

**Universal Design for Learning: Examining Access Afforded by Children's
Search Engines**

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ISSN: 1535-0975

Abstract

Young children benefit from authentic opportunities to conduct online searches. Decisions related to the use of children's search engines versus universal search engines should include considerations for the affordances of technology that accommodate learner variability. Using Universal Design for Learning (UDL) as a framework for providing access to learning materials, this study includes an analysis of the affordances of search engines for both children and the general population. UDL, an inclusive framework for learning, leads contemporary efforts to create comprehensive access to educational curricula for *all* students, especially those with learning variabilities. The focus of our study is on one of UDL's principle, multiple means of representation for content access, and ways children's search engines address its guidelines of perception, language and symbols, and comprehension.

Keywords

Universal Design for Learning, multiple means of representation, affordances, technology, search engines

Just as modern buildings are designed with elevators, ramps, automatic doors, and adaptive lighting for people of varying needs and abilities, internet search engines are continually updating and adapting with easier access to the vast amount of information housed and connected in that global repository. In 2019, the Pew Research Center reported that only 10% of U.S. adults do not use the internet, meaning 90% do (Anderson, Perrin, Jiang, & Kuman, 2019). Internet use in the home, workplace, and across all disciplines, requires a set of skills to navigate information, sort commentary from news, determine content from advertisements, identify biases and opinions, and discern source validity and reliability. These skills are required for research at every level, and therefore, must be addressed and taught to children. Explicit instruction of Web literacy skills aligns with research that supports exposure to online experiences at an early age to develop literacy skills (Baildon & Baildon, 2008; Leu, Forzani, Timbrell, & Maykel, 2015; Vasinda & Pilgrim, 2019). Leu, et al. (2015) suggested that schools “begin teaching and learning new literacies as early as possible” (p. 350). In other words, opportunities to conduct online searches are necessary, in the same way that opportunities to read books to and with young children are necessary. In addition, differentiation for learners in an online environment is necessary, just as differentiation occurs with other learning materials. The good news is that accommodating features, such as speech recognition and autocorrect, are increasingly a part of the search engine design. Just as with architectural access for all, these search engine accommodations are available to everyone. In this article, we share a study in which search engine features are analyzed using a framework called Universal Design for Learning.

Inspired and influenced by the Universal Design (UD) thinking of architectural access, Universal Design for Learning (UDL) is an inclusive framework for learning. Developed by

ISSN: 1535-0975

David Rose and Ann Meyers of the Center for Assistive Special Technology (CAST), UDL leads contemporary efforts to create comprehensive access to educational curricula for *all* students, especially those with learning variabilities. *Universal* implies consideration for multiple access points to the same learning goals so that all students, regardless of their individual learning needs, can attain the same learning goal (Rose & Meyer, 2006). *Design* reflects intentional planning for multiple ways to access content and processes as well as multiple ways to represent understanding through various materials, formats, and assessments (Meyer, Rose, & Gordon, 2014). A one-size-fits-all mentality does not work for architectural design or learning design due to learner variability and diversity. UDL's theoretical framing reflects the notion that everyone can learn complex concepts through the support of effective scaffolds.

Theoretical Perspective

The UDL framework builds foundations of scaffolded learning and represents a shift in how we consider learner needs and differences. Rather than learners needing to adapt to the curriculum, this shift in thinking focuses on how the curriculum needs to adapt to the needs of the learners (Coyne, Ganley, Hall, Meo, Murray, & Gornan, 2007), much like the architectural features of a building are designed to meet the needs of all people. UDL claims Vygotsky's sociocultural theory, specifically scaffolding, as a theoretical framework. Although Vygotsky never used the term "scaffolding," a major feature of scaffolding is the interaction between a learner and another more knowledgeable person who can provide necessary assistance until the child can complete the task independently. This support is referred to as the Zone of Proximal Development (ZPD). ZPD represents the area of learning where scaffolding of new information is most effective and most likely to be learned (Vygotsky, 1978). Teacher support gradually

ISSN: 1535-0975

diminishes as learners become more independent with the new concept or skill until it becomes part of their Zone of Actual Development (ZAD). Teachers who use UDL principles consider learners with language, reading, or writing variabilities, as well as physical variabilities when they plan instruction so that everyone has access to learning new content, concepts, and processes. Through UDL, teachers maximize student engagement and opportunities for learning by intentionally planning lessons and assessing learning by considering what students can do in the best of circumstances with the right tools and resources (Coyne, Pisha, Dalton, Zeph, & Smith, 2013).

