Digital Frayer Model

Supporting Vocabulary Acquisition With Technology and UDL

Robin Dazzeo, Hawaii State Department of Education, and
Kavita Rao, University of Hawaii at Manoa

TEACHING Exceptional Children, Vol. 53, No. 1, pp. 34–42. Copyright 2020 The Author(s). DOI: 10.1177/0040059920911951

Ms. Wright is a special education teacher who has worked with secondary students with learning disabilities in inclusive English language arts (ELA) classrooms for the past 6 years. She and her co-teacher, Ms. Greene, plan collaboratively and purposefully integrate strategies to support all learners by considering universal design for learning (UDL) guidelines as they plan lessons. Although their students with learning disabilities generally make adequate progress toward mastering skills related to their individualized education programs (IEPs), Ms. Wright has noticed that students' academic vocabulary knowledge remains significantly below grade level. Formative, summative, and standardized assessments have indicated that these students have difficulty with reading comprehension, and she is concerned that their unfamiliarity with the vocabulary is a contributing factor. On several occasions, she has observed students skipping over unknown words when reading, incorrectly guessing word meanings based on context, or simply giving up on a reading task they perceive as too difficult.

Ms. Wright has shared her concerns with her co-teacher, and they have agreed that they should alter their vocabulary instruction and build in new supports for vocabulary acquisition for all students, with and without disabilities. On the basis of studies she has recently read, Ms. Wright feels that their current method of having students look up unknown words may not be the best way to increase word acquisition. She suggests to Ms. Greene that they try an approach that goes beyond simply memorizing definitions of words and encourages deep processing of a word's meaning. This includes providing student-friendly explanations rather than dictionary definitions. The teachers agree that an intervention that aims to increase word knowledge and, therefore, literacy skills is necessary. Ms. Wright suggests using the Frayer model, an instructional strategy that utilizes a graphic organizer to teach vocabulary. The teachers create a worksheet with multiple Frayer model templates that allows students to visually depict each vocabulary word via synonyms (examples) and antonyms (nonexamples), illustrations, and sentence creation.

Importance of Vocabulary Instruction

Learning new words is a crucial component to students' reading comprehension (Beach et al., 2015), and vocabulary knowledge has been identified as a predictor of comprehension in middle and high school (Swanson et al., 2017). Students identified with learning disabilities often struggle with word acquisition. Moreover, in secondary settings, students with learning disabilities are often so far below grade-level expectations that the compounded challenges with literacy can extend to problems with comprehending and communicating academic concepts across content areas (Gersten et al., 2001). With the various directives to address standards and prepare students for standardized assessments, teachers can lack the time, support, and resources to successfully implement practices to improve vocabulary knowledge and, therefore, the comprehension skills of students with disabilities.

> Students identified with learning disabilities often struggle with word acquisition.

Furthermore, the process of learning vocabulary never stops, as students continually encounter new words in a variety of contexts (Taylor et al., 2009). Therefore, providing explicit instruction and finding effective, evidence-based strategies to engage learners in the acquisition and retention of new words can be useful for increasing literacy skills across the curriculum. Research demonstrates a strong correlation between vocabulary and reading comprehension, yet there is a gap between effective and evidence-based vocabulary instructional practices and what is actually taught in the classroom (Greenwood, 2010). The following commonly used vocabulary practices, when used in isolation, do not result in strong word acquisition: wide reading, looking up unknown words in a dictionary, using context clues, memorization of word meanings, and using words in a sentence (Dalton & Grisham, 2011). Rather, learning new words is an active process where students relate the newly acquired word with prior knowledge and connect it to their past experiences (Rupley et al., 2012).

Although the instructional strategy described in this article can be used to support all learners, the purpose of this article is to address the needs of students with learning disabilities, who are often several grade levels behind in reading comprehension. Specifically, this article explores how an explicitly taught instructional practice that integrates an evidence-based practice with technology impacts vocabulary acquisition for students with learning disabilities. In this article, we will describe how technology tools in today's classrooms can provide an engaging and assistive digital spin on the Frayer model, which has been in use as a vocabulary development tool for over 50 years (Frayer et al.,1969). In addition, this article also examines how co-teachers can collaboratively use UDL as they plan instruction in order to reduce barriers and address learner variability in an inclusive classroom setting.

UDL Connections

UDL is an instructional design framework that can be used to address learner variability in the classroom (Meyer at al., 2014; Rao & Meo, 2016). At their core, the

> Technology tools in today's classrooms can provide an engaging and assistive digital spin on the Frayer model, which has been in use as a vocabulary development tool for over 50 years.

