

Symbols in Learning and Literacy

WHAT RESEARCH TELLS US



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Most people may agree that one of the core purposes of education is to help students develop the ability to understand and respond to information. Students arrive in schools and classrooms with varied skills and abilities, different social experiences, dissimilar exposure to instruction and other discordant factors, but educators and therapists are asked to fulfill the core purposes of education for each of them.

As educators—specifically educators of children with disabilities—we look for pedagogical tools to assist in our continual effort to meet the diverse needs of the ever-changing student population. Symbols have emerged as **essential teaching and learning supports** for some students to achieve the goal of understanding and responding to information.

Put simply, a symbol is something that represents something else.¹ The words *symbol* and *icon* are often used interchangeably, as both terms can represent other objects or concepts. A few examples of symbols are figures, signs, representations and images.



n2y Staff

At n2y it's our mission to support special educators and administrators in the work you do every day to teach and nurture unique learners. To that end, in consultation with our in-house specialists and scholars in the field, we produce white papers that are topical, informative, and relevant to your practice to help you stay current on key issues in special education.

Symbols are not limited to nouns. Symbolic representations of all parts of speech are just as important as object identification through nouns. Symbols on street signs instruct drivers to slow rates of speed near pedestrian crossings or due to changes in road conditions. Today's technology (computers, devices, etc.) uses symbols to represent applications or actions within applications for printing, downloading and saving, for example.

Symbolic representations of all parts of speech are just as important as object identification through nouns.



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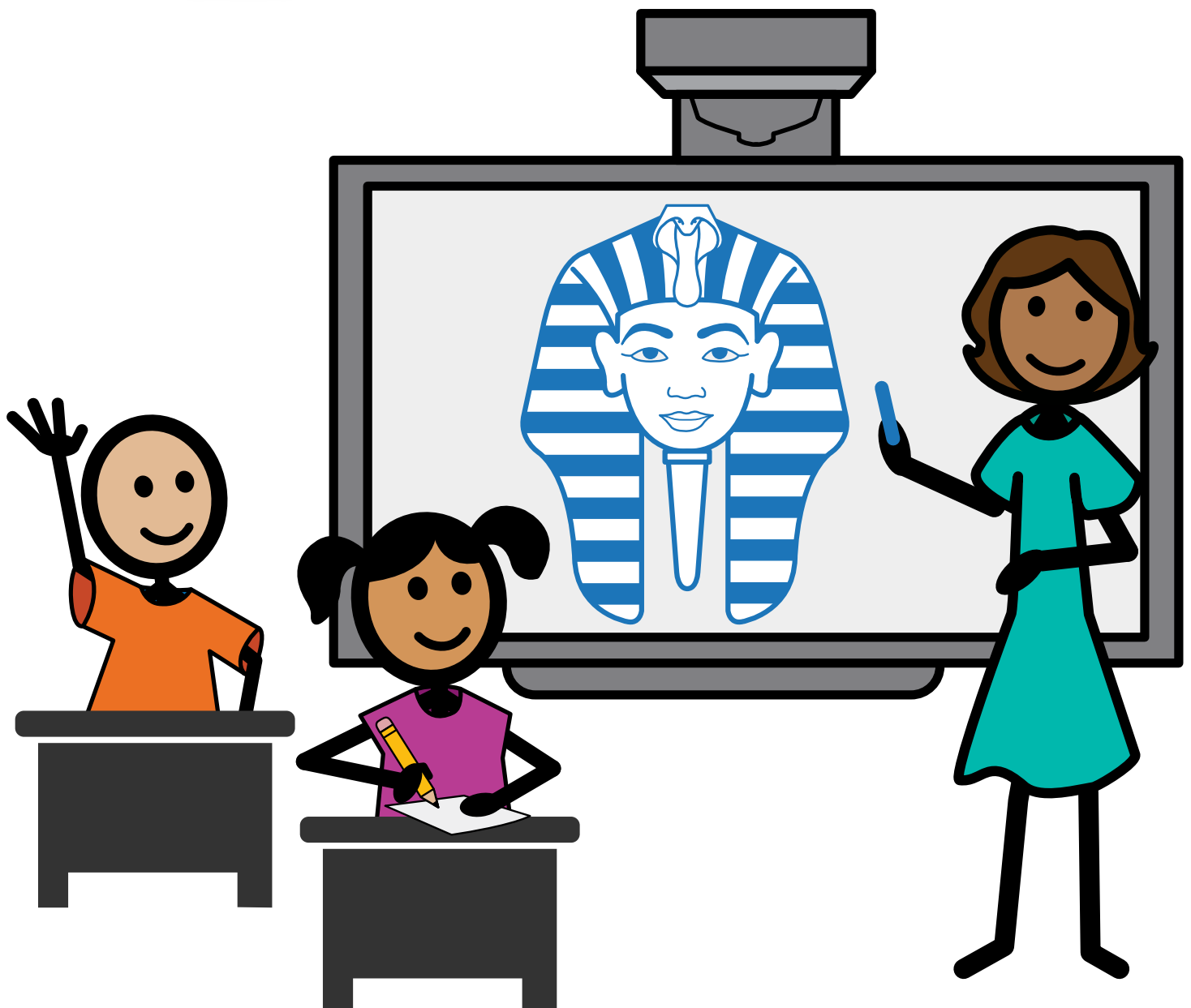
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Symbols Have **DEEP ROOTS IN HISTORY**



