# Where UDL and Applied Behavior Analysis Intersect: Organizing Environments to Support Student Learning

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### Abstract
Universal design for learning is rooted in cognitive theory, but behavioral science has generated similar suggestions about how to best design environments to maximize student learning. This paper briefly overviews the theoretical differences and highlights some ways behavioral science has converged on similar practical strategies for teachers. One goal is to enhance teacher ability to design learning environments to meet diverse student needs.

### Keywords
Applied Behavior Analysis, Antecedent Strategies, UDL Strategies

## INTRODUCTION
Over the past 50 years, a body of empirical evidence has accumulated that has shed light on the relevance between specific environmental contexts of learning and students responses associated with those contexts. For example, it has been demonstrated that a systematic and explicit approach to literacy instruction is highly effective for producing desired literacy outcomes (National Reading Panel, 2000). Thus, arranging instructional environments that incorporate features consistent with a systematic and explicit approach to literacy instruction is a good starting point for most learners. However, other environmental factors amplify and attenuate learner responses to instructional situations. For example, systematic and explicit literacy instruction that incorporates content based on learner interests (e.g., a favorite cartoon character) may have the effect of improving reading-related behavior. Similarly, presentation of systematic and explicit reading instruction that incorporates learner preferences (e.g., partially animated storybook on a computer versus traditional book) may compound the positive effects, thereby leading to increased acquisition and mastery of targeted skills. Conversely, the presentation of systematic and explicit literacy instruction that does not incorporate student interests and preferences may slow (or prevent) acquisition and mastery of the targeted skill. Thus, educators may be more effective when they complement effective instruction with specialized features to meet the learning needs of a diverse student body. This is a primary tenet of UDL as well as a behavior-based approach to teaching and learning.

## UDL AND BEHAVIORAL SCIENCE
The universal design for learning (UDL) framework organizes strategies in three categories: representation, engagement, and action and expression (CAST, 2011). Universal design for learning is rooted in cognitive theories of learning that, generally speaking, propose that learning is controlled by internal processes that receive, classify, code, encode, store, and retrieve information. By extension, UDL aims to organize stimulus inputs from the environment in ways that are both conducive to the learner's internal processes that, in turn, lead to a repertoire of behavior intended by the teacher (e.g., 120 words read aloud per minute; explaining differences between mammals and reptiles). Accordingly, a key practical feature of cognitive theory, and UDL in particular, is the emphasis on arranging the environment to optimize student learning and development. However, the specific practices that emerge from the framework also are largely supported by decades of behavioral science.

Behavioral science has a long history of discovering ways to modify environments to produce socially significant behavior (Baer, Wolf, & Risely, 1968; Cooper, Heron, & Heward, 2007). There exists much confusion and debate between cognitivists and behaviorists about the relevance of the brain's behavior for explaining behavior (e.g., Wessells, 1981). Putting those issues aside, behavioral theory describes learning as the result of relationships between the environment prior to and following an emitted behavior. A behavior analytic approach requires understanding relations between the environment and the learner's behavior, but does so without relying on assumptions about brain functioning. This approach aims to capitalize on understanding the environment-behavior relations in for teaching/learning situations. Behavior analytic teachers rely on a scope and sequence of instruction and knowledge about their students (e.g., their interests and preferences, unique personal history, cultural factors, and etc.) to strategically arrange the learning environment. From a practical perspective, behavior-based teaching emphasizes organizing the learning environment that both maximizes the probability of desired behaviors and minimizes the probability of undesirable behaviors. This clearly aligns with UDL in that it prioritizes optimizing environments for diverse learners.

Cognitive and behavioral theories are in many ways at odds with each other, but divergent theories are arguably less relevant than the convergence on practical applications. For example, if behavioral theory and cognitive theory are capable of explaining the same observations (e.g., critical features of environments that predict student behavior), then specifying the details of those observations has a practical value for professionals that ought to be clarified and disseminated (while theory-loving scientists continue to debate the merits of their explanations). Teachers do not care about which theory best explains the facts; they want practical strategies they can put to use in their classroom to on Monday morning.

Cognitive and behavioral scientists alike have discovered strategies and practices that are demonstrably useful and effective for achieving desired educational outcomes. Both paradigms emphasize organizing learning environments in ways that make specific behaviors (e.g., reading, writing, problem solving, cooperation, communication, task completion, and so on) more likely to occur while simultaneously reducing the probability of undesired behavior (i.e., behaviors incompatible with pre-determined desired behaviors). Several strategies for optimizing learning environments are familiar to UDL proponents (e.g., present information in different ways, allow choices for expressing knowledge, vary difficulty of tasks, teach self-regulation),

but behavior analysts have accumulated a similar set of strategies for increasing the likelihood that students will respond in desirable ways to specific environmental arrangements. Such strategies include interspersing

