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This article demonstrates an approach for teachers to use outcomes from activities using the universal design for learning expression principle to evaluate student knowledge in content areas. Based on the student's level of explanation using a variety of expression methods, teachers can determine whether students need additional support for re-teaching a concept or whether students are ready for additional practice or challenge. Various levels of technology can be used for formatively assessing student understanding, from no technology (e.g., paper and pencil) to mid- or high-technology tools found in most classrooms, including computers and tablets.

Keywords: *content area instruction, expression, formative assessment, standards-based outcome, technology, Universal Design for Learning*

There are many challenges that teachers face in today's instructional environment. Fulfilling federal and state legislative requirements, following one's local education agency's pacing of curriculum and progress monitoring guide, and meeting the ever-widening varying levels and needs of students can feel harrowing. Yet, there are teachers who are successful with moving their students forward toward growth and deeper understanding. One approach to supporting students in developing and evaluating their understanding of content is through the merger of the instructional framework of Universal Design for Learning and formative assessment.

Inclusive Legislation

According to the United States Department of Education (USDOE, 2018), over 50% of students ages 6 - 21 served under the Individuals with Disabilities

Education Act (IDEA) Part B spend 80% of their day in the general education classroom. Students with learning disabilities (LD) make up a little more than one-third of the increasing number of students with disabilities currently being educated in the general classroom (USDOE, 2018). Forty-one states, Washington, D.C., four U.S. territories, as well as the Department of Defense Education Activity, have adopted, and are in the process of implementing, the Common Core State Standards (CCSS). Likewise, these states have determined the types of assessments that will measure student understanding of these more complex standards (Common Core State Standards Initiative, 2019). Given that students with disabilities are in the general education setting the majority of their academic day, teachers must find ways to support all learners through the Universal Design for Learning (UDL) framework (Meyer & Rose, 2005; Rose & Meyer, 2006; Rose, Meyer, Strangman, & Rappolt, 2002). However, with the necessities of inclusion arises the need for accountability, which typically in the United States (U.S.) translates into progress measured using local and state assessments. Under the IDEA 2004 and the No Child Left Behind Act (NCLB) of 2001, reauthorized as the Every Student Succeeds Act (ESSA, 2015), students with disabilities are required to participate in their district and state accountability assessments.

Despite the push for inclusion and accountability for students with LD, the status of the unmet educational goals of school readiness is still of considerable concern today at the local, state, and national levels. Specifically, the average four-year high school graduation rate at 84% is at its highest since 2011, however for students with Hispanic, Black, and America/Alaskan Native backgrounds, remains lower than 80%, (USDOE, 2018). The achievement gap between students of color and white students in reading and math is larger than ever (USDOE, 2018), and student outcomes from the Program for International Student Assessment show U.S. performance has declined slightly in reading and science and significantly in mathematics from 2009 to 2012 and again from 2012 to 2015 (USDOE, 2018). Under ESSA (2015), the term UDL refers to a scientifically valid framework that provides flexibility in the ways information is presented, in the ways students respond to or demonstrate knowledge and skills, and in the ways students are engaged such that barriers in instruction are reduced by using appropriate accommodations and supports and students meet high academic achievement expectations (ESSA, 2015). Additionally, each state, in coordination with local educational agencies, must develop or improve high-quality academic assessments to include UDL principles in mathematics, reading/language arts, and science, and any other subject area determined by the state. ESSA supports assessment that includes “multiple up-to-date measures of student academic achievement, including measures that assess higher-order thinking skills and understanding, which may include measures of student academic growth and may be partially delivered in the form of portfolios, projects, or extended performance tasks” (ESSA, 2015, p 30). ESSA is supporting the refocus on the purpose of assessment, the goal of which is to truly understand and measure students’ knowledge. Under these new guidelines, states move from a summative high-stakes assessment model to a balanced and continuous assessment model that includes opportunities for improving and increasing formative assessment activities.