UDL guidelines, published by CAST (www.udlguidelines.cast.org), address the accessibility of curriculum for all students. A key premise of UDL is that students should not be required to adapt to the needs of the curriculum; rather, the curriculum can be adapted to the varied ways in which students learn (Meyer et al., 2014). Teachers can use UDL guidelines to design and implement instruction, integrating flexible and engaging options when planning their instructional goals, methods, materials and assessments. A curriculum designed with a UDL lens identifies and removes barriers to learning while building scaffolds and supports to take into account a wide range of learner differences (Cook & Rao, 2018; Hall et al., 2015; Meyer et al., 2014; Rao & Meo, 2016; Schreiber, 2017).

UDL can be used to reduce barriers and proactively integrate supports for students with disabilities in the general education inclusive classroom. Yet, regardless of an identified disability, many secondary students struggle to fit into a one-size-fits-all standardized curriculum. In fact, the idea that there are general education students and special education students grossly oversimplifies learner differences, as it does not look at classroom populations holistically (Meo, 2008). The guiding principles of UDL can be used to address learner variability, building in supports for all learners, with and without disabilities. The UDL framework gives teachers a schema for designing inclusive classroom environments, and the guidelines can be used by co-teachers while co-planning, implementing instruction, and assessing students. Designing curriculum through a UDL lens allows teachers to effectively minimize barriers to learning by identifying potential barriers from the onset rather than having to modify the supports given to students throughout a lesson when barriers present themselves. Co-teachers can proactively work together throughout the planning, implementation, and assessment process to provide scaffolds and supports for all learners (Rao & Berquist, 2017).

Research on Implicit Vocabulary Instruction

The Nation's Report Card (National Center for Education Statistics, 2012) reiterated the important role that vocabulary instruction has on reading comprehension, and the Institute of Education Sciences practice guide on improving adolescent literacy provides educators with recommendations in specific evidence-based or promising practices in vocabulary instruction (Kamil et al., 2008). The recommendations include (a) providing explicit vocabulary instruction, (b) dedicating a portion of regular classroom lessons to explicit vocabulary instruction, (c) providing repeated exposure to new words in multiple contexts and allowing sufficient practice sessions in vocabulary instruction, (d) giving sufficient opportunities to use new vocabulary in a variety of contexts, and (e) providing students with strategies to make the independent vocabulary learnings.

In their hallmark book *Bringing Words to Life: Robust Vocabulary Development*, Beck et al. (2013) make several recommendations for how to design meaningful vocabulary instruction. First, teachers should provide student-friendly explanations of the word rather than dictionary definitions. These explanations should explain the meaning of the word in everyday language, and they should characterize the word and how it is typically used. After characterizing each word, teachers can provide synonyms to build on the working knowledge of a word's meaning and help with recall. Last, teachers should engage students in word-play activities that encourage deep processing of each word's meaning. Word-play activities allow students to connect new vocabulary to words students already know through a variety of interactive tasks, such as applying meaning across contexts, conversation snippets, sentence writing opportunities, and representing the word as an image (Beach et al., 2015; Beck et al., 2013).

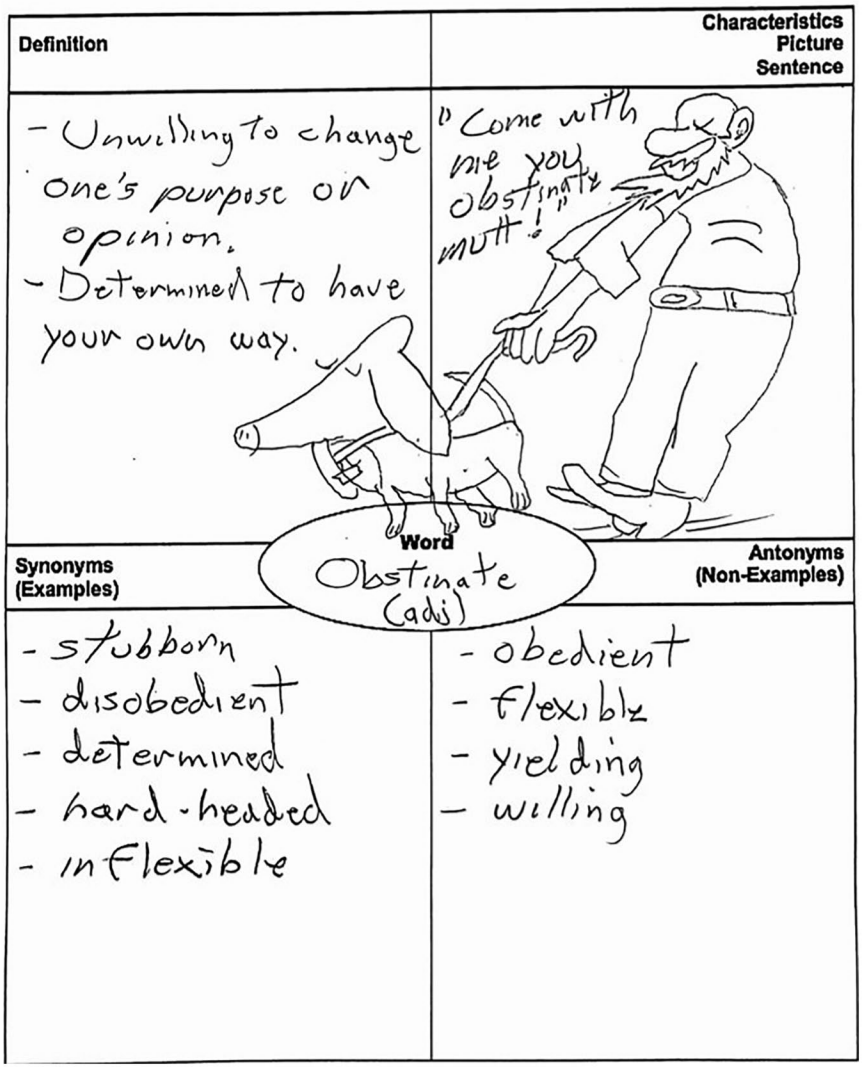
> Incorporating several guidelines for the active processing of vocabulary, graphic organizers are identified as an effective vocabulary instruction tool.