Symbols Have Deep Roots in History

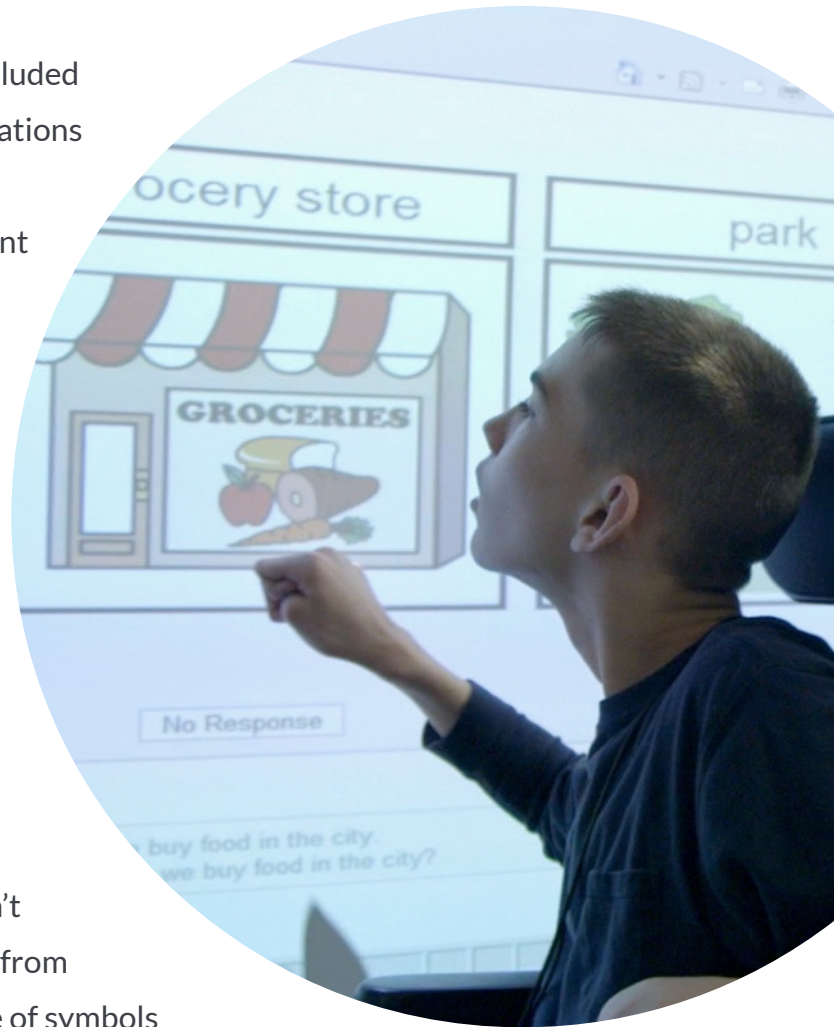
The use of symbols with technology may be relatively new, but human history is filled with examples of the substitution of vision and language for written expression. For example, rock paintings date back 30,000 years in human history.² Incorporating expression and information, these cave drawings or rock paintings are early evidence of human use of visual representations to communicate experiences and knowledge.