UDL Principles and Technology Support

UDL includes three principles: Multiple Means of Engagement, Multiple Means of Expression, and Multiple Means of Representation. Multiple Means of Engagement, the *why* of learning, is the affective network that signifies ways interest and purpose engage and motivate learners (CAST, 2018). Multiple Means of Representation, the *what* of learning, is the recognition network that explains how content is represented and how information is processed by learners (CAST, 2018). Multiple Means of Expression, the *how* of learning, is the strategic network involving how learners monitor progress and demonstrate learning (CAST, 2018). UDL provides a framework of support and access for *all* learners to become self-directed and independent.

With advances in technology, UDL now promotes “taking advantage of the power and customizability of modern technology to deliver, by design, flexible instructional practices directly within the core instructional curriculum where students can access them on an individualized basis” (Lapinski, Gravel, & Rose, 2012, p. 7). Technology provides opportunities

ISSN: 1535-0975

for UDL that extend beyond the scaffolding and support of learning. We propose that internet tools consistently provide accommodations and access for learners that need scaffolding, but they also provide conveniences that may appeal to anyone. These scaffolds and conveniences align well with UDL principles. The focus of our study is on children's search engines and how UDL's multiple means of representation are built into many search engines.

Multiple Means of Representation: Guidelines for Access

Search engines include unique features that enable users with various skills and abilities to access information on the internet. The affordances of search engines align with the UDL principle of multiple means of representation. Consider the learner who struggles to type due to a physical disability or a broken arm. The classroom teacher must consider ways to accommodate these learners. If assigned research on the internet, these learners may struggle to search the internet with the keyboard. Search engine features enable these learners to use speech-to-text (STT) tools during their search. The same may hold true for learners with spelling or language barriers. Built-in accommodations, like spell-check, STT, and translation capabilities, enable students to access information. Lesson design is critical for teachers to provide access for these learners.

CAST (2018) provides three guidelines to consider when it comes to the representation of content for all learners (Table 1). *Perception* is one of the three guidelines (CAST, 2018). Think back to the student with the physical disability or broken arm. These students needed opportunities to interact with flexible content that does not depend on a single sense. In other words, these students and others need options for sight, hearing, movement, or touch. *Perception*, as a guideline, is reflective of the idea that students need multiple access points.

ISSN: 1535-0975

Search engines may provide a customized display of information, alternatives for auditory information, and alternatives for visual information.

Another guideline is *language and symbols* (CAST, 2018). This guideline involves communication through languages that create a shared understanding. Students with weak language and symbols skills might need teachers to clarify vocabulary, syntax, and structure or support the decoding of text or mathematical symbols. Teachers may also need to promote understanding across languages or across multiple modes of media. Think back to the struggling speller and the student with the language barrier; these students benefit from intentional design that enables them to access language. Search engines may provide tools for text-to-speech (TTS) or STT accommodations to support these learners.

Comprehension is another of the three guidelines (CAST, 2018). Students developing comprehension skills need teachers to plan a variety of ways to activate or supply background knowledge, highlight patterns, critical features, big ideas, and relationships; guiding information processing and visualization; and maximizing transfer and generalization. Search Engines are used frequently by all learners and provide a starting point for our study of multiple means of representing on the internet.

Universal Search Engines

For the purpose of this research, a *universal* search engine includes those most widely used by the population (like Google). Most people are familiar with the function of a search engine, even if the exact term for the search tool is unknown. Search engines are “special sites on the Web that are designed to help people find information stored on other sites” (Franklin, n.d., para. 2). They work using various algorithms, and in general, search engines provide search

ISSN: 1535-0975

results based on important words, keep an index of the words they find and where they find them, and allow users to look for words or combinations of words in a particular index (Franklin, n.d.).

Even educators unfamiliar with UDL terminology have probably seen its principles in action with internet use. For example, Google, Yahoo, and Safari, among others, provide access to tools like microphones (in the search bar), which enable STT capabilities for students or internet users unable to access the internet with a keyboard. In addition, the artificial intelligence (AI) features of many search engines, referred to as Autocomplete (Sullivan, 2011) or Google Suggest (available since 2008), anticipate the spelling of search terms supporting developing spellers or those looking for information that is difficult to spell. As soon as a search begins, possible topics appear so the user can select from options before finishing the search inquiry (Figure 1).

