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How to teach digital reading?

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Abstract

This paper offers a discussion of the knowledge, skills, and awareness involved in digital reading. Reading, in this paper, is used in the broader sense to include deriving meaning from media on a digital screen. This paper synthesises key ideas from existing studies and presents a taxonomy for the teaching of digital reading. The taxonomy includes the development of: 1) the knowledge of linear and deep reading strategies; 2) basic and critical information skills; and 3) a multimodal semiotic awareness. The goal of this paper is to unpack the specific knowledge and skills for digital reading which will support educators, including classroom teachers and librarians, on the aspects to pay attention to as students engage in digital reading. This paper argues that, in addition to equipping students with the knowledge of reading strategies and information skills, an awareness of how the various semiotic modes make meaning is fundamental to effective digital reading.

Keywords

Digital literacy; higher education; information literacy; multimodal semiotic awareness; reading skills; Singapore

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1. Introduction

Nordquist (2017) defines 'digital reading' as 'the process of extracting information from a text that is on a digital device' – computers, tablets, mobile phones, and e-readers. The process may be mediated by reading applications (e.g. iBooks on the iPad). Digital reading usually involves the reading of multimodal digital texts, that is, the combination of embedded images, videos, and other media elements, in addition to language, in a text (Buccellati, 2008). These multimodal digital texts can include e-books, social media communication, and articles on websites.

Digital reading is a part of information literacy (IL) which is defined as the ability to think critically and make balanced judgements about any information we locate and use (Chartered Institute of Library and Information Professionals (CILIP), 2018). IL is required in education to enable learners to perceive relationships between important ideas, to ask novel questions, and pursue innovative lines of thought (CILIP, 2018). In digital reading, we similarly argue that students need to develop *deep reading* strategies to not only search for specific information, but also to engage with information processing to draw inferences, construct complex arguments, and make connections to their own experiences.

The knowledge and skills for digital reading, described in this paper, are situated within the *Framework for Information Literacy for Higher Education*. This framework is founded on the

premise that students today have a greater role and responsibility in creating new knowledge, to understand information, and to be able to use information, data, and scholarship ethically (Association of College and Research Libraries (ACRL), 2016). The ACRL framework is organised into six concepts: 'authority is constructed and contextual', 'information creation as a process', 'information has value', 'research as inquiry', 'scholarship as conversation', and 'searching as strategic exploration' (ACRL, 2016).

The knowledge, skills, and awareness needed for digital reading are aligned to the concepts in the ACRL framework. In digital reading, the knowledge of linear and deep reading strategies guides students in recognising the constructed and contextual nature of authority as well as positioning reading experience as inquiry-based research. The basic and critical information skills needed in digital reading support students in the knowledge building activity where information search is a strategic exploration, and where information creation is both a process and a product. Finally, we introduce the importance of multimodal semiotic awareness in digital reading, which develops the understanding that information has value and the dialogic nature of scholarship.

Pew Research Center reports that the number of readers in the United States choosing e-books over print materials has risen from 17% in 2011 to 28% in 2016 (Perrin, 2016). The growing interest in digital reading corresponds with the advancement in technology and reader software enhancements. Concerns on the use of screens resulting in visual fatigue and visual discomfort when reading (Hellmich, 2014) are gradually mitigated to the extent where studies suggest that there is no significant difference in visual fatigue from using e-readers compared to reading on paper (Benedetto et al., 2013). This finding affirms the results reported in an earlier review of empirical literature, that the fears of increased visual fatigue from reading off screens seem unfounded (Dillon, 1992).

Electronically published texts and digital reading have also become more prevalent in the classroom, as they are used to complement print texts across a range of curriculum areas (Walsh, 2010; Donham, 2013). In light of these developments in technology and the growing ubiquity of digital reading, this paper explores the question of how educators, including classroom teachers and librarians, can guide students to develop the knowledge, skills, and awareness for digital reading. We posit that teaching digital reading involves the development of: 1) the knowledge of linear and deep reading strategies; 2) basic and critical information skills; and 3) a multimodal semiotic awareness. While the first two aspects are generally recognised, this paper builds a case for the importance of inculcating a multimodal semiotic awareness in students to support digital reading. This paper also complements past research on information literacy that has examined the issue of quality student reading, such as the development of a university reading strategy for students in the higher education sector (Garfield, 2007), with a proposed taxonomy for digital reading.

