Article

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INTRODUCTION

"Seeing comes before words" (Berger, 1972). Berger, a media theorist, suggests that we look and recognise before we can verbally articulate. This hierarchy in the construction of meaning is widely accepted in early childhood education, yet by the time we reach tertiary education the learning emphasis has shifted from image to text (Kędra, 2018). The relationship between seeing and knowledge is not treated with the same academic rigour as the relationship between the written word and knowledge (Kearney, 2020). This is perhaps due to deeply rooted beliefs that literacy is only about reading and writing. Images are not seen to be as effective in learning as their word-counterparts. Indeed, anecdotally, the authors have observed graphics and pictures referred to as 'pretty pictures' in learning contexts and the creating of visual media to be the domain of artistic people. While this may not be intentional, comments like this imply there is an underlying belief that images are aesthetic "add-ons" to their text counterparts and thereby undervalue their integral part of meaning-making (Ervine, 2016).

We suggest this inferred pedagogical bias is at odds with the potential visual media has to enhance learning. In addition, this predisposition does not support building competencies in the use of the visual communication modalities we use every day. Contemporary technology is overwhelmingly dominated by images online and on social media. These digital platforms have significantly facilitated image use and dissemination. However, despite visual literacy being identified as a key twenty-first century competency (New Media Consortium, 2005), tertiary education is still lagging in terms of integrating visual literacy into academic culture and policy (Fragou & Papadopoulou, 2020). The capacity to create and consume visual content has become an essential skill in life and work, so why is this skill not integrated in education?

Like language acquisition (literacy), visual literacy entails the ability to use, interpret, produce, and evaluate visual content. According to the Association of College and Research Libraries (ACRL) framework (2011), a visually literate citizen is a competent contributor to a body of shared knowledge and visual culture. Visual literacy skills include the ability to:

- Determine the nature and extent of the visual media required.
- Find and access relevant visual media effectively and efficiently.
- Interpret and analyse the meaning of images.
- Evaluate images and their sources.
- Design and create meaningful images and visual media.
- Understand many of the ethical, legal, social, and economic issues surrounding the creation and use of images and visual media, and access and use visual materials ethically.

We argue the dominant focus on writing and reading overlooks these essential capabilities, thereby potentially disadvantaging our learners.

For a pedagogical shift required to integrate visual literacy in the curriculum, we propose the need to:

1. Expand the concept of what it means to be 'literate' in the contemporary milieux.
2. Understand how visual media provides opportunities to develop social and cultural competencies.
3. Understand how visual media supports communication and facilitates human learning processes.

EXPANDING LITERACIES

In a rapidly growing environment of visual content consumption and creation, our definition of literacy (or literacies) needs to evolve responsively so that it "engages with the multiplicity of communication channels and media" we experience (Cope & Kalantzis, 2000) and acknowledges the networked and diverse participatory culture we live in. Media and digital literacy are now fundamentally implicated in the practice of everyday work and life, such as applying for jobs, finding research-based information, locating and engaging in educational opportunities.

According to Hobbs (2010), a new concept of literacy is emerging, defined as "the ability to share meaning through symbol systems in order to fully participate in society"; these symbol systems include language, still and moving image, graphic design, sound, music and interactivity. Hobbs proposes that these evolving literacies should be considered an inclusive collection of literacies that support each other rather than compete. Each literacy type reflects distinctly different theoretical ideas or contexts, social and cultural competencies. Collectively they include the use of text, tools and technologies; engage critical thinking skills and analysis; encompass both message composition and creation; and promote social, cultural and ethical reflection. Cheryl Stephens, Director National Institute of Māori Education Te Whare Wānanga I Awanuiārangi (Ako Aotearoa, 2012) also advocates "multiple literacies" with visual literacy as a key skill for a strengths-based pedagogical approach to support and engage our Māori and Pasifika learners. This framework would similarly support neuro-diverse learners, many of whom have advanced visio-spatial skills (Ako Aotearoa, 2012).