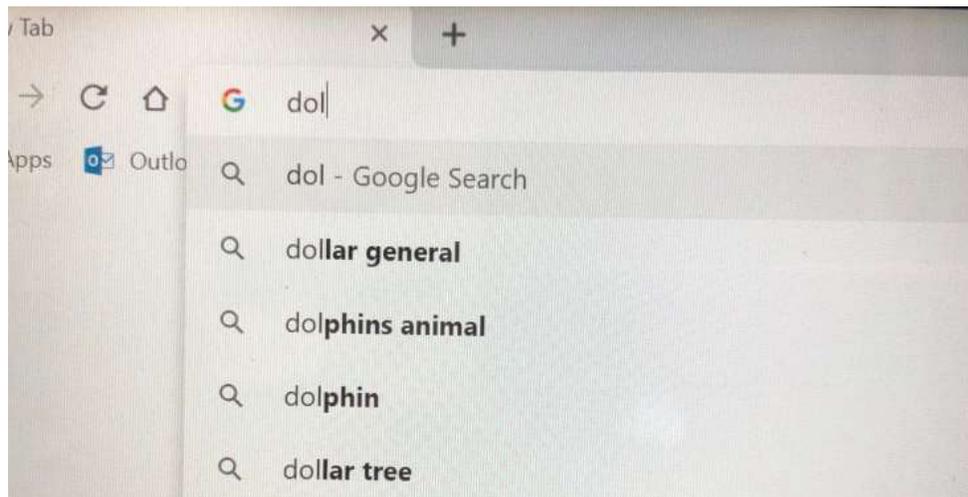


Figure 1. Google Suggest or Autocomplete

ISSN: 1535-0975

Internet browsers and search engines also allow users to change language settings in order to conduct searches using a preferred language. This type of accessibility alleviates language barriers for our English Language Learners (ELLs) and emergent multilingual students (Figure 2).

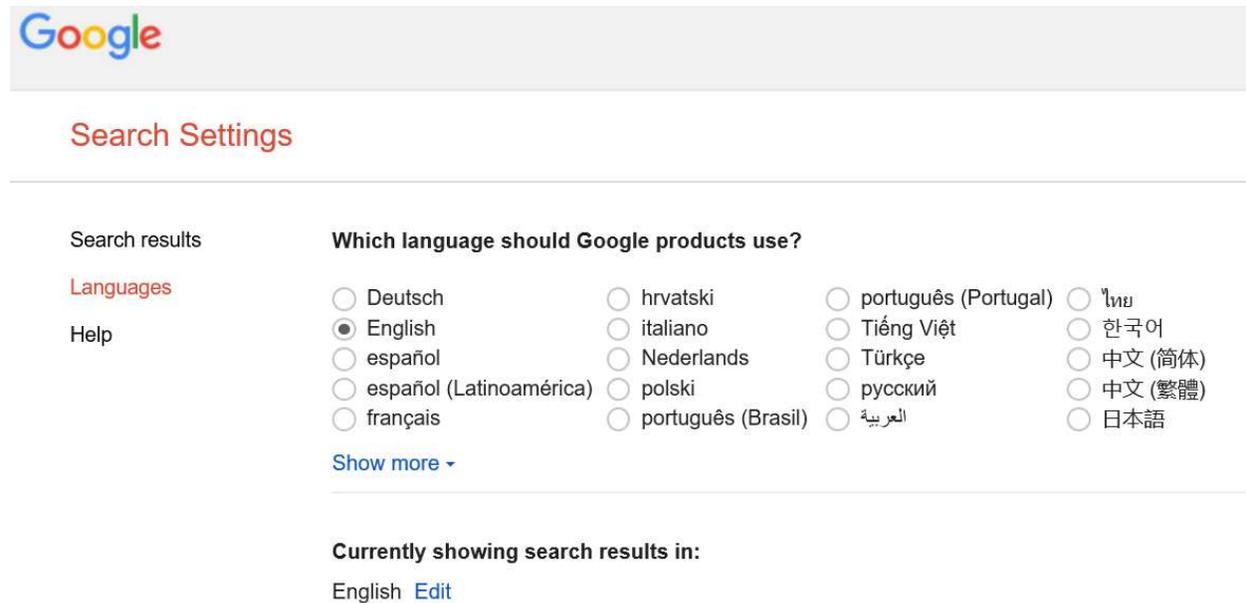


Figure 2. Language Affordances

In addition to the spelling, STT, and language features, some search engines offer setting adjustments and customization for users. Google settings include: languages, turn on SafeSearch, hide private results, advanced search (with even more options), search activity, your data in search, and search help. A Google Advanced Search offers additional ways to narrow a search, including but not limited to website domain (.edu, .com, etc.), file type (Adobe Acrobat, Microsoft Powerpoint, Shockwave Flash, and more), and usage rights (free to use or share, free to use, share or modify, and more). Other internet features include tools to adjust the font type and size. The options are incredibly broad when it comes to differentiated instruction for all

ISSN: 1535-0975

learners. Table 1 presents an alignment of internet features and UDL guidelines for Multiple Means of Representation.