According to many historians, hieroglyphs were the form of communication used in ancient Egypt, dating back 5,000 years. Hieroglyphs typically were representative of real objects and were occasionally stylized by the artist. Sometimes, the same sign or symbolic hieroglyph had content that allowed it to have different meanings.



Hieroglyphs are fascinating in that they also included grammatical signs, alphabet letters and combinations of symbols to represent concepts. Symbolic representations were used to record government information, religious events and weather patterns, and to augment oral traditions across cultures. Chinese picture symbols based on pictographs date back about 4,000 years. It is generally accepted and widely understood that some Chinese characters used in the Chinese language today contain picture symbols.

While humans have a rich history in the use of symbolic representation for language, learning, communication and tradition,³ we don't have baseline studies or empirical data derived from randomized clinical trials (RCTs) around the use of symbols for individuals with complex needs. Research designs for these students are neither desirable nor possible for a variety of practical, ethical and scientific reasons.⁴ Such reasons include describing the participants with standard practices, including more than one participant, pretreatment experiences and variables and implementation fidelity due to access needs and differences.



3 O'Neil, 2006

4 Snell, Brady, McLean, Ogletree, Siegel, Sylvester, Mollica, Paul, Ronski, & Sevcik, 2010

VISUAL SUPPORTS

Are an Identified
Evidence-based Practice



Visual Supports Are an Identified Evidence-based Practice

Given the incidence and prevalence of children with autism spectrum disorder (ASD), more organizations are reviewing treatment models and intervention practices for efficacy. The National Professional Development Center (NPDC) on ASD identified a collection of evidence-based practices (EBPs) that focus on specific learner outcomes.⁵ Among the identified collection of EBPs are visual supports. Visual supports are “concrete cues that provide information about an activity, routine or expectation and/or support skill demonstration.”⁶ The authors describe visual supports as providing assistance across activities and settings through a variety of forms including: icons, drawings, written words and more. In fact, visual supports, according to the NPDC, meet evidence-based criteria with 18 single-case design studies.⁷ When analyzing this focused intervention with outcomes for the learner in mind, visual supports can be effective in addressing “social, communication, behavior, play, cognitive, school-readiness, academic, motor and adaptive skills.”⁸

Visual supports
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5 Wong, Odom, Hume, Cox, Fettig, Kucharczyk, Brock, Plavnick, Fleury, & Schultz, 2014

6 Wong et al., 2014

7 Wong et al., 2014

8 Hume, 2013

Research Shows **BENEFITS OF GENERAL SYMBOL USE**



Research Shows Benefits of General Symbol Use

Across disciplines, research corroborates the use of visual supports for language, memory, cognition and communication. Research conducted in a variety of areas lends evidentiary support to the idea that symbols are assistive to people in general.

Symbols Hold Value Alone and Combined

While symbols have value independent of each other, they also have combinatorial relationships with other symbols.⁹ Research in the area of language acquisition using robots reveals that it is possible to learn new words from basic symbols through the transfer of knowledge.¹⁰

Symbols and Words Are Intertwined

Symbols or images and words work together, despite being stored in different parts of the brain, to form perceptions, language and memory.¹¹ Words and images are not stored in



9 Cangelosi, Hourdakis, & Tikhanoff, 2006

10 Cangelosi et al., 2006

11 Pulvermüller, 2008

one central location in the brain but at sites throughout the brain. Mapping neuronal activity has been nearly impossible because, with the exception of sensation and movement, mental processes of neuronal activity are widely distributed all over the brain.¹² Consider event memory as an example: event memory is not primarily language based; however, events in memory can become so interrelated with language that what we recall is the linguistic description of the event. When the brain develops new forms of representations, it does not discard the old ones, but in fact uses the old structures for new purposes.¹³