VISUAL LITERACY AND CULTURAL COMPETENCY

According to photographer Susan Sontag (1977), ways of thinking and representing the world are inscribed within images. The same concept presents itself in a digitally mediated and manipulated environment where images have the same power to define our reality, furnish a dominant ideology and reinforce stereotypes. This has implications for both ākonga (learners) and kaiako (teachers) when selecting, creating and analysing images. Just as it is important for learners to question the credibility of textual information: where it appears, who authored it, to whom it is being addressed, and what has been included or omitted, the same criticality needs to be applied to visual media. Media and art history studies have been analysing the impact images have on influencing socio-political reality for decades. These disciplines understand that any pictorial representation has the power to "injure" (Lester & Ross, 2003), even unintentionally. As contributors to our global visual culture, kaiako have the responsibility to play a leading role in challenging stereotypical and reductive portrayals, with an opportunity to shift attitudes towards marginalised communities. We can contribute to this through the critical and informed choices we make regards the visual media we use in learning and teaching. Part of this visual literacy aspect also includes ensuring images are used appropriately, including ethical use, and copyright considerations.

It is reasonable to presume that our learners, often considered 'digital natives', have an innate capability to think or learn in a visual way due to their deep engagement with technology. However, an empirical study by Brumberger (2011) found that there were relatively low levels of critical engagement amongst post-secondary students with what they visually consume. While they can use and communicate with images, they do not necessarily know how to interpret, evaluate or use images effectively. This suggests that mere exposure to imagery is not enough and that critical visual literacy skills need to be explicitly taught. This may pose a challenge for educators who lack the knowledge and visual analytical skills themselves.

According to Loerts and Belcher (2019) visual literacy skills can help cultivate identity and emphasise an "active construction of knowledge" where learners become active practitioners, producing new knowledge, while drawing on their own references of meaning. In an ako-based classroom, both learner and educator bring their own interpretation of meaning to the discussion and both will inform the other (Kearney, 2020). Kaiako can facilitate these discussions and learners can use those responses for further image analysis. Opportunities to engage with images from different cultures, contexts and perspectives can promote a greater appreciation of diversity. When learners draw on and make connections between these extended literacy competencies, their awareness of bias, culture and ethics expands; critical thinking and problem-solving skills are engaged and they become active participants in their own learning journey. These make up the "'constellation of life skills" Hobbs (2010) refers to, that are necessary for full participation in our media-saturated, information-rich society.

VISUAL LITERACY AND LEARNING PROCESSES

In teaching, words and images are the two tools we have at our disposal; however, kaiako generally have greater skills and confidence in using words, as mastering reading and writing are predominantly the skills fostered from an early age. The ability to analyse, use and create images effectively is a more neglected skill. As Clark and Lyons (2010) propose, often images are deployed in instructional contexts without a clear learning objective or with the intention to entertain or create visual interest. They warn that while images may initially engage the learner, pictures used to decorate or for humorous effect will likely detract and depress the actual learning at hand. They are what Garner et al. (1989) refer to as "seductive details." Harp and Mayer (1998) documented the negative effects of irrelevant video content and text in a science lesson. While readers rated them as entertaining, learning was significantly better when the 'seductive' content was omitted. Mayer (2009, as cited in Clark & Lyons, 2010, p. 93) concludes that "adding interesting but irrelevant pictures and words had a strong negative effect on people's understanding of the explanation presented in the lesson."

However, the benefits of using effective visuals in learning and teaching have been widely accepted by cognitive research through understanding how our brains process and retain information (Carney & Levin, 2002). There are two parts to this cognitive process: working memory and long-term memory. Working memory is our mental 'workspace' where complex reasoning, learning tasks and manipulating information occurs. Long-term memory refers to the mental storage space where information from short-term memory is stored and can be recalled over a long period of time.