2. Affordances of digital reading

The screen is an interface into the digital world. Digital reading involves harnessing the affordances of the digital technology to provide a unique experience different from print reading. Unlike digital reading, the affordances of reading on print materials are well-recognised. For instance, Mangen et al. (2013) observe that print materials may be easier to navigate as students can readily revisit something they had already read. Students also report that they are able to concentrate better when given printed materials to read, especially for long academic readings (Baron, 2015). Reading on paper may also be aesthetically more enjoyable, because print gives readers a sense of where they are in the book – they can 'see' and 'feel' where they are in the text (Jabr, 2013). This is an experience that digital reading lacks.

An affordance of digital reading is that it can transform reading as a solitary experience into a social experience – with interactions, collaborations, and discussions. This can be compared to the 'book clubs' in print reading. However, digital reading has the added affordances of being asynchronous and continuous, as one can participate in the engagement and discussions of the reading content at any time and at any place (Sangani, 2009). Digital networked environments increasingly reshape reading and writing into a social experience; one that is mediated by social media sites, web blogs, wikis, and other forms of Web 2.0.

Students need to see themselves as active participants of a community of readers, where reading is socially valued and there are rich social interactions among members as they participate in the group's activities (Strommen & Mates, 2004). For teenagers, peer influence and interactions are important in cultivating positive reading attitudes (Merga, 2014). The social behaviours around reading are also mirrored online where students engage in online reading communities, especially through following authors and the reviews of other readers on fan-fiction website (Loh & Sun, 2019). When the reading platform is online, students also rely on their social relationships with friends as part of their strategy for finding stories they like to read online. Therefore, the ecology of reading ensures students, regardless of gender (Loh et al., 2020) and social classes (Loh & Sun, 2020) have a community of fellow readers and reading resources, online and offline, to motivate and support their reading.

Another affordance of digital reading is that it provides access to a wider selection of texts and hence the range of materials can motivate and engage young people to develop reading as a habit (Herold, 2014). The digitalisation of reading materials has increased the accessibility of texts (Rich, 2009). Teachers are able to access a larger quantity of texts, as well as provide a large variety of texts for students to choose from. It has also become more convenient for students to access digital materials and look for specific information. Reading platforms with levelling affordances, such as *Newsela*, can also cater to students of different digital reading abilities. Such platforms provide texts of varying degrees of complexity and formative assessment functionalities for students to self-regulate their reading, choose texts that match their reading abilities and level up progressively (Paul, 2014). As McRae and Guthrie (2009) observe, with the increase in choices over texts students can have greater control of their own learning. This, in turn, has a positive impact on reading ownership and motivation.

When online materials, such as academic journals and e-books, are more convenient for them to access, and when print editions of the same content are unavailable or expensive, students may turn to digital reading as an alternative (Foasberg, 2014). The implementation of full-text indexing and searching capabilities of reader devices or search software is a useful tool and models one of the most innovative benefits for readers of electronic texts (Brown, 2001).

With digital readings, students can also access active reading tools readily and use them productively. For instance, digital tools for annotation exist on most e-reading platforms. They also have features that allow users to share their annotations for collaborative work. With the rise of the Web 2.0, the proliferation of digital resources and the ubiquity of digital mobile technologies, such as smartphones and tablet devices, annotation has evolved from an isolated practice to a collaborative one (Seatter, 2019). Such digital tools include *Annotation Studio*, *Hypothes.is*, and *Google Docs*, as well as annotation projects such as *Open Utopia* and *Infinite Ulysses*. In the classroom context, Saaris (2016) observes that the digital reading tools available on digital devices encourage students to read actively through annotations and collaborations. Note-taking and annotation applications have been developed to be user-friendly and can facilitate a student's active reading process in ways that are familiar to students from their experience with reading print materials. By allowing students to render their comprehension visible to themselves, these note-taking and annotation tools also allow students to track their own progress. As such, Saaris (2016) argues that digital reading can facilitate the development of a habit for lifelong reading.