Symbols Fill Gaps in Linguistic Knowledge

Consider Solomon and Barsalou's examination of the word *wing* (as cited in De Vega et al., 2008). Some perceptual information is required for the reader or listener to know which wing we are discussing. Is it a butterfly wing? (What did you picture?) A wasp wing? (Did you visualize one?) A bird wing? (Did you imagine the feathers?) An airplane wing or the West Wing of the White House? Context is needed for the listener to understand which is meant, but prior human experience, visualization or memory adds to the understanding and meaning of the word *wing*. Using more words to explain the concept may be far more cumbersome and less beneficial than simply pairing the symbol with the word.

12 Pinker, 1994

13 Kintsch, 2008

Symbols Close Gaps in Cultural/ Experiential Differences

Many of the words we know are learned through reading; however, if a student with complex needs has limited reading experience and preliterate skills, we as **educators have an obligation to provide rich perceptual experiences** in context with literacy instruction. Language is sensitive to perceptual input. Words we know at both the verbal and perceptual levels allow us to really experience the world.¹⁴

Symbols Are Essential for Communication and Understanding

Purely verbal communications cannot account for perceptual differences, especially those based on experience.¹⁵



14 De Vega et al., 2008

15 Kintsch, 2008

Let's take one sentence and substitute one word in it to see how the language in context reflects our learning and the imagery associated with the words.

He walked into a store and bought a *newspaper* to cover his face from the rain.

He walked into a store and bought a *matchbox* to cover his face from the rain.

He walked into a store and bought a *ski mask* to cover his face from the rain.

Two nouns indicate items that offer protection from the rain, but one does not. Based on our life experience and knowledge of what a matchbox is, we can say that sentence does not make sense, or we could look at a visual reference and say that it wouldn't work.¹⁶

Let's try one more sentence with a proper noun substituted for the common nouns.

He walked into a store and bought a *Nubrella®* to cover his face from the rain.

If we have not had a perceptual experience with a Nubrella or prior knowledge of it, we are left with passively accepting the statement without context or seeking clarification of the foreign concept. (By way of explanation, a Nubrella is a hands-free umbrella resting on the head and shoulders that would shield someone's face from the weather.) So, for students with complex needs for whom language generation can be challenging, literacy experiences can be lacking and exploring the environment can be out of the question, providing a visual reference in the form of a symbol is crucial.

For students with complex needs... providing a visual reference in the form of a symbol is crucial.

Assistive Nature of **SYMBOLS**



Assistive Nature of Symbols

Specific to augmentative and alternative communication (AAC) interventions for autism, a research summary by Debora Nunes¹⁷ reviewed 56 studies between 1980 and 2007. Numerous studies showed **visual graphic systems have positive aspects** that include their iconicity, non-transient nature and limited motor demands.

When people remember a list of words, read a sentence or listen to a story, their brains function on multiple levels, not solely at the word or symbol level. Our brains use imagery to make words more memorable.¹⁸ Our brains construct models that are multimedia creations. Perceptual and motor areas in the brain become activated, and memories are formed. Our brains recall the words, symbols and experiences together, not in isolation, and certainly not all in the same places in our brains.¹⁹ Symbols aid the brain in creating imagery, understanding and memory.

Link to Educational Goals

Regarding literacy and instruction, such statements about the assistive nature of symbols make sense. Of course, we want students with complex needs to have rich and diverse imagery to store and use. Of course, we want shared and guided reading experiences to build memories all over the brain. We definitely want to expand students' vocabulary using combinations of symbols and text to **expose them to novel language and concepts** throughout the course of instruction.



ICONICITY

Correspondence between form and meaning.