Teaching New Words Through the Use of a Graphic Organizer

Several studies (e.g., Bos & Anders, 1990; Palmer et al., 2014) have examined vocabulary acquisition and word retention through the use of graphic organizers. Graphic organizers are visual tools used to help learners identify, understand, and recall the meaning of words they encounter in text. These maps allow for the visual representation of the connections between a word's meaning and a set of related words and concepts. Additionally, learning to create these maps aligns with ELA Common Core State Standards in the literacy strand. Incorporating several guidelines for the active processing of vocabulary, graphic organizers are identified as an effective vocabulary instruction tool (Palmer et al., 2014; Rupley et al., 2012; Taylor et al., 2009; Zorfass & Gray, 2014). The Frayer model (***Figure 1***) is one example of such a graphic organizer that allows for student inquiry in the word acquisition process (Frayer et al., 1969; Palmer et al., 2014; Rekrut, 1996). Teachers identify the word and provide a student-friendly meaning. Students then identify examples and nonexamples (e.g., synonyms and antonyms) and differentiate between which characteristics help to define the word or concept and which do not. Additionally, the Frayer model adds another dimension to connect to word meaning by depicting the word as a drawing or using it in a sentence. It also activates prior knowledge of a topic and builds connections.

Research indicates the efficacy of using graphic organizers for word mapping, and the Frayer model has been identified as effective for teaching vocabulary to students with disabilities (Peters, 1974; Wanjiru & O-Connor, 2015; Zorfass & Gray, 2014). In studies conducted by Bos

Figure 1 **Example of a completed Frayer model created by a student**



and Anders (1990) and Abdollahzadeh and Amiri (2009), researchers focused on the effectiveness of semantic mapping and graphic organizers and their impact on word learning, comprehension, and the retention of these skills compared to the traditional vocabulary learning method of looking up a definition. Peters (1974) and Wanjiru and O-Connor (2015) examined a specific graphic organizer, the Frayer model, to focus on parallel aspects of word learning as compared to definition-only practices. Results of all four studies were consistent: Graphic organizers, such as the Frayer model, enhance word learning. Moreover, research offers empirical evidence supporting the intentional preteaching of vocabulary found across all content areas (Alexander-Shea, 2011; Bintz, 2011).

Ms. Wright and Ms. Greene Implicitly Teach Vocabulary via the Frayer Model

Ms. Wright and Ms. Greene decide to use the Frayer model to analyze and synthesize selected vocabulary from the Greek tragedy Antigone, *by Sophocles. The seven words selected from the prologue through Scene 2 (e.g., proclamation, obstinate, transgress, contempt) are chosen with the intent to span across content areas, as these same students are also enrolled in a U.S. History class. Furthermore, the words they select will appear again in the remainder of the novel, subsequent novels in the 10th-grade curriculum (e.g.,* Othello*), and nonfiction, informational readings (e.g., historical readings of the time periods of the novels read and in student research of history and social events today).*

To begin, students are given a printout of four blank Frayer models on one page. A second handout lists each vocabulary word, part of speech, and a student-friendly definition. Utilizing direct instruction, Ms. Wright and Ms. Greene decide on a team teaching approach for this lesson.