Digital reading offers new possibilities for interacting with digital multimodal texts, which can engage individual readers' preferences and reading styles. Digital multimodal texts are often embedded with hyperlinks, annotations, and multimedia that promote exploration of key ideas beyond the given text. These embedded elements provide students with alternative ways of interacting with the text (e.g. the audio reading of a poem, video of a movie adaptation of a book). Digital reading also provides students with an unprecedented level of agency and interactivity in navigating their reading experience as compared to print reading. Students are able to direct the reading experience and chart their reading paths across hyperlinks to various hypertexts and webpages (Carusi, 2006). Readers have also been found to invest more cognitive effort in reading an online news story if they were stimulated with many story choices on the first page (Wästlund et al., 2008). Digital texts therefore engage the readers in the reading process as they are given control over what they read and how they read, and they can see immediate results from the choices they make as readers (Patterson, 2000).

With the applications used to facilitate digital reading, teachers can also guide and monitor students' reading and learning processes. According to Saaris (2016), teachers are able to scaffold students' reading by embedding notes in the margins. This guides students to consider important aspects of the text. Teachers can also stop the student at a given point in the reading assignment and track the student's progress by embedding quizzes or questions to check for understanding.

Ross et al. (2017) note that students' preferences and attitudes towards reading in a particular medium affect the influence of the medium on their reading experience. It has been found that students who preferred reading from screens performed similarly over time to students who had read the texts from paper. However, students who are overconfident about their digital reading efficacies tend not to put in the requisite cognitive effort into digital reading, hence impeding their reading performance (Myrberg & Wiberg, 2015).

While students may prefer digital platforms for leisure and personal reading (Singer & Alexander, 2017), especially when these readings did not require any form or note-taking, they still find print reading favourable for academic materials (Foasberg, 2014; Loh & Sun, 2019). However, as digital texts are increasingly used to complement print texts in the school curriculum (Walsh, 2010), students will need to develop the skills to read and work with digital texts effectively and be guided by the purpose rather than be passively influenced by the medium.

3. Digital reading in higher education

Pecorari et al. (2012), in a study on reading in higher education, have found that students perceived reading, be it in print or digital format, to be of limited importance. They concluded that students' resistance to reading may be related to a lack of motivation as a result of low reading ability. Other studies have also reported that some tertiary students have difficulties in engaging with reading strategies such as using annotation tools for collaborative and deep reading (Seatter, 2019), making connections from one digital text to another using keyword searches (Park & Kim, 2016), deploying critical reading strategies such as evaluation and analysis (Manarin et al., 2015), and evaluating digital texts for their reliability by comparing and finding contradictions in the texts (Baildon & Baildon, 2012). As such, students, even at the tertiary level, could benefit from reading instruction and not have educators assume that they already have the reading skills, especially for digital reading (Fisher et al., 2011).
The increased use of mobile devices, such as smartphones, for reading amongst students have also contributed to new reading behaviours such as browsing and scanning, more selective reading, less in-depth reading, and lower reading concentration (Liu & Huang, 2016). Schulmeister (2013) also observed that educators tend to assume that students have no trouble

with digital reading because they are fluent in the use of technology as digital natives. This assumption, however, is flawed because digital reading skills, such as critical evaluation of digital texts, are not developed incidentally as a result of leisure media use (Bennett et al., 2008).

Given that the reading experiences in higher education are increasingly digitally-mediated, students are disadvantaged when they do not have the knowledge, skills, and awareness to perform effective digital reading. Not only are they not able to meaningfully make sense of the weath of knowledge expressed in digital multimodal texts, but they are also not able to discern the nuances of meanings made in these texts, make appropriate textual evaluation, and exercise critical thinking. Hence, even as digital reading is becoming more common in higher education (Rockinson-Szapkiw et al., 2013), equipping educators to provide guidance and support for tertiary students in digital reading grows ever pressing (Karchmer-Klein & Shinas, 2012). In this paper, we hope to make a contribution towards this goal by unpacking the knowledge, skills, and awareness for effective digital meaning-making by offering a taxonomy of digital reading for educators.

4. Methodology

This paper is a theoretical think piece that focuses on the synthesis and evaluation of past research on digital reading to develop a framework that describes the knowledge and skills for digital reading. The literature review in this meta-synthesis was undertaken by the authors. A keyword search using terms such as digital reading, digital texts, information literacy, online reading, critical digital reading, multimodal semiotic awareness, and linear and nonlinear reading strategies was agreed upon. The date range limitation for searching papers was set from 1990 to the current year as the focus was primarily on current research on digital reading.