Table 1: *Multiple Means of Representing*

UDL Guidelines	UDL Teaching Strategy Checkpoints	Available features on internet searches
Provide options for perception	<ul style="list-style-type: none"> • Offer customized display of information • Offer alternatives for auditory information • Offer alternatives for visual information 	<ul style="list-style-type: none"> • ✓ • ✓ • ✓
Provide options for Language and Symbols	<ul style="list-style-type: none"> • Clarify vocabulary and symbols • Clarify syntax and structure • Provide support for decoding of text or symbols • Promote understanding across languages • Illustrate through multiple media 	<ul style="list-style-type: none"> • X • X • ✓ • ✓ • ✓
Provide options for comprehension	<ul style="list-style-type: none"> • Activate or supply prior knowledge • Highlight patterns, critical features, big ideas, relationships • Guide information processing, visualization, and manipulation • Maximize transfer and generalization 	<ul style="list-style-type: none"> • ✓ • X • X • X

CAST (2018). Adapted from Universal Design for Learning Guidelines version 2.2. Retrieved from <http://udlguidelines.cast.org>

Search engines designed to engage young learners typically offer bright-colored interfaces and child-friendly user formats that are deemed safe with reduced distractions. Unfortunately, the child-friendly search engines that many teachers use for safety reasons and limited search results may not provide the same design features that the universal websites provide (Table 2). In other words, the standard search engine may best provide greater support and affordances for learner needs.

Table 2. *Search Engines for Children*

Search Engine	Website Address	Description
Kiddle	Kiddle.com	Provides a safe visual search engine for kids.
Kidtopia	https://www.kidtopia.info/	Provides only websites recommended by teachers, librarians, and library and educational consortia.
DuckDuckGo	https://duckduckgo.com/?t=hp	Provides a search venue with no tracking, no advertising, and no targeting
KidRex	https://www.alarms.org/kidrex/	Provides “a fun and safe search for kids, by kids! KidRex searches emphasize kid-related webpages from across the entire web and are powered by Google Custom Search™ and use Google SafeSearch™ technology.”
SafeSearchKids	https://www.safesearchkids.com/	Provides a filtered search result, powered by Google
KidzSearch (used Kidzsearch as its search engine)	https://www.kidzsearch.com/	Provides a “family friendly” search
DibDabDoo (use Safari to search)	https://www.dibdabdo.com/	Child safe filtered internet search that uses Google Custom Search™
Kid’s Search	https://kidssearch.com/	Provides a safe search engine with no ads.
WackySafe	https://wackysafe.com	Provides screened, kid-related webpages from across the web, powered by Google Custom Search™ and use Google SafeSearch™ technology

As seen in the descriptions provided on the search engine websites (Table 2), most search engines advertise safety and filtered searches. We wondered if these built-in safe searches not only provide filters from harm, but also limited the number of search results so students would have fewer sites to sift through. In addition, we wondered if these search engines offer the same design features, and hence affordances, that standard search engines provide.

Method

In our previous analysis of children's websites (Vasinda & Pilgrim, 2019), we learned that children's websites do not always reflect what we refer to as the "Web in the Wild" (p. 97). At first glance, websites designed for children may appear similar to websites for the general population. There are menu bars, search boxes, and sometimes *liking* features, but content is often vetted to the extreme. For example, children's sites are often closed platforms, or *walled gardens*, in which searches stay within the service provider's site. In children's sites, there are often few hyperlinks, and, if there are hyperlinks, they connect to information within the service provider's site, in contrast to open platforms in which users have access to the World Wide Web. While this may be a good option for the youngest learners, it does not provide novice users with authentic skills needed to navigate the Wild Wide Web.

The purpose of this research was to analyze search engines designed for children to see what types of user support in terms of UDL's guidelines for multiple means of representation were available and if they were the same as those for universal search engines. This feature analysis, conducted in the summer of 2019, entails a systematic study of nine search engines designed for children. The research question for this study is: *How do adaptive affordances of*

ISSN: 1535-0975

search engines designed for children differ from adaptive affordances of universal search engines?

Data Collection and Analysis

We first conducted a general search for children’s search engines in the summer of 2019, using the keywords “children’s search engines.” We examined the lists of suggestions offered by various websites, including educatorstechnology.com and makeuseof.com. We were seeking sites designed specifically to be search engines. We checked out each search engine—in some cases, the search engines were no longer available. For example, Yahoo kids and other search engines powered by Yahoo were unavailable. GoGooligans appeared to be available but was not functioning properly; therefore, it was omitted from the list. In addition, we vetted suggested search engines to ensure they enabled children to conduct authentic searches on the internet. We omitted any results that resulted in a walled garden, meaning the site was a closed site so that a search stayed within the website pages (Technopedia, n.d.; Vasinda & Pilgrim, 2019), and these are often subscription sites in which a membership or site license must be purchased. For example, Fact Monster was suggested as a children’s search engine by Educator’s Technology (<https://www.educatorstechnology.com>), but Fact Monster only enables web searches within the Fact Monster site instead of the internet beyond Fact Monster’s “walls.” Our search for children’s websites resulted in a total of nine free search engines for children (Table 2). DuckDuckGo seemed to be for a general audience, but we included it because it consistently appeared in searches for children’s search engines, and its name has a child-like quality with a play on words from a children’s recess game Duck, Duck, Goose.