¹⁷ 2008

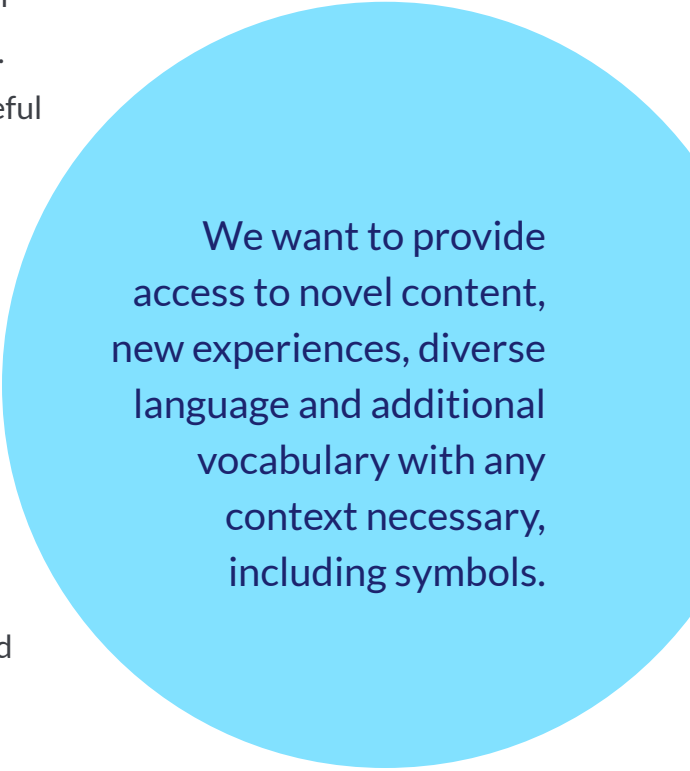
¹⁸ Paivio, 1969

¹⁹ Pinker, 1994

To the extent that we want students to achieve one of the presumed core purposes of education—to understand and respond to information—we want to provide access to novel content, new experiences, diverse language and additional vocabulary with any context necessary, including symbols. “If the goal is merely to provide access to content and careful attention is paid to selecting picture symbols that reflect the meaning of words in the text, it is reasonable to expect that pictures will increase access to content that otherwise would not be accessible.”²⁰

Adding Context

Symbols are assistive because they add context for people learning new information. Did any of us understand what a text message was before we saw one? If I had described it in words to you, would it have made sense? Didn't it make more sense after seeing and experiencing an actual text message? What if you did not have, could not access or could not manipulate a cell phone? Would you ever understand the concept of text messaging? “For students relying on a partner to read the text aloud, pictures or picture symbols added to the text may help students track the text and build comprehension.”²¹



We want to provide access to novel content, new experiences, diverse language and additional vocabulary with any context necessary, including symbols.