A variety of online databases were searched using National Institute of Education Libris, Google Scholar, Science Direct, and EBSCO. Journals such as *Social Studies and the Young Reader, Middle School Journal, Library Hi Tech, E-Learning and Digital Media, Reading Improvement, Educational Research Review, Ergonomics, Journal of Research in Reading, College and Research Libraries, Journal of Information Literacy, Computers in Human Behavior, Journal of Adolescent & Adult Literacy, Journal of Documentation, Australian Journal of Language and Literacy, The Reading Teacher, Library and Information Science Research, Studies in Higher Education*, and so on were searched. Websites that include scientific discussions about digital reading such as *Scientific American* and *USA Today* were also included.

5. Teaching digital reading

5.1 Knowledge of linear and deep reading strategies

While reading in print is mostly a linear process, digital reading can be both linear and non-linear. Students can navigate digital texts and decide their own reading paths. As such, a pre-requisite for effective digital reading is that the student possesses linear reading strategies, usually associated with print reading (Hahnel et al., 2015).

Even with digital reading, students would need to develop the deep reading strategies associated with print reading (Turner & Hicks, 2015). Unfortunately, it has been observed that students tend to discard familiar print-based strategies for boosting comprehension when reading digitally. As Herold (2014) notes, students tend to almost reflexively skim the surface of digital texts in search of specific information, rather than dive in deeply in order to draw inferences, construct complex arguments, or make connections to their own experiences. When reading on screens, students seem less inclined to engage in metacognitive learning strategies, and do not use methods such as setting specific goals, rereading difficult sections, and checking how much one has understood along the way (Jabr, 2013). Despite the fact that a

variety of tools for digital annotation exists, Jabr (2013) also observes that students also tend not to apply their print annotation skills to digital texts.

Studies have shown that students tend to activate certain schema based on the medium. Readers have been found to adopt the strategy of 'power browsing' when they read on screen. The average times that users spend on e-book and e-journal sites are usually very short, that is, four and eight minutes respectively (Rowlands et al., 2008). They scan horizontally through titles, contents pages, and abstracts. Website users have a habit of browsing pages rapidly and read only about 20 percent of the content on an average page (Nielsen, 2008; Weinreich et al., 2008). The typical screen-based reading strategy is characterised by more time spent on browsing and scanning, keyword spotting, one-time reading, non-linear reading, and reading more selectively with less time spent on in-depth reading and concentrated reading (Liu, 2005). The use of speed reading, browsing, and scrolling negatively affected students' text comprehension (Sanchez & Wiley, 2009) and contributed to an overall decline in the level of comprehension (Dyson & Haselgrove, 2000), especially for students with a low working memory capacity.

In not knowing how to apply print reading strategies to read digital texts, students are unable to benefit from the evidence showing that print-based reading strategies, such as rereading, can facilitate integrative processing where a second-pass reading uniquely predicted verbal and graphical recalls, and the transfer of knowledge (Mason et al., 2015). Such strategies encourage reflection and analysis for critical understanding (Calinescu, 1993).

Print texts tend to be structured for linear reading, allowing for ease of navigation from one portion of a text to the next, and re-reading of certain portions of a text if required, thus aiding comprehension (Mangen et al., 2013). According to Hahnel et al. (2015), such linear reading processes are also pre-requisites for comprehension of digital texts. As students navigate digital texts, they should also be able to choose particular strategies of hyperlink selection, such as selecting a link in relation to a reading goal or personal interests. If necessary, they should also revisit relevant texts (Hahnel et al., 2015). These claims are consistent with the finding that students who read digital texts by relating the ideas of a text into a coherent mental representation score higher in inferential comprehension measures than students who follow less cohesive hyperlink routes (Salmerón & García, 2011).

In-depth processing, or deep reading strategies, often associated with print reading, also need to be developed as part of effective digital reading. Lauterman and Ackerman (2014) found that participants, when guided, can achieve cognitive and metacognitive processes important to in-depth processing for reading comprehension even in digital reading. Therefore, educators should guide students to learn how to use in-depth processing methods (Wolf & Barzillai, 2009) instead of adopting a shallow processing style, such as scanning and skimming strategies, often almost reflexively when reading on screen (Sidi et al., 2017). The in-depth processing could be fostered by simple methodologies such as writing keywords to summarise the text (Lauterman & Ackerman, 2014; Sidi et al., 2017). In-depth processing can also be fostered by asking critical questions at specific junctures in the text and checking for contextual and definitional information to verify the reliability of the claims made in the text. With exposure, practice and experience, students should be able to achieve better reading comprehension in reading digital texts (Delgado et al., 2018).