Formative Assessment Purpose and Goal

Representations of knowledge (assessment) play a central role in human cognition (Mislevy et al., 2012). Assessment in today's classrooms is ongoing and continuous. Students experience both summative assessment, which is typically an end of unit test that summarizes or assesses students on all the concepts learned within a unit of study, and formative assessment, which involves measuring student learning throughout the unit of study formally and informally, allowing teachers and students an opportunity to gauge understanding of the individual concepts taught within the unit. Although summative assessment is necessary and gives us a picture of our students' cumulative understanding of content, this article focuses on the significance of formative assessment as a driving force behind instructional decisions.

Both summative and formative assessment can be the same format; however, most summative assessments are administered in a more formal approach. Students respond to a multitude of questions in different content areas, using paper and pencil or a computerized method. Formative assessment (Black & William, 1998, 2010; Clark, 2011; Heritage, 2010; Heritage, Kim, Vendlinsky, & Herman, 2009) is a flexible yet systematic and continuous process used during instruction by teachers. It involves eliciting and then interpreting student knowledge, then using that information to drive instruction (Ateh, 2015). Unlike summative assessments, formative assessments are typically performance-based or action-oriented, and include responding to a single question in writing, orally, or as a demonstration of knowledge, such as creating a concept map. Formative assessment is the ideal approach to evaluate learning and directly supports a feedback loop to students as instruction is adjusted to close gaps in learning. When delivered more frequently, it improves the reliability of student performance outcomes, and provides the teacher with data (Fisher, 2019).

Student assessment data should drive instruction. Educators should design instruction with a learning goal in mind and must ask themselves the critical question of, "*What do I want students to know, understand, and be able to do*?" (Tomlinson, 2017). This is designing for understanding; one of the basic tenets of designing for understanding occurs when students can autonomously make sense of and transfer their learning through some facet of authentic performance through explanation, interpretation, application, alteration in their perspective, empathy, or self-assessment of knowledge. Further, a continuous improvement approach toward achievement requires regular reviews of units of study where teachers focus on learning by checking for learner meaning making success (McTighe & Reese, 2013).

Although formative assessment provides for flexibility as to how student knowledge is expressed (e.g., journals, exit tickets, graphic organizers, and checklists), it is planned and pre-determined in order to identify what students know and where their gaps in understanding are, so that teachers can improve their learning and correct misconceptions (Popham, 2008). Having choice and flexibility built into assessing student knowledge aligns well with the UDL principle of action and expression. Additionally, opportunities for students to develop their metacognition by implementing both peer and self-assessment as a part of the process enhances students' understanding of their knowledge and thinking along with teacher understanding of student thinking.

Overall, the purpose of assessment is critical when creating formative assessments which inform teachers of student readiness for a summative evaluation of their understanding of the concepts learned. Measuring student learning is now a requirement through legislative accountability; more importantly, measuring student learning through formative assessment provides useful feedback for teachers in measuring the effectiveness of their teaching by linking student performance to specific learning objectives, and supports students in developing and understanding their own learning connections (Fisher, 2019). The UDL framework lends itself well to formative assessment by eliminating unnecessary barriers and supporting learner variability through flexible assessments using UDL guidelines and aligning assessments to learning goals (CAST Professional Learning, 2015).

Universal Design for Learning

Universal design for learning (UDL) is an instructional framework aimed to optimize learning by reducing barriers through the scientific insights of how people learn (Hall, Cohen, Vue, & Ganley, 2014; Meyer & Rose, 2005; Meyer, Rose, & Gordon, 2014). Students in every classroom vary in their interests, strengths, and needs. Meyer et al. (2014) contend that UDL is not a prescriptive checklist or formula with a set of methods or tools that can be applied to every situation, but rather an approach that uses principles and guidelines as a way to guide teachers into creating or choosing tools, methods, and practices dependent on varying learners' needs and interests. The UDL framework is an innovative brain-based approach to meet students' variability and is composed of three principles: providing multiple means of engagement, multiple means of representation, and multiple means of action and expression. These principles support the needs of all students in the teaching and learning environment in a purposeful, intentional, and meaningful manner (Meyer & Rose, 2005; Meyer et al., 2014; Rose et al., 2002).