²⁰ Erickson, Hatch, & Sally, 2010

²¹ Hudson, Browder, & Wakeman, 2013

Providing Access

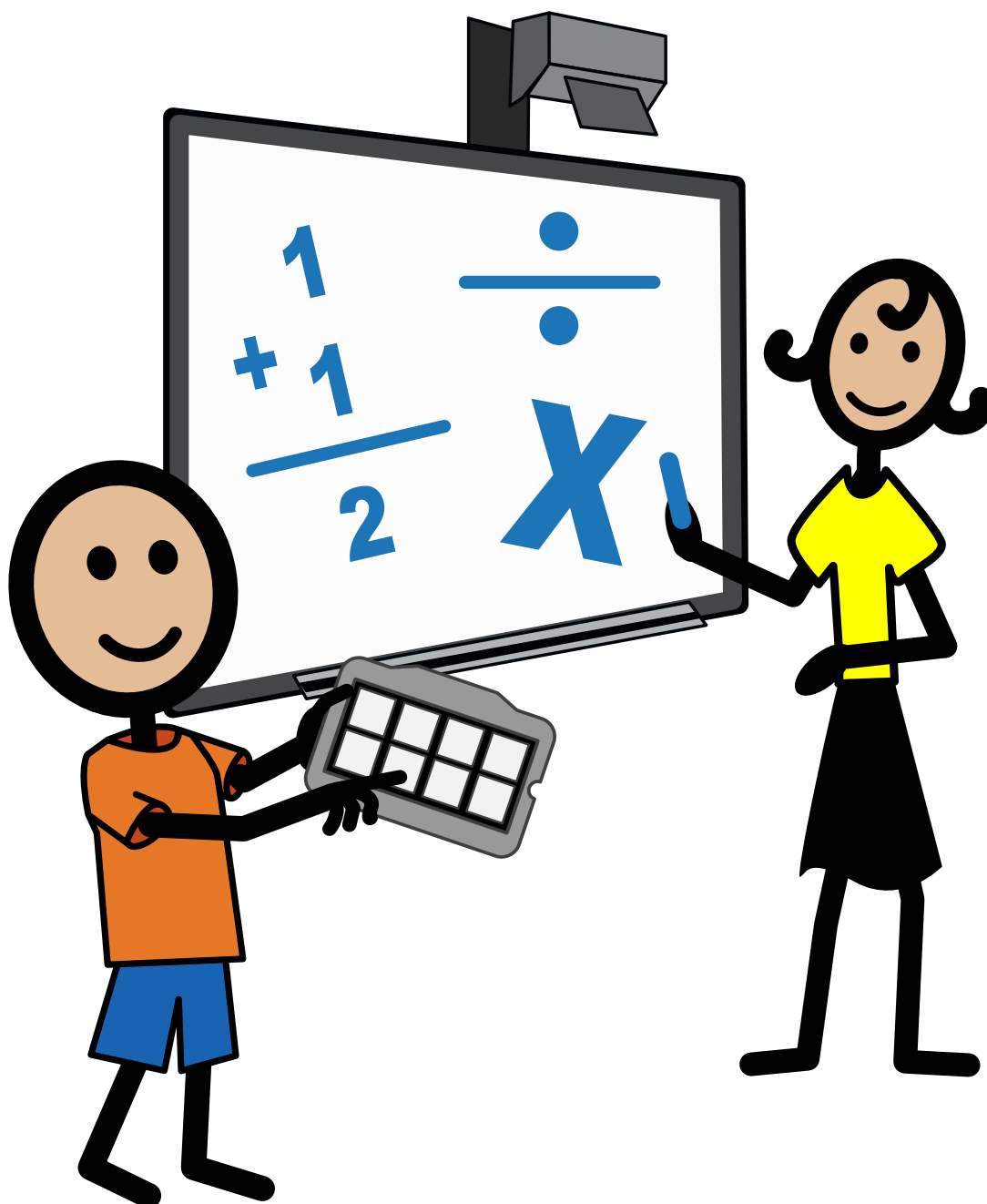
Symbols are assistive because they provide access to content that may not be accessible otherwise. No one would deliberately impose a hardship on people with cognitive disabilities by removing supports such as symbolic representations in text. “Non-educators often make the mistake of equating access to information with access to learning.”²² Denial or premature removal of access supports would not be acceptable for people with physical disabilities, significant vision impairments or deafness.

At this point, we have some **evidence-based practice** and practice-based evidence that symbols are assistive in a variety of ways for people of all cognitive abilities. Picture-symbols, as supports, have been mentioned in Universal Design for Learning documents through the U.S. Department of Education, countless UDL and universal access or explanation documents, university textbooks and many more published works. The idea that symbols are assistive is well understood.

Looking a little more deeply at the symbols themselves, some ideas and concepts are more easily understood with a photo or symbols. Still, even within a symbol set or system, some concepts are simply easier to depict in two-dimensional form due to the nature of language.



ICONICITY of Symbols



Iconicity of Symbols

Iconicity refers to the continuum that describes symbols by ease of recognition. The degree to which words, symbols or signs are related to their associated oral language is a feature of language in general. Bellugi & Klima²³ developed a body of work including a spectrum of iconicity from transparent to opaque related to gestural signs, but which has application for graphical signs as well.



Most Accessible

Transparent symbols visually resemble concrete objects or a specific concept and are highly guessable. An example of a transparent symbol would be an image of an apple. The image is probably guessable as an apple for many viewers unless their life experiences preclude this knowledge.