Educators also need to watch out for students' frequent habits of scanning and scrolling of digital text which increase the cognitive demands on readers (Proaps & Bliss, 2014; Wästlund, 2007) and train them to adopt strategies of focused, critical, analytical, and deep reading for better comprehension of the text contents. Students who grew up with technology should also be trained to avoid specific multitasking activities or task switching (Salmerón et al., 2018) that involve high cognitive load online such as memorising of content irrelevant to the text they are

reading which will impair their reading comprehension (Cho et al., 2015). Instead, multitasking with productive behaviours such as note-taking or accessing a dictionary while reading digital texts should be promoted (Subrahmanyam et al., 2013; Tran et al., 2013). Students can also be taught reading strategies such as chunking (Casteel, 1990; Sutherland-Smith, 2002; McNamara et al., 2007; Hock & Mellard, 2011; Bolos, 2015) where the text is broken up into smaller chunks for in-depth processing of important ideas and to seek links that would take them to important information they wanted for reading comprehension (Patterson, 2000). Chunking can also encourage a broader conceptualisation and more lateral thinking about topics (Sutherland-Smith, 2002) when students make connections to the real-world context to facilitate their digital text comprehension (Park & Kim, 2016).

Developing in students the knowledge of linear and deep reading strategies, including using print reading strategies in digital reading is foundational. These strategies also encourage students to ask critical questions during reading as part of inquiry research. They are also led to evaluate the claims made by the authors in the text and learn to recognise that authority is both constructed and contextual, as expressed in the ACRL framework. Table 1 summarises the linear and deep reading strategies.

Table 1: Linear and deep reading strategies

Linear and deep reading strategies	Description
Linear reading strategies	Reading for *gradual* understanding
Multiple (linear) reading pathways	Students read through the digital text multiple times linearly. For each reading, they will adopt a different entry point and pathway through the digital text by selecting different options (Jewitt, 2005). This reading strategy enables students to understand the multiple perspectives or interpretations afforded by the digital text in reading comprehension.
Deep reading strategies	Reading for *in-depth* understanding
Chunking	Students break up dense information in digital texts to ease their processing of the digital text's content (Casteel, 1990; Sutherland-Smith, 2002; McNamara et al., 2007; Hock & Mellard, 2011; Bolos, 2015).
Annotation	Students make a list of the key pieces of information relating to the topic such as phrases or single words, then group these pieces of information by searching for common factors. The list can be annotated in the digital text using the tools provided (Turner & Hicks, 2015; Saaris, 2016).
Making connections	Students can make connections to facilitate their digital text comprehension in three ways: . By linking information from a paragraph of the digital text to another paragraph in the same digital text.

	. By linking information (e.g. definitions and contextual information) from another digital text to the current digital text. . By linking information in the digital text to the real-world context (Park & Kim, 2016).

5.2 Basic and critical information skills

Basic and critical information skills are important aspects of digital reading. With digital reading, students will have access to a large variety of sources and information online. Accessing information requires technology proficiency. This includes the knowledge of how to operate the computer and other digital devices. It also involves knowing the schema of the structures and functionalities of digital environments (Hahnel et al., 2015). Navigation involves the knowledge of how to use hyperlinks to move to another website or digital content to access related information and curation involves the knowledge of how to share information sources online to other users to build knowledge.

Basic information skills include the actions of accessing and navigating the information on screen. From the perspective of schema theory, information skills can be seen as a collection of previously learnt prototypical schemes about the structures and functionalities of digital environments (e.g. publisher information can be found in 'About' sections; using back buttons restores the last web pages displayed). Such schemes could support the construction of a cognitive map and can help students to orientate and fluently locate pages within a hypertext (Hahnel et al., 2015). Basic information skills can be developed through 'hybrid reading strategies' (Park & Kim, 2011) or adapted from print-based reading strategies. These hybrid strategies include dialoguing, evaluating the text and deciding what to read, making a connection, previewing, scrolling up and down and moving back and forth, sharing an information source, and using references (Park & Kim, 2016).