UDL was launched by researchers at the Center for Applied Special Technology (CAST, 2019) and is based on the architectural concept of universal design, which ensures that products and environments can be accessed by all people. Technology is rooted in the UDL framework. With universal design in mind, CAST set about exploring how new technologies could be used to improve the educational experiences of students with disabilities utilizing assistive technology. Assistive technology resources have been able to level the playing field by reducing barriers for individuals with disabilities. Likewise, digital media technologies are providing versatility and transformation into classrooms for all learners by providing students with ways to access and share information from images to text to video (Rose & Meyer, 2006).

Multiple Means of Engagement

The UDL framework supports learner engagement by making learning personally meaningful, providing options for recruiting student interest, options for sustaining effort and persistence, and options for developing the ability to self-regulate (Meyer et al., 2014). Engagement in and with learning is critically important so that students find some aspect of the standard or content concept to be engrossing and to sustain their interest. Providing multiple means of engagement through the UDL framework focuses on the *why*, or deeper purpose, of learning. Engagement is individualistic; what sparks and holds one student's interest may likely differ for another student. Learner engagement links to learning that is relevant and valuable for each learner and the ability to regulate their learning, formulate their own learning goals, and persist in the achievement of those goals (Meyer et al., 2014).

Rapp (2014) describes the principle of Multiple Means of Engagement as the first principle of UDL for designing curriculum that uses many different ways to engage students in learning including a variety of tasks and learning situations. Some students are naturally interested in a topic while others may need to be motivated by maximizing student choice and relevant material (Scott & Bruno, 2018). Rapp further contends that each student is unique in his or her learning preferences and abilities and the way they engage in various learning opportunities. Catching students' interests and helping them sustain effort, persistence, and self-regulate their learning behaviors to reach end goals and objectives is a critical part of engagement (Rapp, 2014; Scott & Bruno, 2018).

Multiple Means of Representation

Providing multiple means of representation focuses on the *what* of learning and supports students in the way they perceive and recognize information as they integrate it into their existing knowledge base so that comprehension of the information is complete. When it comes to the teaching and learning environment the principle of multiple means of representation is met through building or connecting to existing background knowledge, supporting learners in recognizing patterns or critical features within the information, scaffolding information for processing, clarifying vocabulary, syntax, structure, and symbols, using multiple means of media, and offering alternatives for auditory, visual, or other needs to decode and process information (Meyer et al., 2014). The purpose of multiple means of representation is to ensure information is presented equally to all learners by reducing barriers using a wide array of media (text, video, audio) and instructional techniques (Scott & Bruno, 2018).

In today's classrooms, multiple means of representation can be observed through a constructive, connected lesson plan where teachers engage students' attention and move through a series of instructional approaches from direct to guided to independent learning activities in a variety of ways such as using videos, discussion, images, realia, lecture, written materials, PowerPoint, song, audio-recorded stories, or lecture, etc. Rapp (2014) noted when content is provided in multiple ways, students are going to have access to new learning objectives. New learning objectives will be reinforced in many ways, and students will develop learner expertise because they are familiar with multiple ways to receive information and know what works best as they explore ways to learn new information.

Multiple Means of Action and Expression

Providing students with multiple means of action and expression focuses on the *how* of learning. Teachers support action and expression as they actively involve the student in learning activities both individually and with their peers, support the development of their executive functioning skills so that they can set goals appropriately and plan and monitor their own progress, alter strategies to improve successful outcomes, and support the student's ability to construct connections to what they learned and demonstrate their newly found knowledge using varied response methods of assessment (Meyer et al., 2014). When considering the UDL principle of action and expression, teachers provide options in the way students can tell us what they know and understand, who may not be fully able to demonstrate their knowledge on a standard assessment due to barriers in test media, meaning, and paper and pencil alone (Rose et al., 2002). This support particularly assists students with LD or a struggling student who may have difficulty with written expression. Expression is student output (Rapp, 2014) demonstrated in a way that allows students to show what they know and understand. Through varied methods of expression, students have greater opportunities to make sense of the content by seeing and experiencing alternative pathways to share what they know. When students share with their peers what they know, understand, and are able to do, they also serve as a model demonstrating what can be achieved and what it takes to achieve it.