Accessible With Context

Translucent symbols are not readily guessable without additional information. Translucent symbols are often learned over time. Symbol knowledge can vary, but some examples of translucent symbols might be questions or emotions.

Least Accessible

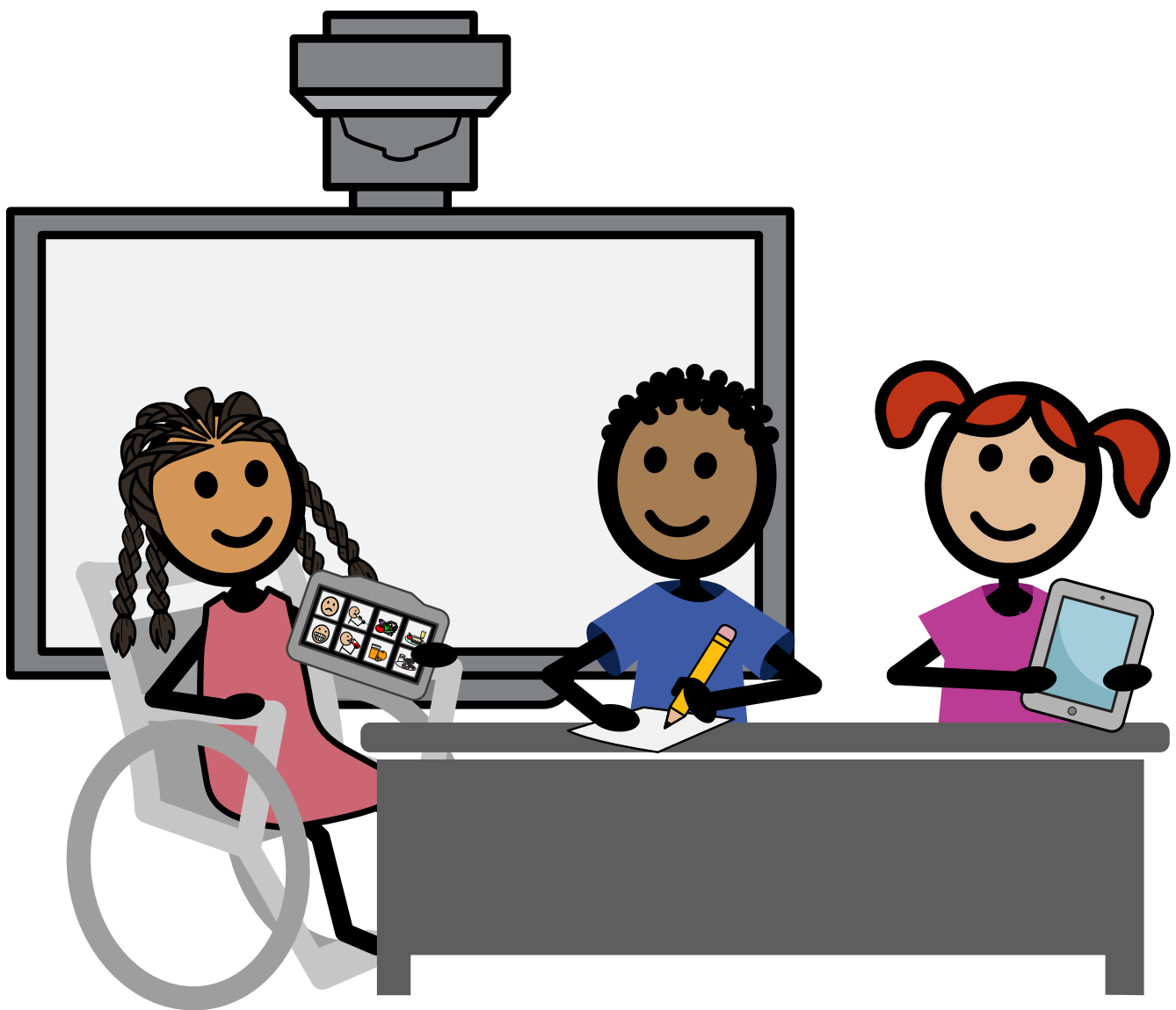
Opaque or abstract symbols may not have visual relationships to their referents. The form of the image may not obviously reflect its referent and, in fact, may be quite arbitrary. Opaque symbols can vary as well, but a few examples might be letters and numbers.

