

Getting from Here to There:

UDL, Global Positioning Systems,
and Lessons for Improving Education

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“Education should help turn novice learners into individuals who are expert at learning—individuals who know how to learn, who have already learned a great deal, and who want to learn even more.”

Introduction

Establishing good educational policies and practices depends first and foremost on being clear about what we want to achieve. What is the goal of education in the twenty-first century? In writing the Universal Design for Learning (UDL) guidelines with our colleagues at the Center for Applied Special Technology (CAST), we have argued that the goal of education is not simply the mastery of knowledge but the mastery of learning. Education should help turn novice learners into individuals who are expert at learning—individuals who know how to learn, who have already learned a great deal, and who want to learn even more. At commencement all graduates should be well prepared in their own individual ways for a lifetime of learning as content-area experts (if they choose), masters of trades and crafts, artists, scientists, or whatever else life has in store.

UDL is an approach that addresses and redresses the primary barrier to making expert learners of all students: inflexible, one-size-fits-all curricula that raise unintentional barriers to learning. Learners with disabilities are most vulnerable to such barriers, but many students without disabilities also find that curricula are poorly designed to meet their learning needs. Traditional curricula—and, for that matter, the policies that support them—are too prescriptive in how students reach the end goal of mastering learning. They provide few routes to success, requiring individuals in all their diversity to follow the same narrow roads.

Of course, diversity is the norm, not the exception, wherever individuals are gathered, including schools. When curricula are designed to meet the needs of the broad middle—at the exclusion of those with different abilities, learning styles, backgrounds, and even preferences—they fail to provide all individuals with fair and equal opportunities to learn. Curricula should make clear the goals of learning and then provide guided support for reaching those goals.

In this article, to illustrate the principles of UDL, we describe an instrument that many of us use every day: the Global Positioning System (GPS) that many of us now have in our cars. The GPS is a good analogy because it embeds many of the same features that are needed in education. In fact, the GPS may serve as a better example of UDL than most traditional educational curricula.

One Goal, Many Routes

The GPS guides travelers to their final destinations by asking three important questions:

- What is your present location?
- What is your destination or goal?
- What is the best route for reaching that goal?

To assist individuals in finding their present location, the GPS offers multiple options. Users can click a button that reveals their exact location, type in a starting point, or speak their present location into the instrument. The GPS builds in these alternatives to ensure that it will obtain an accurate starting point for every user. We highlight this feature of the GPS because in schools, we often do not know the “present locations” of our students. We might have twenty-five students in a classroom, and each student has unique background knowledge as well as varying strengths and weaknesses; these twenty-five all start in very different places. When we think about the GPS in relation to UDL, it is clear that the GPS builds in features to account for this diversity among individuals.

Once the starting point has been determined, the GPS then addresses the question, “What is your destination or goal?” Again, the GPS assists individuals in setting their objectives by offering alternatives. For example, you can choose to enter your destination by yourself, or you can search from previous destinations. If you do not know the exact location, you can even choose to select from the Yellow Pages. The GPS very rarely restricts users to only one option; it embeds a wide array of choices to support travelers in selecting their objectives. In terms of UDL, the GPS understands the importance of setting goals and providing the necessary supports to reach them.

Finally, the GPS supports travelers in selecting a route. The GPS does not assume that there is only one way to get travelers to their destinations; it recognizes the need to offer alternatives so that users can choose the route that best suits their needs. For example, you can select your route based on the shortest time, the most use of freeways, or the least use of freeways. In fact, some systems even allow you to choose the most scenic route. When we think about the GPS in terms of UDL, it is asking, “What kind of route do you want?” or “What kind of route is best for you?” This ability to customize according to individual preferences is a key element of UDL.

The GPS is a perfect analogy with which to illustrate UDL because these three questions—determining a present location, setting a destination or goal, and selecting individualized routes—are crucial when we think about student learning. Students are highly diverse, and this means that they are going to need to take different paths to achieve the same goals.

The GPS is faced with two different challenges: getting you to your destination on time and getting everyone to their destinations on time. This second challenge is a very different challenge from the first. It is not just about providing multiple routes to take one individual from the airport to the Children’s Museum, for example; it is also about being responsive to the many different travelers who want to go to the Children’s Museum. Each traveler will start in a different place and will have varied needs and preferences that the GPS must accommodate. Both of these challenges are interesting from a design standpoint as well as from a technology standpoint.

The GPS is able to address these vastly different challenges by embracing technology. In fact, the GPS utilizes technology well in the ways that we want education to use technology well. To get travelers to their destinations, online technology is much more effective than a traditional printed paper map. The GPS also draws upon the power of technology to differentiate. The GPS recognizes that there are many paths, and this awareness allows different people from different places to all get to the same objective. The GPS takes full advantage of the power and flexibility of technology in its design, and we hope that schools will be able to harness this power in the design of their curricula as well. Of course, it is worth noting here that even in low-tech environments, curricula can and should be responsive to individual needs. Technology can make this easier to accomplish in some settings but is itself never a substitute for a well-designed curriculum or thoughtful, responsive instruction.