In order to systematically investigate children's search engines, we analyzed universal search engines to determine accommodating features for online searching. The resulting checklist includes both features and distractions found on universal websites when conducting internet searches. For example, menu options such as language choices and interpretive spelling are common features on Google. Additionally, potential distractions such as ads and social media icons (Pinterest, Facebook, Twitter, etc.) are included, as well. The domain (.com, org, etc.) of each search engine was also examined. Adaptive search engine features were examined to evaluate alignment with UDL Guidelines (Table 3). STT capabilities on search engines reflected UDL's guideline related to perception, so this became a data point for the researchers. An identifiable checkpoint for *Language and Symbols* was online language translation, so language options also became a data point for the researchers. Autocomplete became a checkpoint for comprehension, as researchers noted the ease of finding keywords when Autocomplete appears during the search. This checkpoint for *Comprehension* is easily identifiable, so the researchers agreed to use it as a data point. Other data points overlapped as multiple means of representing. Images within menu options, for instance, is a feature that may assist a variety of learners.

In this qualitative study, data sources included children's search engines, which were analyzed to determine the existence of affordances of children's search engines and how they may or may not differ from universal search engines. Researchers used the key word *dolphins* to initiate a search on each search engine for children. The researchers systematically examined the home page of each search engine, looking for features that enabled STT, language preference, autocomplete, etc. In addition to the checklist, researchers kept notes, which included special search engine features.

Table 3: *Search Engines Designed for Children*

Search Engine	# of results	Ads (Y/N)	Social Media	Domain	Menu Options (Y/N)	Speech -to-Text	Auto-complete	Language Options
Kiddle	446,000,000	Y	N	.co	Y	N	N	N
Kidtopia	407,000,000	Y	Y	(.info)	Y	N	N	N
DuckDuckGo	N	Y	Y	.com	Y	N	Y	Y
KidRex	251,000,000	Y	N	.org	N	N	Y	N
SafeSearchKids	233,000,000	Y	N	.com	Y	Y	Y	N
KidzSearch	233,000,000	Y	Y	.com	Y	*	Y	N
DibDabDoo	420,000,000	Y	N	.com	Y	N	N	N
Kid's Search	249,000,000	N	N	.com	Y	N	N	Y
WackySafe	226,000,000	Y	N	.com	Y	Y	N	Y

Following the search on the children's search engines, we completed the same search for *dolphins* on four search engines for the general population: Google, Safari, Bing, and Yahoo (Table 4). We learned through our search that Yahoo is powered by BING.

Table 4: *Universal Search Engines*

Search Engine	# of results	Ads (Y/N)	Social Media	Domain	Menu Options (Y/N)	Speech -to-Text	Auto-complete	Language Options
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Google	410,000,000	Y	N	.com	Y	Y	Y	Y
Yahoo	29,800,000	Y	Y	.com	Y	N	Y	N
Safari	N/A	Y	Y	.com	Y	*	Y	Y
Bing	29,800,000	Y	Y	.com	Y	N	Y	Y

*Present through the keyboard

In this qualitative study, a deductive approach was taken during data analysis in that the researchers started with pre-existing principles of UDL, specifically the guidelines for multiple means of representation: perception, language and symbols, and comprehension. Data were collected to examine certain aspects of search engines, and data were analyzed to determine the existence of affordances of children’s search engines and how they may or may not differ from universal search engines.

Findings

As we examined features and functions of children’s search engines, we found differences reflective of audience age level and engagement, as one might expect. Search engine differences are important to report, as they relate to differences in how internet users perceive and comprehend information. We present our findings using the guidelines for multiple means of representation found in Table 1, perception, language and symbols, and comprehension, as categories. In addition, a recurring theme related to *safety* will be discussed as a finding.

Perception

ISSN: 1535-0975

The UDL teaching strategies for the perception guideline include offering customized display of information, providing alternatives for auditory information, and providing alternatives for visual information. Three accommodations that support perception are Zoom, STT, and TTS functions. These affordances were found in some, but not all, children's and universal search engines.

Display of information. Display of information includes a variety of ways to visually represent text features. For example, when text size can be increased (Zoom) or a different font can be used, it can be beneficial to internet users with visual issues. The internet in general already provides this capability. Color and its use for information or emphasis is reflective of *perception*. Researchers noted some children's search engines provided color options for users. For example, KidzSearch included an adaptive feature where background themes could be set, and children can select a dark background for the search engine. The use of color in this manner uses contrast as a way to support users with visual impairments. Color was evident throughout all of the children's search engines and used somewhat in universal search engines.