Critical information skills consist of the selection, integration, and evaluation of information provided by digital texts (Salmerón et al., 2018). Gervais (2007) argues that students must learn to select relevant texts from among many, so that they are able to gain a deeper understanding of what they are reading without being distracted by irrelevant information. Selecting digital texts includes the student's awareness of the text content's suitability for their reading level, purpose, and needs (Baildon & Baildon, 2012). Integration involves the synthesis of information from multiple documents or websites. Evaluation of information involves the reader's knowledge to assess digital texts for their reliability so that they can make their own judgements as to the authenticity of the digital text's content (Baildon & Baildon, 2012). Finally, students also need to learn how to evaluate the information they encounter. In this light, educators should guide students in evaluating digital texts for their reliability and comparing and finding contradictions in digital texts (Støle et al., 2018).
The basic and critical information skills where the student adopts non-linear and iterative strategies to search for information online and share the curated information on a learning management system (Wang et al., 2011) support students in knowledge building. This is also evident when students, in practising basic and critical information skills in digital reading, search for information strategically from a range of online sources, critically evaluate the reliability and validity of the selected information, integrate these information into a coherent whole, and present the new knowledge created from the process. As expressed in the ACRL framework, information search is part of a strategic exploration and information creation is both a process and a product. Table 2 summarises the basic and critical information skills.

Table 2: Basic and critical information skills

Basic and critical information skills	Description
Basic information skills	Basic skills to operate the digital device and interact with digital content.
Accessing	Students acquire basic technology proficiency to operate the digital device and its peripherals. They possess the schema of the structures and functionalities of digital environments (Hahnel et al., 2015).
Navigation	Students possess the knowledge of how to use hyperlinks to navigate to other websites to access related information to deepen the understanding of the digital text's content (Patterson, 2000). These hyperlinks may contain definitions or contextual information (Wolf & Barzillai, 2009).
Curation	Students possess the knowledge of how to share relevant information sources online to promote reading and digital literacy (Park & Kim, 2016).
Critical information skills	Critical skills for deeper processing of digital content.
Selection	Students possess the knowledge of how to select the digital text that is appropriate for their reading level, purpose, and needs (Baildon & Baildon, 2012).
Integration	Students possess the knowledge of how to integrate information from multiple documents or websites by displaying multiple documents side by side on a larger screen to facilitate reading (Wiley, 2001). They can integrate the information across multiple documents either by writing on print paper or using annotations on a digital text file.
Evaluation	Students possess the knowledge of how to evaluate the digital texts' contents. For instance, when evaluating digital texts for their reliability, they compare and find contradictions in the digital texts (Støle et al., 2018) to help them to make judgments regarding the authenticity of the digital texts' content (Baildon & Baildon, 2012). Students check the author of the digital text to see if s/he is a credible source. Students also critically evaluate the claims made in the digital texts by asking 'why', 'what', and 'how' questions.

5.3 Multimodal semiotic awareness

In addition to developing linear and deep reading strategies as well as basic and critical information skills, we posit that a pedagogy for effective digital reading also requires developing in students a multimodal semiotic awareness, which is informed by the theoretical orientation of social semiotics (Kress & van Leeuwen, 2001). The central tenet in multimodal social semiotic theory is that communication is conducted with multimodal ensembles drawing not only from verbal and written modes, but also through semiotic modes such as interactivity (Chew & Mitchell, 2019), colour (Kress & van Leeuwen, 2002), tactile (Djonov & van Leeuwen, 2011), and others in digital reading.

Semiotic modes refer to the various sign systems (Halliday, 1978), that is, sociocultural semiotic resources (Kress, 2010) which are combined in communicative artefacts and processes to create meaning. Each semiotic mode has unique affordances or meaning potential in communicating meaning. The meaning potentials of different modes have a fundamental effect on the choice(s) of mode in specific instances of communication (Kress, 2010). The production and reception of modes need common semiotic principles (Kress & van Leeuwen, 2001) to semantically and formally interrelate all sign repertoires present (Stöckl, 2004). One example of a common semiotic principle is semiotic cohesion, which refers to the cohesive devices between different semiotic modes, such as language and gesture (Lim, 2019; Lim, 2021) and language and image (Liu & O'Halloran, 2009).