Universal Design for Learning

UDL helps meet the challenge of diversity by suggesting flexible instructional materials, techniques, and strategies that empower educators to meet these varied needs. A universally designed curriculum is designed from the outset to meet the needs of the greatest number of users, reducing the need for costly, time-consuming, and after-the-fact changes (Rose & Meyer, 2002). Three primary principles guide UDL:

Principle 1: Provide multiple means of representation

Students differ in the ways that they perceive and comprehend information that is presented to them. For example, those with sensory disabilities (e.g., blindness or deafness), learning disabilities (e.g., dyslexia), language or cultural differences, and so forth may require different representations of information in order to access and understand the same content. Moreover, no one type of representation is optimal for a particular kind of content. For example, printed text may be a better medium for teaching and learning history than science and mathematics. In reality, there is no one means of representation that will be optimal for all students or for all types of learning; providing options in representation is essential.

Principle II: Provide multiple means of action and expression

Students differ in the ways that they can navigate a learning environment and express what they know. For example, individuals with significant motor disabilities (e.g., cerebral palsy), those who struggle with strategic and organizational abilities (executive function disorders, ADHD), and those who have language barriers approach learning tasks very differently and will demonstrate their mastery very differently. Some may be able to express themselves well in writing but not oral speech, and vice versa. In reality, there is no one means of expression that will be optimal for all students; providing options for expression is essential.

Principle III: Provide multiple means of engagement

Students differ markedly in the ways in which they can be engaged or motivated to learn. Some students are highly engaged by spontaneity and novelty while other are disengaged, even frightened, by those aspects, preferring predictable routine and structure. In reality, there is no one means of engagement that will be optimal for all students; providing multiple options for engagement is essential (Rose & Meyer, 2002; CAST, 2008).

CAST drafted the UDL Guidelines (2008) to address the call from teachers, administrators, curriculum developers, and policy makers for guidelines to help make applications of UDL principles and practices more concrete. Each principle has three associated guidelines, and each guideline offers several specific options or “checkpoints” (see figure 1-1). These guidelines and their associated checkpoints articulate evidence-based options that should be considered to ensure that students with a full range of abilities and disabilities can access and progress in the general curriculum.

An Analogy for Education: How the GPS Addresses UDL Principles

Sadly for education, the commonly-available GPS exemplifies the principles and guidelines of Universal Design for Learning better than most educational curricula. The following section explores the features of the GPS through the lens of the UDL guidelines.

Principle I: Multiple Means of Representation**Guideline 1: Provide options for perception**

Perception	In order to ensure that information is equally accessible to all learners, the UDL guidelines point out that it is critical to provide several options in the way that the information can be perceived. If we present information that is accessible through only one sensory modality (a spoken lecture, for example) students who are deaf or hard of hearing or students who simply have trouble processing auditory information will not find the information accessible. If our information is presented only through printed text, students who are blind or have low vision will be unable to access the content. Providing options (e.g. captions for the lecture, voicing for the visual text) are essential for equitable learning and teaching
Language and symbols	
Comprehension	

The GPS, much more than most lectures or textbooks, automatically provides the perceptual options recommended in the UDL guidelines. First and foremost, it presents all of its key information by visual and auditory means. Visually, it uses maps to display your location and text to provide directions, locations, and landmarks. But it also presents the same information aurally by “talking you through” each step of your journey and reading any text aloud. If you have a visual impairment, with the GPS you can navigate purely through spoken words and sounds. If you are hard of hearing, you can navigate entirely by visual information. Finally, the GPS builds in options to customize the display of information. In most GPS units, you can make the screen brighter, adjust contrast, increase or decrease the size of images, increase or decrease the volume, and so forth. The GPS recognizes the diversity of perception among travelers and provides multiple representations of information.

Guideline 2: Provide options for language and symbols

Perception	The UDL guidelines also prompt us to consider providing options for the language and symbols in which information is represented. Students in our classes have different strengths and weaknesses with language; if we present information primarily through text, students who have difficulty decoding, students with dyslexia, or students who are English language learners will not have equitable access.
Language and symbols	
Comprehension	

The GPS, in contrast to textbooks, provides many options for the languages and symbols it uses. For information presented in text, the GPS provides the option to hear it read it aloud automatically: for information presented orally, the GPS provides visual options: for information presented in English, the GPS allows users to select the language with which they are most comfortable. Finally, there are even alternatives for language itself. The GPS has a “beep system” that obviates the need for language at all. The various beeps associated with “turn right,” “turn left,” and “stay straight” allow travelers to reach their destination entirely on the basis of sounds.