Display of information also includes the layout of visual or other elements affecting the perception of viewers. The layout of children's search engines was similar to that of universal search engines. Although many children's websites, like National Geographic, include large buttons that can be pressed on a screen by small hands, search engines, for the most part, resembled the linear display of textual information. All of the children's search engines we examined were bright, colorful, and used images appealing to children. KidRex even appeared to be designed by kids (Figure 3).



Figure 3. KidRex interface

Another important text feature related to perception and the *display of information* was the menu. Menus often provide options that narrow searches or provide navigational support. In addition to menu “topics,” menus often contain drag-down boxes that further narrow a search. The only children’s search engine lacking a menu was KidRex. Most search engine menus provided unique menu options for the user. Kiddle’s menu, for example, included Web images, Kimages, news, videos, and Kpedia. Kidtopia had many menu options (Figure 4), including a text-based menu at the top as well as subject-based buttons for users that use images for non-readers. Icons located below the menu bar are centrally located, allowing access with a click of a button to social media sites. We were surprised at the number of social media links included on Kidtopia, seen as smaller icons above the search bar.



Figure 4. Kidtopia

Alternatives for auditory and visual information. Auditory and visual accommodations were offered in both children's and universal search engines. Perception for users with auditory and visual impairments were offered through the accessibility of STT and TTS features. They provide ways to improve viewers' perceptions, and understanding of information, on the site. As previously mentioned, the only universal search engine to offer STT and TTS capabilities for searching was Google.

In order to investigate perception on children's search engines, we specifically examined STT options during our *dolphin* search. Out of the nine children's websites reviewed, SafeSearchKids, Kidzsearch, and WackySafe included STT capabilities. The first two of these search engines are powered by Kidzsearch. WackySafe is powered by Google Safe Search. We didn't find Zoom or TTS capabilities on any of the children's search engines.

Language and Symbols

ISSN: 1535-0975

The CAST checkpoints for the language and symbols guideline include clarification for vocabulary/symbols, clarification of syntax/structure, support for decoding of text/symbols, and illustration through multiple media. The typical affordances for this guideline are language translation features, TTS, and images/visuals such as the menu bar. These features were available for use more often in universal search engines than in children's search engines.

Clarification for Vocabulary, Symbols, Syntax and Structure. CAST (2018) recommends several strategies for vocabulary, symbol instruction, syntax, and structure. In terms of online support, children's search engines addressed vocabulary through the use of teaser texts. Teaser texts embed "support for vocabulary and symbols within the text (e.g., hyperlinks or footnotes to definitions, explanations, illustrations, previous coverage, translations)." Teaser texts are explained in more detail later, as we determined they aligned with *comprehension* as well.

The most basic function of any search engine is to identify items, or websites, in a database that corresponds to keywords, specific vocabulary, submitted by the user. As we *searched* search engines, we noted the web address, or URL (Uniform Resource Locator). A URL creates a symbol to communicate various bits of information to users by stating this information through a specific syntax and structure. A URL serves as a readable address representing a numerical code, or Internet Protocol (IP) address, for the location of resources on the internet, or in this case, the location of the search engine. Understanding the URL format provides insight into information about a website's content, author, etc. For example, <https://literacy.example.com/games> (a fictitious web address) would be interpreted in the format of protocol://domain.extension/other_information. The protocol, https (**h**ypertext **t**ransfer

ISSN: 1535-0975

protocol secure), indicates the site is secure. Next, the domain (IP address) includes the hostname indicating “literacy” is the network location. The last part of the URL is the extension (top-level domain). Theoretically (inconsistently), the extension identifies the source of the content such as country codes and categories (Table 5). The final section of the URL includes other information (this example indicates games), thus completing the unique web address for the resource found using keywords (November, 2008).

The domain differences were significantly different between children’s and universal search engines. As seen in Table 4, all universal search engines had a .com domain, which means commercial or business. Search engines designed for children included a variety of the domain codes listed in Table 5. The domain differences may not mean much, other than teachers often advise students to avoid .com websites and use .edu, .gov, and .org for more reliable information. Yet, of interest, was Kiddle.co, which according to Kiddle the “.co” stands for “children only.” Currently, there are several known meanings for the domain code, .co, beyond Kiddle’s definition such as a new commercial or business domain code since .com is not available for that business and commercial business any longer and countries use it to identify their country (i.e., .co.cn means China). However, the approved definition by the Internet Assigned Numbers Authority for the .co code is for the country of Columbia (i.e., co.co) (Retrieved from <https://www.iana.org/domains/root/db/co.html>). So, extensions can be inconsistent in their meaning, but generally, the meanings for .edu, .gov and .org sites are recognized accurately and consistently.