Rapp (2014) contends that learners need options for being physically active in learning activities and options for ways to communicate (e.g., writing, speaking, drawing, designing), and develop and practice executive functioning skills. Allowing student choice in how they express their knowledge informs us not only what the student knows but also how they learn (Scott & Bruno, 2018). Student expression of their knowledge translates to formative assessment.

Multiple Means of Assessment

Although not considered a principle under UDL, assessments that are universally designed reduce barriers. Assessments should vary just as students should be engaged, the teacher represent content, and students share what they know (Rapp, 2014). Whether formal or informal, summative or formative, paper and pencil, portfolio, or alternative, the way students are assessed also need to vary (Rapp, 2014; Scott & Bruno, 2018) and should be based on student need providing a "holistic snapshot" of the student (Scott & Bruno, 2018).

Merging Formative Assessment and UDL-Expression

School districts within every state are using some form of teacher evaluation program which incorporates student self-assessment of concept understanding (Darling-Hammond, 2014). Formative assessment tools that encourage expression of student knowledge can impact inclusive teaching for students with high-incidence disabilities (i.e., learning disabilities) and all learners by evaluating the level of knowledge demonstrated to direct the next steps in instruction. The purpose of this article is to highlight various tools that will enhance the expression of student knowledge and support teacher instruction by giving teachers a more vivid example of what students' perceptions are of their knowledge, actual demonstration of their knowledge, and through the analysis of that information, determine if students need to be provided a challenge or extension activity or review and reinforcement, enabling a more personalized instruction for all students but particularly for students with special needs (Cornelius, 2013).

According to Prensky (2010), today's learners enjoy participating in discussions and group work, sharing their own ideas, and listening to the ideas of their peers discovered through explorations of the world around them. They want to feel valued and respected, do work that is authentic and has merit, and are extremely tech savvy outside the school environment. Students who feel valued and respected and are working on meaningful tasks using a variety of technology will be more motivated and engaged in learning. With today's students in mind, today's teachers need to be sure that, no matter what subject they are teaching, they are teaching it with the future in mind. Classroom teachers often attempt to incorporate digital technology in their lessons through instruction. Providing students opportunities to demonstrate and express their knowledge by infusing digital technology into formative assessment activities can help them better analyze, evaluate, and create, moving them to a deeper level of understanding.

Formative Assessment and UDL-Expression

A teacher is teaching his students to use models to describe the movement among plants, animals, decomposers, and the environment using Next Generation Science Standards 5-LS2-1 Ecosystems: Interactions, Energy, and Dynamics (NGSS Lead States, 2013). After several days of instruction where students learned about matter and the carbon cycle, the students are asked to draw a diagram and write key terms and ideas as well as visual representations (pictures) of the concepts. Students can then be grouped into pairs and share their diagrams with each other. To determine the level of student understanding, the teacher can ask students to identify their own level of understanding using a scale from 1 to 4. Each scale score indicates the level of understanding of the standard and the demonstrated evidence that supports the level of understanding and mastery. An example of self-evaluation with levels of understanding relevant to the standard above is found in Table 1.