First, Ms. Wright introduces each word to the class by reading it aloud and breaking it into its syllabic components. She then asks the class to read the word back to her together (choral reading). Ms. Wright also reads

aloud the student-friendly definitions and discusses the part of speech. Via a think-aloud, Ms. Greene models how to complete the Frayer model for the first vocabulary word (e.g., "obstinate"), leading a class discussion on synonyms (e.g., stubborn," "uncompromising") and antonyms (e.g., "flexible," "agreeable") of the word. Ms. Greene next asks the class to use the word in a sentence, challenging students to create sentences that illustrate the word's meaning (e.g., "The obstinate baby would not eat the mushy peas"). As the class discusses the first word, Ms. Wright writes the students' examples on an overhead copy. Students are next instructed to draw an illustration that depict the word's meaning. Ms. Wright and Ms. Green then guide the students to complete a Frayer model for each of the remaining words, providing supports when necessary (see ***Figure 1****).*

Although many of their students enjoy this activity and there has been measurable growth in word acquisition, they notice that students are still sometimes frustrated by challenges with spelling, grammar, and their artistic ability to depict ideas visually on their graphic organizers. Together, they consider ways that they can integrate the technology available in the classroom to engage their students and enhance their vocabulary instruction.

Research on Using Technology to Engage and Support Students With Learning Disabilities

In today's classrooms, teachers are encouraged to design engaging lessons that hold students' interest. The past decade has seen a marked increase in the integration of technology in schools, and many studies suggest that the use of technology and multimedia in the classroom has the potential to contribute to increased engagement and learning for students. Furthermore, when used with sound instructional strategies, technology and media can provide appropriate scaffolds for students with diverse learning needs (Carnahan et al., 2012; Dalton & Grisham, 2011; Howard & Howard, 2017; Kennedy et al., 2014; Kennedy & Deshler, 2010).

To increase student engagement in the active process of learning new words and concepts, teachers can use digital tools and technology-based strategies that support direct instruction, active learning, and student interest. When designing lessons, teachers can consider how digital tools can be integrated to support specific instructional objectives. Researchers have identified ways to integrate digital tools to foster vocabulary growth and ensure that students' varied needs and interests are met and independent word learning is promoted (Carnahan et al., 2012; Dalton & Grisham, 2011; Rupley et al. 2012).

> When designing lessons, teachers can consider how digital tools can be integrated to support specific instructional objectives.

An easily accessible multimedia tool that is often overlooked in technology-based strategies is PowerPoint and its online counterpart, Google Slides. Google Slides can be used creatively for expression, as students can create slides that allow them to interact with new words in a variety of ways: writing, graphics, animation, video, and audio (Dalton & Grisham, 2011). For example, to illustrate the definition of a word, teachers and students can create a Google Slide as a multimedia glossary item that, in effect, becomes a multimedia graphic organizer for each vocabulary term. Moreover, through Google Slides, students can create interlinked hypermedia learning tools that link video, sound, graphics, and text elements with the one another or to the internet. To increase collaboration, student slides can then be combined into a master slideshow where they can hyperlink their slides to other versions of the same word (Pritchard & O'Hara, 2009, as cited in Dalton & Grisham, 2011, pp. 311–312).

Digital technology aligns well with the UDL guidelines. For example, technology expands the ways that materials can be presented to students with supports and multiple representations built in (Guidelines 1, 2, and 3), creates interest and engagement (Guideline 7), allows for multiple ways for students to express what they know (Guidelines 4 and 5), presents options and opportunities to communicate and collaborate (Guideline 8), and provides incremental supports to access and meet the learning goals (Guidelines 6 and 9) (CAST, 2018; Schreiber, 2017). In addition, for students with learning disabilities, the integration of an evidence-based practice with a technology-based solution furthers literacy learning and promotes significant vocabulary gains (Kennedy & Deshler, 2010).

Ms. Wright and Ms. Greene Plan and Modify Through a UDL Lens

To plan their vocabulary unit using the Frayer model, Ms. Wright and Ms. Greene consider the UDL guidelines as they design an engaging and comprehensive lesson. They use UDL to reduce learning barriers and build on all learners' strengths. To begin, they discuss the purpose of their instruction, addressing many preplanning questions (e.g., What are the individual learning needs of the students with disabilities? What supports will students need to be successful? What barriers arise in relation to lesson goals and instructional methods?) as they connect UDL guidelines to curriculum planning. On the basis of their answers to these questions, they state clear learning goals aligned to the Common Core State Standards. Once completed, Ms. Wright and Ms. Greene consider what they have done in the past to address the needs of their students in regard to vocabulary acquisition and discuss what barriers currently exists in the curriculum, in the instructional methods they have been using for vocabulary acquisition, and in their IEPs that prevented access, participation, and progress. With consideration of the UDL framework, they create flexible goals, materials, and assessments to engage students in their learning and accommodate learner differences. ***Table 1*** *provides an overview of the teachers' co-planning process and UDL connections.*