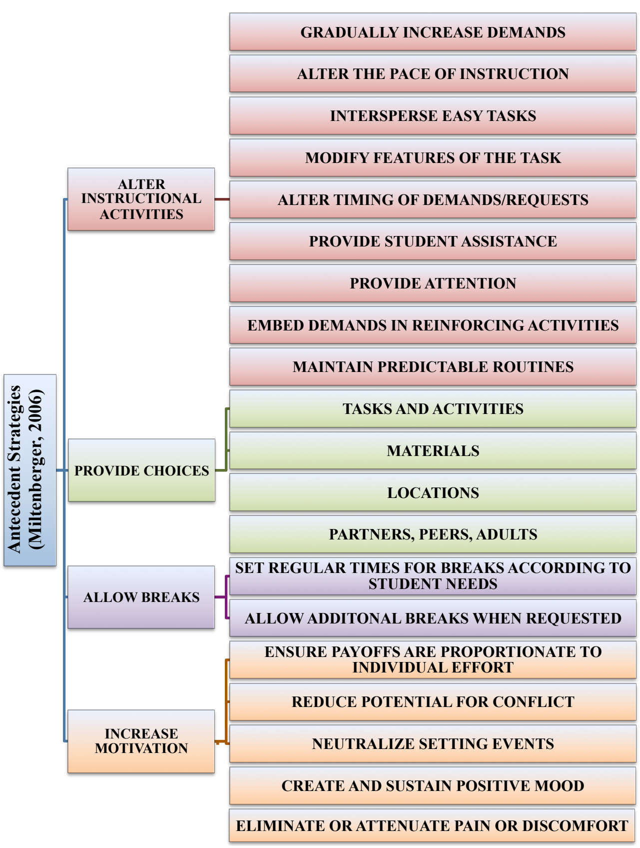


**Figure 3. Behavior analytic strategies for designing learning environments to meet student needs.**

easy tasks, providing choices of materials for completing tasks, and using consequences to boost motivation, to name a few (Miltenberger, 2006). Figure 1 shows a variety of behavior analytic strategies identified by Miltenberger (2006) for designing learning environments to meet student needs.

Embedded instruction is one specific behavior analytic strategy that aligns well with UDL principles. Embedded instruction involves the strategic integration of multiple and varied opportunities to practice a skill throughout the day. For example, rather than reserving instruction of specific skills for a period of the school day and seeking ways to accommodate the learning needs to a specific lesson, teachers using an embedded approach integrate opportunities for learners to perform targeted skills throughout the day. This allows teachers to schedule activities without being constrained to specific times of day (e.g., literacy block, math time) for instruction. For example, a teacher charged with promoting student understanding of concepts of measurement may arrange for brief and/or lengthy opportunities to engage in behavior consistent with mastery of measurement concepts. The teacher may find opportunities to practice measurement during arrival, recess, lunch, physical education class, passing time, when in the library, and etc. By arranging for multiple opportunities to practice the skill throughout the day, the teacher can better accommodate diverse learners while instilling deep understanding of the concepts and, more importantly, the applied values of the skill.

Figure 2 is an example of an embedded instruction matrix. The teacher lists the daily activities in the first column and the learning objectives for the student in the first row. A mark is indicated in each box when it has been determined that the learning objective may be embedded into the activity. The teacher then creates a concise plan for instruction that integrates the opportunity during the activity. Each activity may have multiple learning objectives and each learning objective may be practiced multiple times and in varied ways throughout the day.

EMBEDDED INSTRUCTION MATRIX

| DAILY ACTIVITIES | Time | Obj. #1: | Obj. #2 | Obj. #3 | Obj. #4 | Obj. #5 | Obj. #6 | Obj. #7 | Obj. #8: |
|---|---|---|---|---|---|---|---|---|---|
| Arrival/Breakfast | 7:45-8:00 | X | X | X | X | | | X | X |
| Meeting | 8:00-8:15 | X | X | | | | | X | |
| Math | 8:15-9:15 | X | X | | | X | X | X | |
| Art | 9:15-10:15 | X | X | | | | | X | |
| Outdoor Explore | 10:00-10:30 | X | X | X | X | X | X | X | X |
| Group Project | 10:30-11:45 | X | X | X | X | X | X | X | X |
| Lunch | 11:45-12:00 | X | X | X | X | | | | X |
| Group Project | 12:00-1:15 | X | X | X | X | X | X | X | X |
| Science | 1:15-2:30 | X | X | | X | | | | |
| Community | 2:30-2:30 | | X | X | | X | X | X | X |
| Dismissal | 2:00-2:10 | X | X | | | X | | X | |
| | | **# Opp: 10** | **#Opp:11** | **# Opp: 6** | **# Opp: 6** | **# Opp: 6** | **# Opp: 5** | **# Opp: 9** | **# Opp: 6** |

**Figure 4. Example of an embedded instruction matrix.**

From this matrix, teachers can organize specific plans for instruction that integrate several critical skills. In Figure 2 above, the teacher has arranged for an outdoor period for exploration. All of the eight objectives for a learner (number of learning objectives will vary by curriculum and learner needs) are integrated into this activity, thereby ensuring that critical skills are acquired, practiced, and applied in conjunction with each other (e.g., cooperation, problem solving, geometry, ecosystems, writing sentences, making observations, and synthesizing findings). Such organization emphasizes learning outcomes that inform the organization of environments conducive to the learning process rather than adapting existing instructional structures to accommodate diverse learners. In other words, this approach, irrespective of theoretical orientation, emphasizes identification of learning standards at the outset (rather than a curriculum) and allows the teacher to reverse engineer the learning environments most conducive to student mastery.

## CONCLUSION

One potential benefit of considering the behavior analysis research literature is to further clarify what specific strategies and tactics overlap with those outlined in the UDL literature. It may be that knowledge about effective practices can be clarified if strict adherence to theoretical orientations are set aside in favor of an accounting of the observed facts about student learning. Both paradigms emphasize designing environments in ways that reliably correlate with valued behaviors, including complex academic, social, communicative, and other skills. This somewhat utilitarian approach may not only have practical benefits to students with diverse learning needs, but also may further clarify areas in need of empirical investigation while providing broader understanding about how the theoretical orientations of the two different paradigms overlap.

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