Table 1

Level of Understanding for Next Generation Science Standard N.G.S.S. 5-LS2-1

Score	Standard & Evidence
4	Use models to describe the movement among plants, animals, decomposers, and the environment (N.G.S.S. 5-LS2-1). Student creates a carbon cycle using 2 or more food chain models or diagrams using several animals and plants that are part of the chain. They are able to label and describe both orally and in writing the pathway of each chain.
3	Use models to describe the movement among plants, animals, decomposers, and the environment (N.G.S.S. 5-LS2-1). Student creates a carbon cycle using single, complex (3 or more animals) food chain and is able to label and describe the pathway of the chain both orally and in written form.
2	Use models to describe the movement among plants, animals, decomposers, and the environment (N.G.S.S. 5-LS2-1). The student can create a carbon cycle using a single simple food chain that may appear similar to 1 used during instruction from the content materials. The learner may require verbal prompting for oral and/or written explanation.

1	Use models to describe the movement among plants, animals, decomposers, and the environment (N.G.S.S. 5-LS2-1). Student creates a partial carbon cycle where some information is present but significant aspects are missing.

Students who are able to explain their diagram clearly to a partner peer beyond the given instructional resources (including additional elements) rate themselves as a 4 with a confirmation of that rating by their partner peer, based on the evidence. Students who are able to independently explain their detailed diagrams using the instructional resources from class lessons rate themselves as a 3, again receiving a confirmation rating by their partner peer. Students able to explain their diagram with their partner peer with minimal prompting rate themselves as a 2. A score of 2 may also represent a diagram with less detailed scientific evidence and support from the lessons. Again, the score must be validated by the partner peer. Finally, the student that requires several verbal or physical prompts to refer back to the instructional resources or who has an incomplete diagram rate themselves as a 1, validated by their partner peer.

Based on the students' rating and confirmation after being evaluated by the teacher, students can be divided into groups to either enrich their thinking, develop deeper understanding, or review and reinforce concepts. PowerPoint is an excellent tool to incorporate technology with the infusion of a universal design for learning framework into the formative assessment process. To demonstrate this science standard, students can download diagrams or images from the internet and insert text boxes to label and explain the images. As an alternative, Prezi flows or moves from content to content and allows for a visually enhanced presentation. Similar to PowerPoint but considered a higher-level technology tool, VoiceThread can allow students to create a narrated slide or PowerPoint with inserted images. The use of technology allows students who might struggle with drawing illustrations the option to find images through the internet and those who may have difficulty with written response the option to verbalize their knowledge orally. Additionally, multiple options are available for learners with different capabilities and engagement interests (e.g., oral presentation, pictorial representations).

Merging formative assessment strategies with the UDL principle of action and expression presents opportunities when teaching concepts within social studies or science. For example, provide students with an opportunity to combine their existing knowledge with newly acquired information gained through a WebQuest that can be displayed in a concept map such as a Bubble Map (Figure 1) which is one of Thinking Map tools designed by Hyerle (2009). Once maps are created, students can deepen and enrich their knowledge and understanding by sharing their maps with peer partners and the class.

