's responses. Not only is the learner's performance more contextually controlled, but it also helps to shape more flexible, contextually relevant responses, which addresses a common criticism of ABA skill acquisition of learners responding in rote, superficial ways instead of a rich, complex, and contextually appropriate answer indicating a flexible and deep understanding (Miller & Spiker, 2021; Sandoval-Norton et al., 2019).

To further illustrate the point of how Operate can shape flexible, contextual responses, consider the following example of gathering ingredients for a recipe. After learning to gather ingredients for a recipe (with or without a pictorial list of ingredients), the instructor arranges an opportunity where the instructor gathers the ingredients for a recipe, then asks the learner to verify whether the ingredients are correct and fix any inaccuracies. The learner then discriminates between what is needed/not needed and missing (discriminates), then replaces/removes any incorrect or unnecessary ingredients and gathers any needed ingredients (generates). The complexity and flexibility planned for by the designer and executed by the learner progress toward desired outcomes of instruction beyond concept memorization (i.e., generativity, application, generalization).

Demonstrate

The final level of instruction in this framework is *Demonstrate*. At the Demonstrate level, the designer continues to play an active role in transferring control from a highly programmed environment to a more situationally specific one (i.e., naturally occurring) filled with discriminative stimuli and reinforcers to recruit and maintain the learner's performance of the skill. It is not simply the practice of the skill in a learner's natural context but instruction that focuses on transferring the skill to natural contingencies, establishing a durable skill in the learner's behavioral repertoire. At a fundamental level, this ensures that instruction is programmed and delivered to measure the learner's demonstration of the skill as it would naturally occur, like Johnson et al.'s (2021) description of simple generative responding. Controlled instructional variables at this level may include proximity of instructors, frequency of reinforcement, and variability in features of the discriminative stimuli, all of which are programmed to evoke and maintain more generative, extinction-resistant demonstration of the skill (Johnson et al., 2021).

The features of Demonstrate are unique from the other levels. At the Demonstrate level, skill instruction occurs in the learner's natural environment. Therefore, naturalistic teaching arrangements must be implemented, making it the only level of instruction that specifies both the learning objective and the instructional delivery approach, encompassing both "what to teach" and "how to teach." Other instructional arrangements, such as discrete trial instruction or frequency building, may not be employed in Demonstrate, because they decontextualize instruction (Johnson et al., 2021; Snyder et al., 2015). Demonstrate, as level within this framework, is situated as the final step, to ensure the transfer of the terminal skill, after moving through all previous levels of instruction. Dependent on the learner and environmental factors, the designer may implement Demonstrate after Discriminate, Operate, or Generate if (1) the controlled variables that define the instructional step are maintained; (2) the discriminative stimuli and maintaining consequences of the attributes of that step must occur in the learner's natural environment; and (3) the skill is ultimately transferred to contextual (natural) contingencies.

Table 5 displays some programmatic examples of Demonstrate. In *Organizes Materials*, the learner must physically demonstrate organizing materials in a specific context as it naturally arises in their life. For example, a learner prepares to leave for a holiday break. The teacher communicates expectations to their class, one of which is to ensure all desks are tidy before the students leave. The learner then arranges their materials in their desk in such a way that satisfies the definition provided by their teacher. Though the instructional cue comes from the teacher, the expectation of a clean desk is a regular part of the classroom's routine in preparation for a holiday break. This example differs from the same skill in the Generate level such that an everyday situation sets the occasion for the learner to perform the skill.

The Demonstrate level is perhaps the most critical yet overlooked level of instruction. In programming

Table 5 Demonstrate Examples per Skill

Skill and Brief Description	Rationale
Object Identification	The learner identifies objects by selecting or tacting the object in naturally occurring situations
Answers Questions about Appropriateness of Social Behavior at a Restaurant	The learner demonstrates understanding of consequences of their behavior by stating those consequences after their behavior, during naturally occurring situations
Organizes Materials	The learner organizes materials appropriate to the context when cued by the context