Ms. Wright considers how to convert the traditional Frayer model into a digital format. She decides to create a set of Google Slides that includes the remaining vocabulary words in Antigone. Each slide has the selected word and

Table 1 **UDL-Based Design Questions and Decisions**

Step	*Instructional decisions*	*Connections to UDL*
1. State clear goals Related questions: (a) What standards does this lesson address? (b) What are the lesson objectives?	(a) CCSS ELA Standard 9-10L.4: Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on Grades 9–10 reading and content, choosing flexibly from a range of strategies. (b) Students will develop an understanding of key vocabulary words in the current text (*Antigone*). clarify their understanding of complex words and words with multiple meanings.	Teachers developed a clear goal statement that focused on the core skills involved in this lesson. The lesson objectives highlighted what students would learn.
2. Identify barriers, student preferences, and needs Related questions: (a) What barriers exist in mastering goals/objectives? (b) What barriers exist in the learning environment? (c) What specific accommodations are necessary as stated in the students' IEPs?	(a) Complexity and novelty of content-specific words, lack of background knowledge, lack of context to decipher words, challenges with retention of definitions of complex words, lack of engagement (b) Finding time/opportunities to develop deep understanding of words, dictionary definitions not being student-friendly (c) Extended time, preferential seating, instructions provided orally and in print, frequent checks for understanding, graphic organizers	Teachers identified the barriers that arise in relation to the goals/objectives in Step 1. In addition, they identified the skills, preferences, and needs of our students. They also took into consideration specific needs of students with disabilities listed on their IEPs to ensure that those were provided. By taking barriers, preferences, and needs into consideration from the outset, teachers were able to design a lesson that built in various supports and scaffolds consistent with UDL.
3. Develop flexible assessments Related questions: (a) How can we use formative assessments that allow students to demonstrate knowledge in various ways? (b) How can we incorporate scaffolds that help students learn the content or skills for the summative assessments?	(a) Teachers will use formative checks throughout to monitor timely progress and assignment accuracy. They will give specific and meaningful feedback and multiple opportunities to give and get feedback from their peers. (b) Scaffolds will include direct and explicit instruction in vocabulary acquisition; think-aloud; instruction provided orally, in print, and digitally; and the use of technology to allow for greater creativity and support grammar and spelling needs. (c) Extended time, reduction of formative requirements, sentence starters, repeated instructions, written, verbal, and visual instructions provided, prompting	Teachers designed assessments that addressed the following UDL guidelines: UDL Guideline 5: Provide options for expression and communication 5.1: Use multiple media for communication 5.2: Use multiple tools for construction and composition UDL Guideline 7: Provide options for recruiting interest 7.1: Optimize individual choice and autonomy

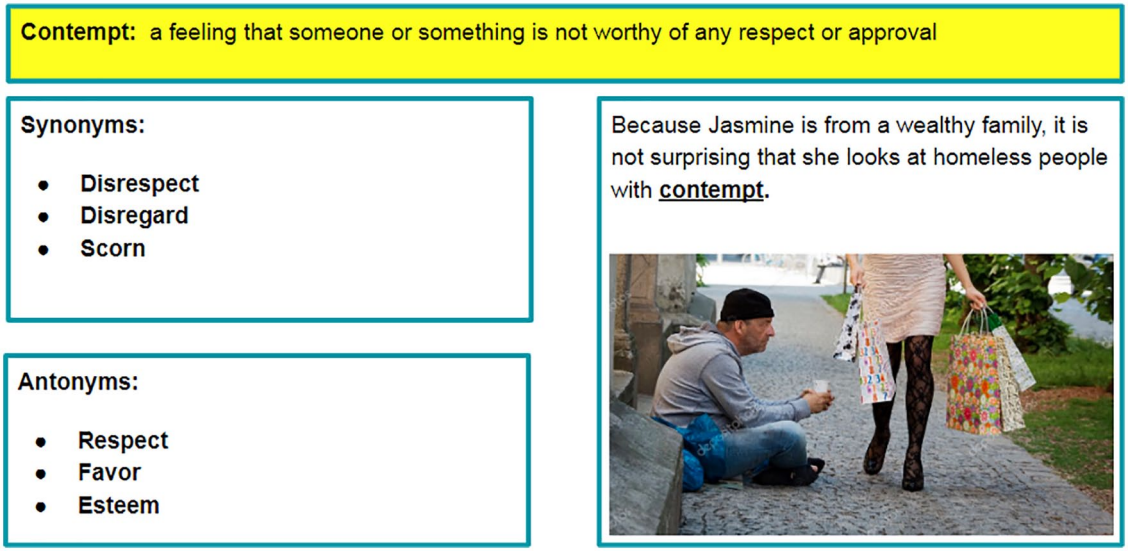
(continued)