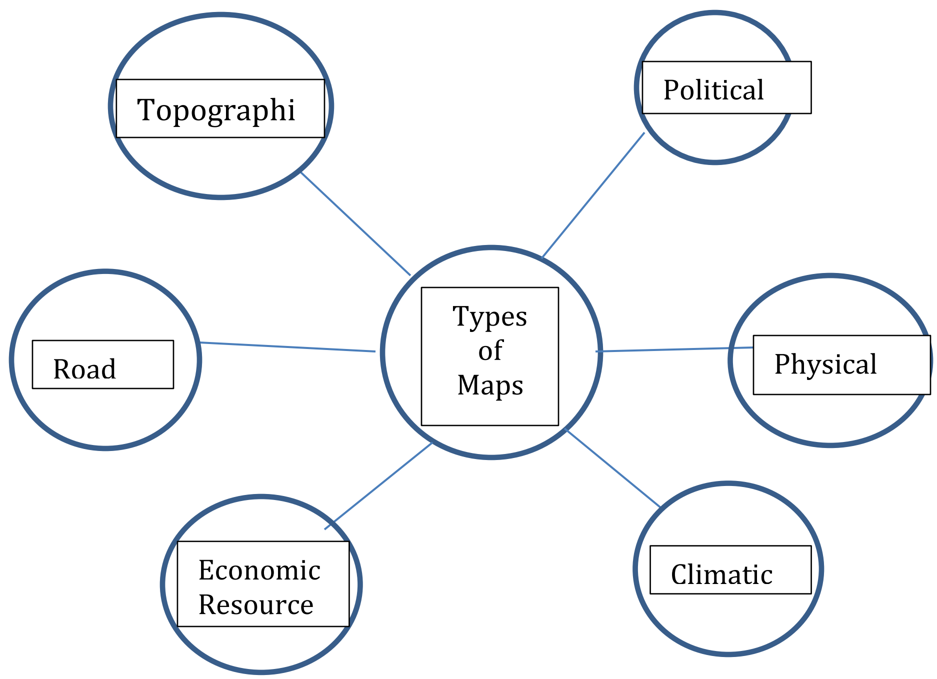

Figure 1. Bubble map

Thinking Maps (Hyerle, 2009) are examples of different content organizational maps that support student understanding by providing multiple ways for students to describe, compare or contrast, sequence, or classify what they learned, as illustrated in Figure 2. Students can take their Thinking Maps and develop a robust written explanation using the key words and details they provided on their maps, or create a project or presentation from the map as a starting point.

In this example, students could partner and review their Bubble Map information, determine their own level of understanding based on a 1- 4 rating scale, and receive a peer rating based on their oral explanation and visual representation of information learned. For students to achieve a rating of a 4, they would need to independently describe how various science ideas are used to ultimately protect the Earth's resources and environment or fully describe the inventor's life, invention, and impact on the economy. Additionally, students would need to extend their understanding with unique information that was not shared during instruction but rather found through their WebQuest exploration. A student achieving a 3 would be able to independently describe how various science ideas are used to ultimately protect the Earth's resources and environment using the information learned during instruction. When a student needs moderate support or prompting to complete their Bubble Map to assist them in describing how various science ideas are used to ultimately protect the Earth's resources and environment, they would earn a rating of a 2. Students who need multiple prompts to assist them to take information learned from instruction and add to their Bubble Map would earn a rating of a 1.