Exposure to more experiences allows each of us to develop knowledge and possibly transfer that knowledge into new situations with novel vocabulary and scenarios. Still, some symbols are naturally more transparent than others, more readily guessable and more easily understood. For less transparent symbols, instruction takes over and symbolic representation is taught and learned.

Some symbols are naturally more transparent than others, more readily guessable and more easily understood.



Implications for **CLASSROOM PRACTICE**



Implications for Classroom Practice

Education teams of parents, end users and speech-language pathologists ultimately decide on the degree of symbol supports required by a student. Dedicated speech communication aids, communication devices, core vocabulary and training are all critical to each individual's success with language acquisition, voice-output and communication. These are intensely personal decisions requiring commitment, follow-through and education surrounding the user. The following suggestions are not meant to supplant the educational team process or the expertise of the speech-language pathologists. They are, instead, a list of global implications of the importance of symbolic representation to memory, cognition and language.

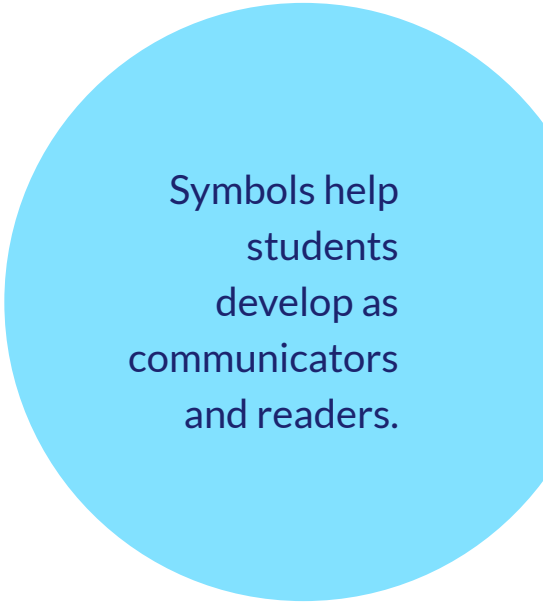


Consider these action items:

- Assess students' need for symbols as a support. Remember that the need can vary based on life experience or subject area.
- **Select symbols to meet students' needs.**
- Use and actively teach symbols paired with text.
- Keep visual supports updated with fresh, contemporary and relevant content.

- Extend visual supports to every environment to encourage reciprocal communication.
- Use symbols to adapt content that would otherwise be inaccessible.
- Choose all different parts of speech to depict in symbols so that users hear rich vocabulary and language.
- Instruct students using all the components of a whole reading program, as well as solid phonics instruction.
- Fade symbol support for literacy as students gain mastery of reading skills.

Language, literacy, communication and speech **must be taught including whatever supports are necessary** to acquire language. Symbols are useful supports across environments to cross language barriers, provide additional context for conveying meaning or to close gaps concerning experience or culture. Symbols help students develop as communicators and readers, empowering them to understand information, **share opinions and make choices**. When carefully selected to have meaning and relevance, symbols are assistive. Symbols enhance memory, understanding and independent functioning. Symbols are analogous to hardware, software and adaptive equipment in terms of providing access to language, learning and literacy.



Symbols help
students
develop as
communicators
and readers.

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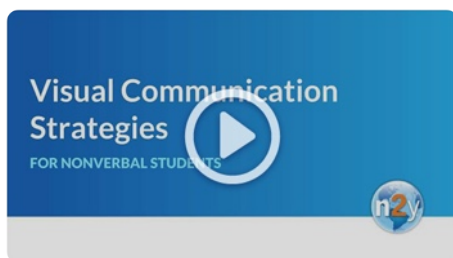
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