Table 1 **(continued)**

Step	*Instructional decisions*	*Connections to UDL*
4. Design flexible methods Related questions: (a) How and when can we provide flexible options during instruction that all learners can benefit from? (b) What options should we include to ensure that students with IEPs have the necessary modifications/ accommodations? Should we provide any of these options to all students? (c) Which co-teaching approaches should we use as we co-instruct this lesson?	(a) Teachers will model activity, provide guided practice, and activate prior knowledge. Selected vocabulary words are likely to be in future readings and across content areas. (b) The Frayer model is a graphic organizer, which will support students who have this accommodation in their IEPs. Reducing the number of synonyms and antonyms and providing sentence starters will also support struggling learners. These options will be provided to all students as the need is identified. (c) Teachers selected team teaching to best support the teaching and learning activities for this lesson. This approach allows for both teachers to be involved in the class, using their collective knowledge effectively to create an engaging learning environment that allows for enrichment and differentiation.	The instructional methods aligned with the following UDL guidelines: UDL Guideline 2: Provide options for language, mathematical expressions, and symbols 2.1: Clarify vocabulary and symbols 2.5: Illustrate through multiple media UDL Guideline 3: Provide options for comprehension 3.1: Activate or supply background knowledge 3.2: Highlight patterns, critical features, big ideas, and relationships 3.3: Guide information processing, visualization, and manipulation UDL Guideline 6: Provide options for executive functions 6.2: Support planning and strategy development UDL Guideline 7: Provide options for recruiting interest 7.1: Optimize individual choice and autonomy UDL Guideline 8: Provide options for sustaining effort and persistence 8.3: Foster collaboration and community UDL Guideline 9: Provide options for self-regulation 9.1: Promote expectations and beliefs that optimize motivation
5. Select flexible materials Related questions: (a) Are there barriers for any students in the materials we are using? (b) What materials and media can we incorporate to give students options?	(a) Traditional word lists and written definitions may present barriers for students. Students will need to know how to use a thesaurus (physical or digital version). (b) The use of technology allows for greater creativity and supports grammar and spelling needs. The activity also increases relevance and engagement as students develop their definition and understanding of the word in a multimodal way.	Materials used aligned with the following UDL guidelines: UDL Guideline 1: Provide options for perception 1.1: Offer ways to customize the display of information UDL Guideline 5: Provide options for expression and communication 5.1: Use multiple media for communication 5.2: Use multiple tools for construction and composition

Note. Adapted from Rao and Berquist (2017). UDL = universal design for learning; CCSS = Common Core State Standards; ELA = English language arts; IEP = individualized education program.

Figure 2 **Example of completed digital Frayer model slide**



provides a student-friendly definition. She includes boxes for the students to list synonyms (examples) and antonyms (nonexamples), an area for an image to be uploaded, and an area for the students to write a sentence that relates to the image. After discussing the idea with her co-teacher, they decide to implement a digital Frayer model in all of their inclusive classes in which students have daily access to Chromebooks. Together, they create a slide set with an example slide for the first vocabulary word (see ***Figure 2****), and Ms. Greene creates the assignment in their Google Classroom. They upload the model slide and make a copy for each student. Later that week, when they are ready to introduce their students to the next set of vocabulary words, Ms. Wright takes the lead and provides direct instruction through modeling on how to create the digital Frayer model slide as Ms. Greene walks around the room to assure students are attending to the instruction and providing support as necessary. She instructs students to find at least three synonyms, two antonyms, and an image from the Internet. She provides clear and explicit instructions in regard to the appropriateness of the images selected for each word. Additionally, she asks students to create a sentence that includes the vocabulary word and alludes to its definition. The teachers allow students to use the rest of the class period to create their slides, supporting and scaffolding as necessary. Although most students are able to complete their slides during this time, some finish for homework. Ms. Wright and Ms. Greene notice that their students are having such a great time finding images and sharing with their neighbors that they decide to extend the lesson to the next day to include time to share slides with one another. During the reading of the play, they encourage students to view their slides as they come across the words in text. When it comes time to study for the postassessment, Ms. Wright and Ms. Greene instruct students to use their slides as a study guide.* ***Figure 2*** *illustrates what a student's end product looks like.*

After implementing the digital Frayer model, Ms. Wright and Ms. Greene reflect on their lesson. Overall, they are pleased with the outcomes; however, they notice that there are still a few areas of support they could offer the next time they assigned vocabulary.