Each of these Demonstrate examples requires the learner to demonstrate the skill in their natural context, and in a functional or useful manner

instruction for the Demonstrate level, instructors address gaps in instructional design, address problematic patterns that may be overlooked or masked during highly structured instructor-directed instruction, and ensure the behavior is observed in contextually appropriate situations and maintained by contingencies existing in the learner's environment, thereby ensuring the validity of the skill. If instructors neglect to implement at the Demonstrate level of instruction, they run the risk that the skill they carefully programmed will not transfer or may transfer in such a way that it is not evoked or maintained by natural contingencies. For example, consider the skill, *Lists Solutions to Problems*, in which the learner hears a problem situation and lists multiple possible solutions. Instructors often stop instruction on this skill when mastery is achieved in more instructor-directed and arranged "table time" instructional arrangements (e.g., discrete trial instruction), where the discriminative stimulus is very explicit and programmed (e.g., "Here is your problem: the sink is overflowing. What can you do?"). These designs, however, do not necessarily account for the nuance and spontaneity of naturally occurring events of the same problem situations. For example, the instructor designs a learning opportunity for the learner to demonstrate that specifically includes the following features in its scope:

(1) Transfer of S^D to contextually occurring stimuli: The learner encounters the sink very full/overflowing; the sink, rather than the instructor, provides a cue to evoke problem-solving behavior.
(2) Fade the amount of instructor participation: The instructor systematically reduces their proximity, utilizes prompt-fading procedures, and minimizes feedback.
(3) Build durability in performance by selecting teaching opportunities that deliver reinforcers at the same schedule as the natural environment: Allows problem-solving strategies to succeed or fail depending on their effectiveness (i.e., not every strategy employed solves the problem).
(4) Design for the transfer of reinforcement, from instructor-managed to context-dependent: Specifically control for and arrange for natural reinforcement (e.g., stopping the overflow or parent praise serving as reinforcers rather than contrived unrelated reinforcers).

Again, the instructor's design of instruction at this level is highly sophisticated, because it requires a thorough analysis of the skill, contextual contingencies, and specific programmatic design to address skill transfer. This example highlights the level of design that is unique to Demonstrate, separating it from other levels of instruction and performance outcomes. There may be overlapping characteristics between the Demonstrate level, generalization, generative responding, and application. Yet, there is a specific distinguishing feature: the *outcomes* of the intervention characterize generalization, generative responding, and application (Johnson et al., 2021; Mace & Nevin, 2017; Stokes & Baer, 1977). These outcomes confirm a well-programmed instructional phase and may occur across all phases of this instructional framework (D-G-O-D). The Demonstrate level, in contrast, is characterized by the instructional *process* throughout the intervention (like the process toward generative responding described by Johnson et al., 2021). Therefore, these are not competing processes or synonymous terms, but rather are separate process or outcome constructs.

A Pragmatic Approach to the D-G-O-D Framework

D-G-O-D within an Instructional Program

This article focuses on illustrating the use of the D-G-O-D framework in developing the instructional scope for a skill that may include multiple levels of instruction. Table 6 displays the instructional sequence within a singular skill, *Makes Conditional Discriminations about Safety Rules,* as it progresses through the various levels of instruction: Discriminate, Generate, Operate, and Demonstrate. The skill's critical attributes, or terminal goal, include the learner experiencing any social situation (familiar to unfamiliar) and behaving conditionally to follow safety rules. This goal may include joining a situation and behaving in alignment with safety rules or changing their positioning/interaction based on the behavior of a communication partner, for example.

Moving the learner through these various phases as part of the instructional sequence prepares them to master the skill safely and comprehensively. In addition, it allows the learner to master the skill in a trained, safe, and contrived context before entering a situation where a safety rule may be broken, thereby placing the learner in an unsafe situation. For example, before placing the learner in a situation in which they are riding the bus and may need to move away from someone who is sitting too close, the learner practices discriminating if the situation is safe/unsafe, tacting if it is safe and unsafe, and saying why it is safe/unsafe. All these steps within the overarching skill are essential components to ensure the learner acquires the skill and minimizes the number of learning trials and potential discomfort.

Table 6 Instructional Sequence (Program Outline) for Safe vs. Unsafe

Level of Instruction	Instructional Step and Instructional Step Description *(changes between steps **bolded**)*
Discriminate	Instructional Step 1: The learner **sees a situation hears the situation and "safe" or "unsafe" and then says "yes" or "no,"** for situations that include safety rules **without conditional discriminations**, for situations **with low inferencing/that are highly familiar**
	Instructional Step 2: The learner sees a situation hears the situation and "safe" or "unsafe" and then says "yes" or "no," for situations that include safety rules without conditional discriminations, for situations **with inferencing/that are novel or minimally familiar**
	Instructional Step 3: The learner sees a situation hears the situation and "safe" or "unsafe" and then says "yes" or "no," for situations with safety rules **with conditional discriminations**, for situations with inferencing/that are novel or minimally familiar
Generate	Instructional Step 4: The learner **sees a situation and says "safe" or "unsafe,"** for situations that include safety rules with conditional discriminations, for situations with inferencing/that are novel/less familiar
Operate	Instructional Step 5: The learner **sees a situation hears the situation and "safe" or "unsafe" and then says "yes" or "no" and why**, for situations that include safety rules with conditional discriminations, for situations with inferencing/that are novel or minimally familiar
Demonstrate	Instructional Step 6: The learner **experiences a situation and changes their behavior to follow safety rules, for situations** that **require no inferencing/that are very familiar** and for safety rules **without conditional discriminations**
	Instructional Step 7: The learner **changes their behavior to follow safety rules**, for situations that r**equire inferencing/that are novel or familiar**, and for safety rules **with conditional discriminations**