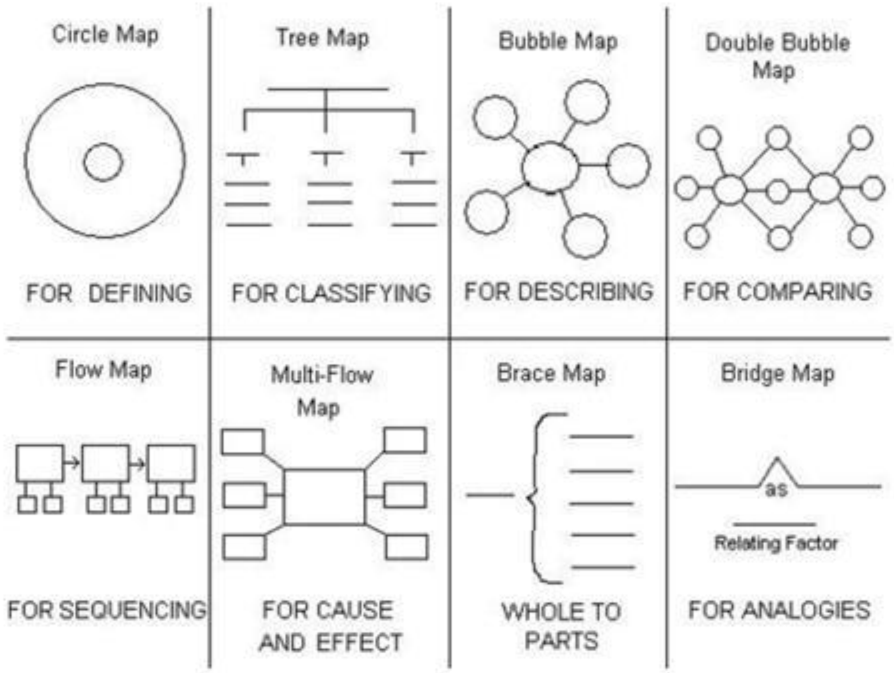

Figure 2. Hyerle Thinking Maps

Bubble and Thinking Maps provide a low-tech option for students to demonstrate their thinking processes about content and represent a visual tool to formatively assess student understanding. High-tech options similar to pencil and paper Thinking Maps include Popplet, Spiderscribe, or student-created Thinking Maps using *SmartArt* or *Shapes* in Microsoft Word or PowerPoint .

Utilizing Technology

There are a variety of options that use the continuum of technology, from paper and pencil to an application on a smartphone for formative assessment. This article provided one example of how the Universal Design for Learning principle of action and expression can be applied within the science content areas, but this principle can be utilized across all content areas. The use of visual representations of information, such as Thinking Maps, in science and other areas, provides the opportunity for student-created formative assessments that use data to explain findings. As technology tools are continually changing, it is important to first determine the objective of the task your students are to complete before selecting the tool. Once you have selected the objective aligned to the content area standard, there are a few options based on your level and comfort in using technology and use of high-tech or low-tech tools. The chart below features *no-tech to high-tech* options with traditional ways for students to complete the objective or task. Additionally, a continuum of computer, web, and software options are available. Because each school district and classroom have different levels of accessibility to technology tools, it is important to consider what teachers are already using on the computers in their classrooms or media center labs. Microsoft Office programs, such as Word and PowerPoint, are often available on computers and can be utilized to assess a student's knowledge of content area concepts, without internet access. Teachers may use online storage (e.g., Google Drive, OneDrive) which offers a variety of free and accessible tools for modeling skills and concepts and formative assessment. Table 3 lists a variety of low-technology to high-technology tools that are available via the Web. These tools are constantly changing but the idea is the same.

Table 3

Sampling of Technology Tools with Traditional and Technology Options

Goal/Purpose Example	**Traditional/No Technology Option**	**Technology Tools**
Compose a narrative story.	Story writing and spiral book binding PowerPoint	Storybird- a language arts tool to assist with writing stories https://storybird.com/
Respond to a question about science content.	Small group collaboration using white boards	YouTube Channel www.youtube.com Padlet – a collaboration tool https://padlet.com/
Summary of science experiment.	Student oral presentation of poster or in-class "TED" talk	PowerPoint using Microsoft or Google Slides documents Prezi https://prezi.com/ Twitter http.twitter.com
Parent communication of current projects.	Class or school newsletter	Blogger: www.blogger.com Seesaw https://web.seesaw.me/parents
Formative assessment of student learning.	Exit ticket or "ticket out the door"	Snapchat https://www.snapchat.com/ Twitter http.twitter.com
Summary of timeline of events or experiment.	Poster of timeline Bullet Journals	Voki http://www.voki.com/ VoiceThread https://voicethread.com/

Assessments in the digital age should be dynamic providing for a full range in customization and adaptation so that we can more accurately evaluate student knowledge and understanding (Rose & Meyer, 2006). Additional ideas shared by the National Center on Universal Design for Learning are found on their website at: http://www.udlcenter.org/implementation/examples/examples5

Conclusion

As classrooms continue to strive to meet the needs of diverse learners, the UDL framework continues to provide critical supports for both teaching and assessing learners in various ways. Utilizing formative assessment within the UDL framework is an important and timely task for today's teachers. Choosing and sharing the variety of assessments, and the level of technology involved is a challenge where teachers can include student choice and voice. Ultimately, whatever the formative assessment tool chosen by students, providing options of ways to share and express what they know makes for an engaging learning environment that doubles as a method for gathering data about student performance to further determine where the next lesson will go. After all, the intent of formative assessment is and should be to understand what our students know (Ateh, 2015) and can occur by applying the principle of action and expression within the universal design for learning framework.

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