Digital reading can involve engagement with different semiotic modes, including pictures, videos and audio, which are included in digital texts. When reading and/or composing multimodal digital texts, students need to possess the knowledge of the design features of digital texts such as their layout and composition. For students to engage in effective digital reading, they need to have the knowledge of how these semiotic modes are integrated together to communicate a desired message to the audience.

We argue that a multimodal semiotic awareness (Towndrow et al., 2013) is important for the reading of digital texts. As students encounter and produce multimodal texts, they need to consider and understand meaning potential of these semiotic modes such as layout, composition, use of text and image or graphics – including aspects such as colour, size, medium, angles – and the way these design features are integrated to suit a specific audience (Walsh, 2010). Otherwise, as Myrberg and Wiberg (2015) observe, many of the multimedia elements, animations, and interactive features found in digital texts may end up as distractions rather than as enhancements to the reading experience.

Multimodal semiotic awareness is developed through educators guiding students to appreciate the meaning behind the design choices made through the various semiotic modes and how they work together to create a coherent message. As students read multimodal digital texts, the understanding and appreciation of how meanings are made across modes help them to evaluate and critically reflect on the messages presented. Towndrow et al. (2013) explain that with multimodal semiotic awareness, students can be nurtured into critical readers and effective creators of multimedia texts. This is achieved by directing attention to the various meaning-making resources in the texts, as well as the ways in which specific choices combine to achieve the desired communicative goals.

When students read and learn from multimedia content embedded in e-textbooks, they will have to navigate and understand how multiple modes such as animated graphs, illustrations, and interactive experiments with voice and video are designed to work together to communicate information to them (Brown, 2001). For instance, while the linguistic resource represents the causal relationship between events in a text to the readers, the visual resources such as the illustrations convey the spatial relationships between entities in the text (Tenbrink, 2007).

Multimodal semiotic awareness can be developed in students through helping them understand how multimodal texts make meaning, specifically the contributions of specific semiotic modes, and their interplay in a multimodal ensemble, to achieve specific communicative purposes. An instructional approach with content informed by systemic functional theory, and pedagogy aligned to the Learning by Design framework widely used in multiliteracies (Cope & Kalantzis, 2015) can be used by educators to effectively teach the viewing and representing of multimodal digital texts (Lim, 2018). The systemic functional approach adopts a genre-based orientation towards multimodality and is organised around the experiential (happenings through processes, participants, and circumstances), interpersonal meanings (engagement and expression of modality), and textual meaning (organisation of parts). The central perspective of systemic functional theory is that the meaning-making process is a result of choice made from a set of possible alternatives (Halliday, 1994) in designing and composing a digital text. The metalanguage to develop a multimodal semiotic awareness is organised by the genre of the multimodal texts. Educators can then guide students in recognising the semiotic choices made in specific text-types to achieve its communicative purposes. The metalanguage to develop multimodal semiotic awareness has been developed for the digital reading of multimodal texts such as posters and advertisements (Lim & Tan, 2017) as well as videos (Lim & Tan, 2018).

Based on the systemic functional approach, Lim (2018) suggests that metalanguage can be developed for the description of specific genre types. The metalanguage is designed to be taught across a series of lessons and are organised in terms of specific lessons on Form, Engagement, Message, and Interplay across the semiotic modes. The metalanguage for Form is about identifying the specific visual, linguistic and multimodal features of the text and relating that to the genre. For instance, for videos, students can be guided to explore the different textual features in a narrative, documentary, and presentation. From there, they can explore how specific features express various functions in presenting the narrative arc or reporting events in the world. The metalanguage under Engagement involves knowledge of the ways to engage the audience and they are typically expressed. For instance, prominence is expressed through choices made in size, sharpness, foreground, and colour contrast. Likewise, address is expressed with different types of gaze. Other visual meanings include distance expressed through shots, mood through colours and lighting, power with angles, and perspective through different points of view. Spatial arrangement is expressed through layout and placement. Music and sound effects also contribute to the aural meanings made. Affect can be expressed through facial expressions, attitude through gestures and dramatisation through motion.