Guideline 3: Provide options for comprehension

Perception	The UDL guidelines also prompt us to consider providing options for comprehension, recognizing that students differ widely in their preparedness to assimilate new information into useable knowledge. They stress the importance of providing information that has “cognitive” options: alternative representations that highlight critical features or provide prompts and models to guide effective information processing, for example.
Language and symbols	
Comprehension	

Typical GPS units provide multiple cognitive options to enhance comprehension. To draw attention to useful information, for example, many GPS units have a built-in product demonstration that highlights the important features of the device for novice users. More importantly, there are many cognitive options in how the GPS displays information. For many users, the optimal representation is a coordinate spatial map view where they can get a “big picture” view of their progress and direction. For others, the optimal representation is a “landmark” view: a list that shows the turns and signposts for them that lie ahead. For still others, the optimal representation is an even smaller chunk of information: just the next turn to be watching for. The GPS provides each of these options with a simple press of a switch.

Principle II: Multiple Means of Action and Expression**Guideline 4: Provide options for physical action**

Physical action	The UDL guidelines also encourage us to provide options for physical action so that students’ motor skills do not act as a barrier to expression. For example, if you asked your students to express what they know about the causes of the American Revolution through a written essay, those students with motor disabilities would not be able to give you an accurate picture of what they know because the motor demands of the task would interfere with fluent expression. Consequently, the guidelines encourage us to provide multiple options for student action.
Expressive skills and fluency	
Executive function	

The GPS has alternatives for physical actions built right into its design. To enter your destination, you have the option of speaking the name of the destination into the device instead of typing it. This feature benefits travelers who have motor disabilities as well as those whose hands are occupied by the steering wheel. The GPS also features embedded word prediction: you type in the first few letters of a destination, and it will predict your word. In three simple clicks, you can enter your destination.

Guideline 5: Provide options for expressive skills and fluency

Physical action	The UDL guidelines also suggest providing options for the skills that underlie expression and communication. These options are necessary because students differ widely in the fluency with which they can use various media and tools to express themselves. For unskilled novices it is important to provide scaffolds that can be gradually released as those learners develop fluency and independence.
Expressive skills and fluency	
Executive function	

The GPS is certainly not an instrument or medium for communication, but it does provide important scaffolds for the novice. For one, most GPS units provide an option to “simulate” the trip ahead, modeling the sequence of turns and choices that the driver will ultimately follow. When you actually proceed along the route, the GPS scaffolds you by breaking your trip into small, manageable steps instead of overwhelming you with the whole sequence at once. Lastly, like a good mentor, it prompts you “just in time” to make the right choices.

Guideline 6: Provide options for executive functions

Physical action	The UDL guidelines also stress the importance of providing support for what are called the “executive functions”: setting goals, making plans and strategies, and monitoring progress.
Expressive skills and fluency	
Executive function	

The GPS provides many options for these executive functions. At the outset, as we noted earlier, it prompts you with options for setting your goal and then provides options in choosing the type of plan you would prefer for reaching that goal. Additionally, one of the most powerful features of the GPS is the immediate feedback it offers to travelers so that they can more easily monitor their progress. What is especially interesting, and instructive, is the kind of feedback that is provided. Instead of harshly saying, “Wrong, go back!” the GPS instead simply says, “Calculating new route.” This is a great example of UDL in its explicit recognition of two things: that you have already made progress and that from where you are now a better route can be found. In terms of UDL, we want to monitor students’ progress (and help students to develop the skills to monitor their own progress) so that even after making mistakes, they can find the best route toward achieving their learning goals.

Principle III: Multiple Means of Engagement

Guideline 7: Provide options for recruiting interest

Recruiting interest	Because students differ significantly in what attracts their attention, and learning requires attention, the UDL guidelines recommend options for “recruiting interest.” One of the simplest options, and supported by a great deal of research, is the offering of choices. Students are much more highly engaged when they are able to make relevant choices themselves.
Sustaining effort and persistence	
Self-regulation	

Not surprisingly, the GPS engages the driver’s interest in large part because it offers choices in almost every aspect of its design. By far the most important choice it offers is the choice in destination. With a GPS, the choices in where to go are nearly infinite and the choices can range from specific addresses, to business locations, to public facilities, etc. But there are many other choices. As noted above, users have choices in how information should be displayed, choice in the language used, choice in the way that selections are made, and so forth. By embedding options, the GPS gives users a sense of control and autonomy over their driving experience. This sense of control and autonomy is essential for students as well.