The following are some ideas of strategies and technology-based tools that can provide enhanced support:

1. Provide students with sentence starters, if needed
2. Use apps or extensions to support spelling, grammar, and punctuation (e.g., Grammarly)
3. Use apps or extensions to support word prediction and read text aloud (e.g., Read&Write for Chrome or built-in text to speech on computer)
4. Assign student pairs or groups to complete slides together or a slide to complete a class set
5. Integrate interactive games during instructional time to reinforce and review new vocabulary (e.g., Kahoot)

Final Thoughts

Supporting vocabulary acquisition across the curriculum is an important instructional aim for teachers. With that in mind, teaching vocabulary effectively, and maintaining fidelity to effective practices, is a challenge faced by many educators in all content areas: language arts, mathematics, social studies, and science alike. Furthermore, learning vocabulary never stops, as we are in a continual process of encountering new words in a variety of contexts. At the secondary level, students regularly encounter challenging vocabulary that is rarely explained within the text itself. Therefore, providing effective strategies to engage learners and support them in the acquisition of new words is a good place to begin the conversation on increasing literacy skills across the curriculum.

The Frayer model has decades of research and documentation of practical use in the classroom. Incorporating technology to create the digital Frayer model can alleviate some of the challenges students may have when completing the graphic organizer as well as increase their engagement in learning new words. For struggling readers and students with

learning disabilities, this framework provides vocabulary instruction that ensures more accessibility and engagement and can improve word knowledge and, therefore, greater access to texts.

DECLARATION OF CONFLICTING INTERESTS

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

FUNDING

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID ID

Robin Dazzeo https://orcid.org/0000-0003-4070-1402

Robin Dazzeo, *MEd, Teacher, Hawai'i State Department of Education, Honolulu; and* **Kavita Rao**, *PhD, Professor, Department of Special Education, University of Hawaii at Manoa, Honolulu.*

Address correspondence University of Hawaii at Manoa Wist 120, 1776 University Ave, Honolulu HI 96816 (e-mail: rdazzeo@hawaii.edu).

REFERENCES

Abdollahzadeh, E., & Amiri, N. (2009). The effect of semantic mapping as a vocabulary instruction technique on EFL learners with different perceptual learning styles. *Journal of Applied Linguistics*, *2*(1), 1–27. https://doi.org/10.1016/j.sbspro.2012.12.198

Alexander-Shea, A. (2011). Redefining vocabulary: The new learning strategy for social studies. *Social Studies*, *10*(3), 95–103. https://doi.org/10.1080/00377996.2010.509371

Beach, K. D., Sanchez, V., Flynn, L., & O'Connor, R. E. (2015). Teaching academic vocabulary to adolescents with learning disabilities. *TEACHING Exceptional Children*, *48*(1), 36–44. https://doi.org/10.1177/0040059915594783

Beck, I., McKeown, M., & Kucan, L. (2013). *Bringing word to life: Robust vocabulary instruction* (2nd ed.). Guilford Press.

Bintz, W.P. (2011). Teaching vocabulary across the curriculum. *Middle School Journal*, *42*(4), 45–53.

Bos, C., & Anders, P. (1990). Effects of interactive vocabulary instruction on the vocabulary learning and reading comprehension of junior high learning disabled students. *Learning Disability Quarterly*, *13*(1), 31–42. https://doi.org/10.1080/00940771.2011.11461773

CAST. (2018). *Universal design for learning guidelines Version 2.2*. http://udlguidelines.cast.org/more/frequently-asked-questions

Carnahan, C. R., Williamson, P. S., Hollingshead, A., & Israel, M. (2012). Using technology to support balanced literacy for students with significant disabilities. *TEACHING Exceptional Children*, *45*(1), 20–29. https://doi.org/10.1177/004005991204500104

Cook, S. C., & Rao, K. (2018). Systematically applying UDL to effective practices for students with learning disabilities. *Learning Disability Quarterly*, *41*(3), 179–191. https://doi.org/10.1177/0731948717749936

Dalton, B., & Grisham, D. L. (2011). eVoc strategies: 10 ways to use technology to build vocabulary. *Reading Teacher*, *64*(5), 306–317. https://doi.org/10.1598/RT.64.5.1

Frayer, D., Frederick, W. C., & Klausmeier, H. J. (1969). *A schema for testing the level of cognitive mastery*. Wisconsin Center for Education Research.