Table 5

Internet Extension Codes and Initial Meanings

Extension Code	Initial Source of Content
.com	Commercial or Business
.edu	Education, usually higher education
.gov	Government
.net	Networking Services (such as email / phone)
.org	Non-profit organizations
.co	Children Only/ Country/ Columbia (country)
.info	Information

Support for decoding of text/symbols. Support for decoding of text/symbols includes TTS capabilities, which is an overlap between the Perception and Language & Symbols checkpoints. Both of these checkpoints offer online tools, which can reduce the cognitive load associated with decoding. An additional way to support the decoding of text and symbols would be translation tools for second language learners. Seventy-five percent of the four universal search engines offer translation features, which are beneficial to a variety of learners and internet users. In children's search engines, only 33% of the nine search engines were found to provide language translation options. The prevalence of ads on children's search engines creates possible distractions to decoding on 88% of the search engines researched. The possibility of being distracted is even more of an issue on universal search engines, since ads were on 100% of the search engines we reviewed.

Universal search engines provide additional language and symbol tools available to support a variety of users' needs for access in the options available on the webpage for each search engine. One such tool automatically offers intuitive suggestions for search terms after an entry is incorrectly typed and submitted by prompting a question in red, "Did you mean:..." followed by a possible correctly-spelled entry given in italics. The consistent exposure to text and symbols will provide assistance in decoding.

Illustration through multiple media. Providing multiple sources to represent the same information is a tool offered on universal search engines. Charts, animations, photographs, and videos are just a few of the ways one source of information could be illustrated in multiple manners than just by text. Our example, *dolphins*, provided these multiple sources of information when searched: video games, images, videos, a definition, and species information. The same affordances were not found on children's search engines.

Comprehension

The CAST checkpoints for the comprehension guideline include activation of prior knowledge, highlighted patterns, features, big ideas, relationships, guided information processing/visualization, and maximized transfer/generalization. Teasers are the main accommodation seen on both children's and universal search engines. However, universal search engines have additional comprehension tools to support the differing needs of users.

Activation of prior knowledge. An affordance of children's search engines were the visuals, or "teasers." We may not have determined what this feature was called had it not been for labels given to "missing" placeholders (Figure 5). Of the children's search engines analyzed, Kiddle, Kidtopica, SafeSearchKids (KidzSearch), DibDabDo, and Kid's Search included teasers.

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The visual feature, seen in Figure 5, provided additional focus on images, which children are typically drawn to during searches. Teasers seen during searches on children's search engines were large and provided scaffolding for young readers for prior knowledge or to provide a hook to entice them to learn more. After investigating if this feature is designated as a teaser in universal search engines, we found that it is still called a "teaser." Teasers on universal search engines are not only image-related, but also text-related, product-related, and more.



Figure 5. Teaser Placeholder

Highlighted patterns, features, big ideas, relationships. Processing information that is not text-related is an important option for users with special needs trying to use search engines. Explicit cues highlighted on a search engine assist users in attending to features that are more effective for their search instead of being distracted by irrelevant links. Universal search engines use patterns and relationships as part of the algorithm to predict word completion, or autocomplete. Autocomplete is an accessible tool for users struggling with comprehension of information. Surprisingly, children's search engines did not offer autocomplete as an affordance for users. It seems as if this might be an important addition to children's search engines since it would assist students struggling to figure out the most effective keyword or entry to find information online.

Guided information processing/visualization and maximized transfer/generalization.

Metacognitive strategies such as links and teasers guide users to process information. Most internet users are able to process information in a sequential manner without prompting, but some users need the suggestive links and teasers to visualize possibilities. Both children's and universal search engines used teasers to guide users towards finding the information they needed based on their entry into the search engine. Universal search engines use links offering prior knowledge or new knowledge and use teasers also to make search engines more accessible to all users. Yet, accessibility is only effective if, after processing information, users are able to generalize what was learned and apply it to a new situation.

Safety

We found many safety functions available on children's search engines that are unique in their efforts to protect young internet users. For example, Kiddle is a kid-safe visual search engine with "safe sites and pages written specifically for kids" (para 1). All Kiddle search results are handpicked and checked by Kiddle editors for content and safety. The first three results of a Kiddle search are safe, trusted sites that are not written specifically for kids, but have content written in a simple way, easy for kids to understand. The fourth to the seventh results are safe, famous sites that are written for adults, providing expert content, but are harder for kids to understand while still filtered by Google Safe Search. Finally, Kiddle search results after that are either handpicked and checked by Kiddle editors or filtered by Google Safe Search, returning kid-oriented results without any explicit content. Kiddle also provides big thumbnails and visual cues to make scanning easier and large Arial font to provide better readability. Additionally, Kiddle does not collect personally-identifiable information and deletes its log every 24 hours.

In analyzing all of the other children's search engines, each claimed to provide a safe search option. Yet, the same can be said for the universal search engines analyzed for this study. Safe searches are a matter of using the settings in the web browser, which enable a safe search, prevent pop-up blockers, and more.