Guideline 8: Provide options for sustaining effort and persistence

Recruiting interest	The UDL guidelines also prompt educators to provide options for sustaining effort and persistence. Many kinds of learning, particularly project-based or inquiry learning, requires sustained attention and effort. However, students differ considerably in their ability to independently sustain the attention that many lessons require. The UDL guidelines suggest options that can help, such as providing options to keep the goal salient and “in mind.”
Sustaining effort and persistence	
Self-regulation	

The GPS would seem to place a lower demand on this guideline because the designer can assume a highly motivated user from the outset (the user has chosen to purchase and use the GPS). But the GPS does include important design features that are very relevant. In particular, most units provide a consistent multiple representation of the goal (often at the very top or bottom of the screen), that constantly reminds you not only where you are going but how much time and distance remain, what time you will arrive at your present pace, and so forth. These are all design features that serve to keep the goal very salient, an important UDL checkpoint.

Guideline 9: Provide options for self-regulation

Recruiting interest

Sustaining effort and persistence

Self-regulation

The UDL Guidelines also stress the importance of developing students' intrinsic abilities to regulate their own emotions and motivations.

The ability to self-regulate—to strategically modulate one's emotional reactions or states in order to cope or engage with the environment more effectively—is a critical aspect of human development. Some students are able to develop self-regulatory skills on their own, either by trial and error or by observing successful adults. Yet, many other students have significant difficulty developing these skills.

This guideline is probably the least applied in the design of the GPS. Quite simply, the designers are not attempting to build independence or self-regulation—both of those goals lie well beyond the scope of getting from the airport to the convention hall. And in that lack of scope lies the critical difference between what a GPS does and what an educational system does, as we shall conclude in the next section.

Is the GPS Really a Good Model for Education?

As we have illustrated, the current GPS effectively embodies most of the UDL principles and guidelines. But it is important to recognize the limitations of the GPS as a model for educational design. To put it starkly, the GPS is an excellent model of universal design, but not of universal design for learning. The difference lies primarily in the goals: the GPS is designed to optimize performance; educational curricula should be designed to optimize learning. That is a big difference.

The different goals of the GPS are most apparent when a traveler visits a particular city, say Boston, several times. On the first visit they would primarily experience the advantages of the GPS: it would help them save time in reaching their destination. But on the next visit the limitations would be more apparent: they would likely find that they remember very little about Boston, about its distinctive topography or landmarks, about how to navigate the peculiar landscape and roads of Boston, how to find and orient themselves to the city's various neighborhoods, and so forth. Most disturbingly, the traveler would find that they are almost as dependent on the device on their subsequent visit as on their first. They find that they have learned one thing for sure: how to depend on the GPS.

The expectations for education are higher. Its goals are not merely to improve immediate performance but to build future capacity—the capacity to be effective in almost any setting because the learner is more knowledgeable, more skillful and strategic, more engaged and motivated. The goal of education is to increase independence not dependence.

It is evocative, and instructive, therefore to imagine the redesign of the GPS with learning rather than performance as its goal. Several differences immediately come to mind. At the outset, the GPS would offer a broader range of options, some that instruct in the most efficient routes for reaching a destination but also others that build understanding of a city's topography, landmarks, history and culture, tourist attractions, or architecture. In truth, a really “educational” GPS would deliver information that best matches the context in which you are traveling with your own stated interests and/or prior experience. By querying you with a few carefully constructed questions (which you would answer by voice, not typing, of course), it could adapt the level of its teaching to your present level of knowledge.

That is but one example, of course. With carefully engineered options, the GPS could also mentor you more deeply by prompting you to stop and investigate various aspects of the city and check your learning with queries that would guide further exploration. It could also be used to develop skills and strategies rather than simply knowledge: skills for navigating in new cities generally, techniques for driving more cost-effectively, strategies for estimating distances and speeds more accurately, experiments in the physics of motion and acceleration.

“The GPS shows us that we can do so much more for education; we must work to make our curricula as responsive to individual differences as this little piece of technology.”

Conclusion

When we think about the GPS in terms of the three principles of UDL, we can see there is an incredible amount of flexibility built into this device that reduces barriers and increases options for all users. This chapter has illustrated the many effective UDL features built into the GPS, and we wish that the curricula in our classrooms were just as effective. To improve our classrooms, we should focus on those same questions addressed by the GPS: Where is each student? What are each child’s goals and objectives? What is a good route for this child? The GPS is much better at addressing these questions than our traditional curricula because so many of the UDL guidelines are integrated into its design. The GPS shows us that we can do so much more for education; we must work to make our curricula as responsive to individual differences as this little piece of technology.

When you finally reach your destination, the GPS narrator announces: “You’ve arrived.” You may not have taken exactly the route you expected, and you might have wondered whether the method was in fact madness. But in the end you reach the destination you set out to find with just the right amount of support. Wouldn’t it be great if our curricula could promise and deliver the same?

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