Gersten, R. F., Fuchs, L., & Williams, J. P. (2001). Teaching reading comprehension strategies to students with learning disabilities: A review of the research. *Review of Educational Research*, *71*(2), 279–320. https://doi.org/10.3102/00346543071002279

Greenwood, S. C. (2010) Content area readers: Helping middle-level students become word aware (and enjoy it!). *Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *83*(6), 223–229. https://doi.org/10.1080/00098650903505423

Hall, T. E., Cohen, N., Vue, G., & Ganley, P. (2015). Addressing learning disabilities with UDL and technology: Strategic reader. *Learning Disability Quarterly*, *38*(2), 72–83. https://doi.org/10.1177/0731948714544375

Howard, N. R., & Howard, K. E. (2017). Using tablet technologies to engage and motivate urban high school students. *International Journal of Educational Technology*, *4*(42), 66–74.

Kamil, M. L., Borman, G. D., Dole, J., Kral, C. C., Salinger, T., & Torgesen, J. (2008). *Improving adolescent literacy: Effective classroom and intervention practices: A practice guide* (NCEE 2008-4027). National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. http://ies.ed.gov/ncee/wwc

Kennedy, M. J., & Deshler, D. D. (2010). Literacy instruction, technology, and students with learning disabilities: Research we have, research we need. *Learning Disability Quarterly*, *33*(4), 289–298. https://doi.org/10.1177/073194871003300406

Kennedy, M. J., Thomas, C. N., Meyer, J. P., Alves, K. D., & Lloyd, J. W. (2014). Using evidence-based multimedia to improve vocabulary performance of adolescents with LD: A UDL approach. *Learning Disability Quarterly*, *37*(2), 71–86. https://doi.org/0.1177/0731948713507262

Meo, G. (2008). Curriculum planning for all learners: Applying universal design for learning (UDL) to a high school reading comprehension program. *Preventing School Failure*, *52*(2), 21–30. https://doi.org/10.3200/PSFL.52.2.21-30

Meyer, A., Rose, D. H., & Gordon, D. (2014). *Universal design for learning: Theory and practice*. CAST Professional Publishing.

National Center for Education Statistics. (2012). *The nation's report card: Vocabulary results from the 2009 and 2011 NAEP reading assessments* (NCES 2013-452). Institute of Education Sciences, U.S. Department of Education. https://nces.ed.gov/nationsreportcard/pdf/main2011/2013452.pdf

Palmer, J., Boon, R. T., & Spencer, V. G. (2014). Effects of concept mapping instruction on the vocabulary acquisition skills of seventh-graders with mild disabilities: A replication study. *Reading & Writing Quarterly*, *30*(2), 165–182. https://doi.org/10/1080/10573569.2013.818890

Peters, C. (1974). A comparison between the Frayer model concept of attainment and the textbook approach to concept attainment. *Reading Research Quarterly*, *10*(2), 252–254. https://doi.org/10.2307/747186

Rao, K., & Berquist, E. (2017). A co-teaching conversation: Using universal design for learning (UDL) to plan lessons together for the inclusive classroom. In E. Berquist (Ed.), *UDL: Moving from exploration to integration* (pp.122–138). CAST Professional Publishing.

Rao, K., & Meo, G. (2016). Using universal design for learning to design standards-based lessons. *Sage Open*, *6*(4), 1–12. https://doi.org/10.1177/2158244016680688

Rekrut, M. D. (1996). Effective vocabulary instruction. *High School Journal*, *80*(1), 66.

Rupley, W. H., Nichols, W. D., Mraz, M., & Blair, T. R. (2012). Building conceptual understanding through vocabulary instruction. *Reading Horizons*, *51*(4), 299–321.

Schreiber, J. (2017). Universal design for learning: A student-centered curriculum perspective. *Curriculum and Teaching*, *32*(2), 89–98. https://doi.org/10.7459/ct/32.2.06

Swanson, E., Vaughn, S., & Wexler, J. (2017). Enhancing adolescents' comprehension of text by building vocabulary knowledge. *TEACHING Exceptional Children*, *50*(2), 84–94. https://doi.org/10.1177/0040059917720777

Taylor, D. B., Mraz, M., Nichols, W. D., Rickelman, R. J., & Wood, K. D. (2009). Using explicit instruction to promote vocabulary learning for struggling readers. *Reading & Writing Quarterly*, *25*(2), 205–220. https://doi.org/10.1080/10573560802683663

Wanjiru, B., & O-Connor, M. (2015). Effects of mathematical vocabulary instruction on students' achievement in mathematics in secondary schools of Murang'a County, Kenya. *Journal of Education and Practice*, *6*(18), 201–207.

Zorfass, J., & Gray, T. (2014). *Connecting word meanings through semantic mapping*. Reading Rockets. http://www.readingrockets.org/article/connecting-wordmeanings-through-semantic-mapping

TEACHING Exceptional Children, Vol. 53, No. 1, pp. 34–42.