Key Differences between Children's and Universal Search Engines

Overall, one of the biggest differences between universal search engines and children's search engines is that universal search engines offered 50-100% of the criteria reviewed for this research. Children's search engines only ranged from 25-88% for the same criteria. Translation options were offered 75% of the time on the universal search engines reviewed but only 25% of the time in the children's search engines researched.

Menu options, autocomplete spellings, and ads were the criteria available most often on all of the children's search engines in this study. Similarly, menu options, ads, and domains were the criteria most often found on universal search engines. The criteria found least often on both children's and universal search engines were STT options, language translations, and social media links. Table 6 provides an illustration of similarities and differences for both types of search engines.

Differences between children's search engines and universal search engines were found to be significant only in search engine appearance, features, functions, safety, comprehension guidelines like autocorrect availability, and social media presence. Otherwise, children's search engines were similar to universal search engines for ads, domain codes, menu options, perception guidelines like STT, and language & symbol guidelines like online translations options. Unless

ISSN: 1535-0975

you are teaching ELLs, it would be beneficial to use universal search engines in order to use the perception and language guideline features only available on these search engines.

Table 6: *Multiple Means of Representing: Search Engines*

Guideline	Checkpoints	Children’s Search Engine	Universal Search Engine
Perception	<ul style="list-style-type: none"> • Customized display of information • Alternatives for auditory information • Alternatives for visual information 	<ul style="list-style-type: none"> • Customized settings (Font size & style, contrast, color, etc.) • STT • TTS 	<ul style="list-style-type: none"> • Customized settings (Font size & style, contrast, color, etc.) • Captions • TTS tools • Uses emoticons, images, & symbols to represent words
Language and Symbols	<ul style="list-style-type: none"> • Clarification for vocabulary/symbols • Clarification of syntax/structure • Support for decoding of text/symbols • Illustration through multiple media 	<ul style="list-style-type: none"> • Online Language Translation (DuckDuckGo) • Images/visuals 	<ul style="list-style-type: none"> • Online Language Translations on Google, Yahoo, and Bing • Images/visuals • Grammar and spelling accommodations • Virtual Assistants (Alexa, Siri, etc.) • Key vocabulary defined • Links to multiple forms of representation (charts, animation, photographs, etc.)
Comprehension	<ul style="list-style-type: none"> • Activation of prior knowledge • Highlighted patterns, features, big ideas, 	<ul style="list-style-type: none"> • Teasers- next to search results to scaffold information 	<ul style="list-style-type: none"> • Autocomplete • Links provided to relevant information which

	relationships <ul style="list-style-type: none"> • Guided information processing/visualization • Maximized transfer/generalization 	processing	might be prior knowledge <ul style="list-style-type: none"> • Teasers--scaffolds information processing
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Implications and Conclusion

By design, the internet accommodates for learning differences through various ways of accessing information, such as textual, video, and audio modes. The comprehensive content and multimodal features are available to anyone seeking information. Additionally, we propose that the affordances of search engine options provide more than a scaffold for learners; they provide equitable access. We suggest that teachers consider the principles of UDL to leverage the accommodating search engine options for equitable access to internet information. These multiple options for access are always available, unlike the temporary scaffolds of assistance typically offered to vulnerable learners working towards fluency of a particular skill or strategy. The internet provides access for all with equity options and convenience features, and therefore, without overt notice of an adaptive technology scaffold.

What does this mean for teachers? Providing authentic experiences with online information is important (Dwyer, 2015). Overall, we recommend many opportunities for students to use the internet to locate and evaluate information. Search engines like WackySafe and KidRex serve as effective tools for authentic searches. Our findings indicate that children's search engines do not include the same affordances for learners as universal search engines. This limitation is an excellent reason for teachers to make sure children are able to navigate both universal and child-friendly search engines safely and effectively. Ultimately, it does not benefit

ISSN: 1535-0975

children to only use children's search engines to locate information if they do not mimic the complexities of web-navigation. Teachers need to consider the use of accommodating search engines like Google and Safari, showing children how to use internet features in the setting options that enable access for all learners. As educators, we have a responsibility to keep our young readers safe, and we also have a responsibility to equip them to handle the discoveries and distractions of reading on the Wild Wide Web (Vasinda & Pilgrim, 2019). Learning to research online needs the same careful and explicit teaching we use for teaching research skills with paper texts. In other words, teachers need to use and model authentic searches and show students how to safely and critically examine Web content.

The Every Student Succeeds Act (ESSA) (2015) encourages states to adopt technology that aligns with UDL. The internet, the world's largest repository for locating information (Leu, Forzani, Timbrell, & Maykel, 2015), and the search engines that provide internet access are designed to support ESSA and UDL intentions. The internet *will* be accessed by children, so with careful lesson design and modeling, teachers can harness the affordances of the internet to make learning accessible for all learners.

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