The metalanguage for Message involves students understanding how the multimodal text persuades the viewers through appeals to authority, reason, and/or emotions as well as how the purpose of the text is expressed through various interests. Students are guided to unpack the depictions in the text in relations to the literal and inferential meanings expressed. Finally, the interpretation of the text are to be interpreted within a context of production and reception. As a multimodal text, the metalanguage for interplay across modes should be made explicit. This involves students in recognising whether the semiotic modes work together to achieve a similar meaning through either the modes repeating, elaborating, or extending each other, or that the semiotic modes express apparently different meanings. When the apparent contradiction can be reconciled, an additional semantics of play results. In the rare instances when the different meanings cannot be reconciled, a sense of ambiguity or at worst, a breakdown of communication could occur.

When new text-types such as picture books (Miller & Watts, 2011) and transmedia narratives (Djonov, Tseng & Lim, forthcoming) on e-readers as well as digital games (Toh & Lim, 2020) are introduced, the previous lesson will be reviewed to add new features relevant to the specific genre. In this way, Liang and Lim (2020) argue that students may progress with the analysis and evaluation of more digital texts to create their own multimodal digital representations.

Multimodal semiotic awareness brings about an appreciation amongst students of the meaning and value of information as well as the dialogic nature of scholarship and authorship, as described in the ACRL framework. This is expressed, for example, where students engage in the meaning-making process of interpreting and integrating information into their digital text assignments from multiple semiotic resources such as the written and visual modes (Lea & Jones, 2011). Table 3 summarises the metalanguage specific to videos for developing multimodal semiotic awareness.

Table 3: Multimodal semiotic awareness

Multimodal semiotic awareness	**Description**		
Metalanguage	This is based on the metalanguage (Lim & Tan, 2018) to develop multimodal semiotic awareness. The example shown here is for videos.		
Aspects	**Functions**	**Expressions**	**Choices**
Form	Organisation (Visual)	Visual Features	Setting, Subject, Action
	Organisation (Linguistic)	Linguistic Features	Narrator: First Person, Second Person, Third Person
	Organisation (Multimodal)	Genre	Narrative, Documentary, Presentation etc
Engagement	Prominence (Visual)	Size, Sharpness, Foreground, Colour Contrast	Large, Medium, Small In Focus, Out of Focus Foreground, Background High, Low
	Address (Visual)	Gaze	Direct Gaze, Indirect Gaze, No Gaze
	Distance (Visual)	Shot	Close Shot, Medium Shot, Long Shot
	Mood (Visual)	Colours, Lighting	Primary, Secondary, Tertiary Bright, Dark
	Power (Visual)	Angle	High Angle, Low Angle, No Angle
	Perspective (Visual)	Point of View	Observer, Character
	Arrangement (Spatial)	Layout, Placement	Order, Organic Positioning, Proximity
	Affect (Gestural)	Facial Expressions	Happy, Sad, etc
	Attitude (Gestural)	Gestures	Positive, Neutral, Negative
	Dramatisation (Gestural)	Motion	Fast Motion, Slow Motion, Freeze Frame
	Aural (Audio)	Music, Sound Effects	Intensity, Tempo, Pitch Types, Silence

Message	Depiction – What	Representation	Literal, Inferential
	Persuasion – How	Appeal	Authority, Reason, Emotion
	Purpose – Why	Interest	Economics, Education, Entertainment
	Interpretation – Who, When, Where	Context	Production, Reception
Interplay	Convergence	Similar Meanings	Repetition, Elaboration, Extension
	Divergence	Different Meanings	Play, Ambivalence, Breakdown

6. Conclusion

In this paper we have discussed how educators can support students in the learning of digital reading. Specifically, we have identified the knowledge, skills, and awareness involved in digital reading, and argued that educators need to guide students in digital reading by developing in them a knowledge of linear and deep reading strategies, basic and critical information skills, as well as inculcate a multimodal semiotic awareness. While the first two aspects are well-established, we hope to present a case for the importance of developing in students a multimodal semiotic awareness as part of effective digital reading.

In an increasingly digital environment, students are likely to be engaged with digital reading, in addition to reading in print. This recognition demands a broadening of our understanding of reading: beyond just reading in print to reading both in print and on screen; from that of reading of books to that of reading of books and multimodal digital texts. The changing communication landscape also requires educators to develop ways to guide and support students' digital reading practices. In light of the zeitgeist where digital reading continues to be more popular and common amongst students, this paper argues for the need to develop a more nuanced understanding of the literacies involved in digital reading, where students can participate actively in digital meaning-making.

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