This example of a program details how a learner can progress through the D-G-O-D framework within an instructional program. It further provides an example of how multiple steps are required in the Discriminate and Demonstrate levels suggesting that there is not a one-to-one correspondence between level and instructional step within a program

D-G-O-D across Instructional Programs

To fully exemplify how a skill may be separated into multiple instructional programs moving through these levels of instruction, refer back to Fig. 1, which outlines *Object Identification* as it moves through the levels of instruction. The ultimate goal of instruction in object identification is for the learner to tact items throughout their day in untrained environments.

Although the long-term goal is for the learner to freely tact items in their environment (i.e., Demonstrate-level performance), some extensive prerequisite skills within the Discriminate, Generate, and Operate levels require instruction. For example, at the Discriminate level, the learner may start with instruction in nonvocal identification. Next, they move to Generate, providing the item's name independently in a structured instructor-directed context. To increase complexity, the learner then moves to the Operate level where they see examples and nonexamples and hear a possible name, then say a "yes" or "no" response, fixing any "no" answers. Finally, as the learner's accuracy, speed of responding, and the number of targets mastered meet the criteria, they may progress to the Demonstrate level, within any of these levels.

Including all these steps within a singular program across sufficient targets would be extensive. As illustrated in Fig. 1, the D-G-O-D programming breaks apart each level into individual programs, with the learner progressing through the framework.

Conclusion

The efforts presented here outline a behavior-analytically developed instructional design framework applicable to any setting and learner to maximize learner competency and instructional efficacy. By systematically considering each level of instruction, the behavior analyst can enhance their analysis of how materials, settings, and learner expectations refine throughout the learning process toward mastery. By applying the same level of systematic approach in designing instruction as behavior analysts do in shaping behavior, our applied discipline has the potential to usher in a new era of support for those who can benefit from our science. Further, new lines of research organized around this system will substantiate the disparate findings observed in the applied domain and support efforts to encourage behavior-analytic applications in various settings and populations. Although many examples used to illustrate the critical features of each level in the D-G-O-D framework are language-based and thus are more sophisticated topographies, this need not be the case. However, those interested in designing sophisticated language programs would benefit from utilizing a systematic design framework like the one outlined here. Further, the levels in D-G-O-D are suitable for instructional design efforts and any instructional arrangement (e.g., discrete trial instruction, naturalistic instruction). In addition, depending on the complexity of the skill and the learner's initial performance, an instructional program can be designed to include all levels in a nonlinear fashion (Layng et al., 2004) or broken into distinct instructional programs.

At this point, the framework remains a set of conceptual constructs logically assembled and built from a foundation of core instructional design principles. The absence of robust experimental validation of this framework need not deter interested practitioners from incorporating features of the D-G-O-D framework. Further, those researching advanced applied behavior analytic instructional practices may find considerable fodder for systematic research efforts, and we encourage all attempts to do so.

Declarations

Conflict of Interest On behalf of the authors, the corresponding author states that there is no conflict of interest.

References

Becker, W. C. (1974). Teaching concepts and operations, or how to make kids smart. In R. Ulrich, T. Stachnik, & J. Mabry (Eds.), *Control of human behavior: Behavior modification in education,* (Vol. 3., pp.). Scott, Foresman & Company.

Chadwell, M., Sikorski, J., Roberts, H., & Allen, K. (2019). Process versus content in delivering ABA services: Does process matter when you have content that works? *Behavior Analysis: Research & Practice, 19*(1), 14–22. https://doi.org/10.1037/bar0000143

Choi, E., & Johnson, D. (2022). Common antecedent strategies within organizational behavior management: The use of goal setting, task clarification, and job aids. *Journal of Organizational Behavior Management, 42*(1), 75–95. https://doi.org/10.1080/01608061.2021.1967834

Engelmann, S. & Carnine, D. (1991) *Theory of instruction: Principles and applications* (2nd ed.). ADI Press.

Gagné, R. M. (1985). *The conditions of learning and theory of instruction*. Holt Rinehart & Winston, Inc.

Greer, R. D., & Ross, D. E. (2008). *Verbal behavior analysis: Inducing and expanding new verbal capabilities in children with language delays.* Pearson Education.

Haughton, E. C. (1972). Aims: Growing and sharing. In J. B. Jordon & L. S. Robbings (Eds.), *Let's try doing something else kind of thing* (pp. 20–39). Council for Exceptional Children.

Hieneman, M., Fefer, S., Isley, S., & Sieders, M. (2022). *Helping your family thrive a practical guide to parenting*. Brooks Publishing.

Johnson, K., & Bulla, A. (2021). Creating the components for teaching concepts. *Behavior Analysis in Practice, 14*(3), 785–792. https://doi.org/10.1007/s40617-021-00626-z

Johnson, K. R., & Layng, T. V. J. (1992). Breaking the structuralist barrier: Literacy and numeracy with fluency. *American Psychologist, 47*, 1475–1490. https://doi.org/10.1037/0003-066X.47.11.1475

Johnson, K. R., & Layng, T. V. J. (1996). On terms and procedures: Fluency. *The Behavior Analyst, 19*(2), 281–288. https://doi.org/10.1007/BF03393170

Johnson, K., & Street, E. M. (2013). *Response to intervention and precision teaching: Creating synergy in the classroom*. Guilford Press.

Johnson, K., Street, E. M., Kieta, A. R., & Robbins, J. K. (2021). *The Morningside model of generative instruction: Building a bridge between skills and inquiry teaching*. Sloan Publishing.

Kubina, R. (2012). *Precision teaching book*. Greatness Achieved Publishing.

Layng, T. V. J. (2019). Tutorial: Understanding concepts: Implications for behavior analysts and educators. *Perspectives in Behavior Science, 42*(2), 345–363.

Layng, T. V. J., Twyman, J. S., & Stikeleather, G. (2004). Engineering discovery learning: The contingency adduction of some precursors of textual responding in a beginning reading program. *Analysis of Verbal Behavior, 20*(1), 99–109. https://doi.org/10.1007/BF03392997

Mace, F. C., & Nevin, J. A. (2017). Maintenance, generalization, and treatment relapse: A behavioral momentum analysis. *Education & Treatment of Children, 40*(1), 27–42. https://doi.org/10.1353/etc.2017.0001

Markle, S. M. (1969). *Good frames and bad: A grammar of frame writing.* (2nd ed.). John Wiley & Sons.

Markle, S. M., & Tiemann, P. W. (1970). "Behavioral" analysis of "cognitive" content. *Educational Technology, 10*(1), 41–45.

Miller, A. S., & Spiker, S. (Hosts). (2021, June 9). ABA Pt. 3: Little Robots (213) [Audio podcast]. *Why We Do What We Do*. https://wwdwwdpodcast.com/episodes/2021/0609-episode-213-aba-pt-3-little-robots-why-we-do-what-we-do

Sandoval-Norton, A. H., Shkedy, G., & Shkedy, D. (2019). How much compliance is too much compliance: Is long-term ABA therapy abuse? *Cogent Psychology, 6*(1). https://doi.org/10.1080/23311908.2019.1641258

Skinner, B. F. (1968). *The technology of teaching*. Vintage Books.

Skinner, B. F. (1974). *About behaviorism*. Appleton-Century-Crofts.

Snyder, P. A., Rakap, S., Hemmeter, M. L., McLaughlin, T. W., Sandall, S., & McLean, M. E. (2015). Naturalistic instructional approaches in early learning: A systematic review. *Journal of Early Intervention, 37*(1), 69–97. https://doi.org/10.1901/jaba.1977.10-349

Stokes, T. F., & Baer, D. M. (1977). An implicit technology of generalization. *Journal of Applied Behavior Analysis, 10*(2), 349–367.

Tiemann, P.W., & Markle, S.M. (1991). *Analyzing instructional content: A guide to instructional content* (4th ed.). Stipes Publishing.

Twarek, M., Cihon, T., & Eshleman, J. (2010). The effects of fluent levels of Big 6 + 6 skill elements on functional motor skills with children with autism. *Behavioral Interventions, 25*(4), 275–293. https://doi.org/10.1002/bin.317

Vargas, E. A. (1982). Intraverbal behavior: The codic, duplic and sequelic subtypes. *VB News, 1*, 5–7. https://doi.org/10.1007/BF03392792