Baddeley and Hitch (1974) propose working memory is divided into subsystems; one which focuses on verbal and acoustic information, called the "phonetic loop", and another, a "visio-spatial sketchpad" its visual equivalent. Both systems are dependent on the "central executive" which is responsible for allocating attention.

Leveraging off the visual and audio subsystems, Paivio (1990) proposed the two interrelated processes as a form of "dual coding." According to dual coding theory: "There are two distinct and independent but interconnected cognitive systems for processing and storing information: an imagery or nonverbal system for nonverbal information and a verbal system for linguistic information" (Vekiri, 2002, p. 266). By using both senses simultaneously we spread the processing of information between the visual and auditory subsystems. Dual coding is sometimes mistakenly conceived as using text and pictures (for example, a PowerPoint slide with words and an image). However, we only use our visual processing subsystem when reading a text and looking at pictures. To distribute cognitive load, use audio (for example, spoken words) and visual media.
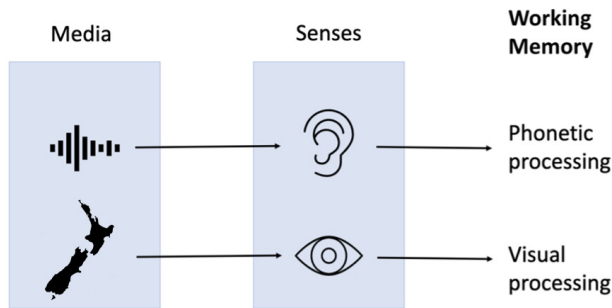
Figure 1. Dual coding occurs when we listen to audio and look at visual media (Adapted from Clark & Lyons, 2010, p. 55).

Sweller et al. (1988) propose that as we have limited capacity in working memory, instructional material should use techniques to reduce extraneous cognitive load. One way to do this is by varying the modality of information—in other words using multimedia in our teaching (Mayer & Moreno, 2010). Multimedia learning occurs when ākonga build a mental representation from words and images that have been presented.

Encoding information in our long-term memory is paramount to a successful learning experience. Referring to Levie and Levie's (1975) research on pictorial memory processes, Malamed (2015) suggests using images provides a "concreteness" for long-term memory as visuals activate associations and prior experience to sensory and spatial experience. This ability to recall images is also referred to as the 'picture superiority effect' (PSE). This theory proposes that we remember pictures better than corresponding words (Hockley & Bancroft, 2011). In a recent study, researchers tested whether semantic relatedness between to-be-remembered items and item presentation format (pictorial versus verbal) affects associative recall. Their findings confirmed memory advantages for using pictures compared with words (Baadte & Meinhardt-Injac, 2019). Including images with words or instead of words will help ākonga create a mental picture of the information which can enhance long-term memory.

While PSE contributes to memory, images are processed more quickly than their word counterparts. Look at the content below. Which did you recognize first – the text or the shape?

Graphic description:

Textual description:
A blue plane figure with four
equal straight sides and four right angles.

It is likely the time taken for you to see (comprehend) the shape versus read (comprehend) the text is quicker. This is because we process pictures more efficiently than words. We can take in and process the data from an image simultaneously, whereas reading text is linear and sequential – it literally takes more time to read the letter shapes and decode the words. This premise is supported by the concept of pre-attentive processing whereby we subconsciously accumulate simple spatial forms at speed (Treisman, 1985).

Our visio-spatial capacity can have a profound impact on learning, for example, if we consider learning procedures or processes. A study by Marcus et al. (1996) compared the time taken to connect several resistors using written instructions to the time it took using a graphic representation. The diagram resulted in a faster performance (Clark & Lyons, 2010).

Text Format:

Using the resistors supplied, make the following connections:
• Connect one end of an 8 ohm resistor to one end of a 3 ohm resistor, and connect the other end of the 8 ohm resistor to the other end of the 3 ohm resistor
• Connect one end of the 3 ohm resistor to one end of a 5 ohm resistor, and connect the other end of the 3 ohm resistor to the other end of the 5 ohm resistor.
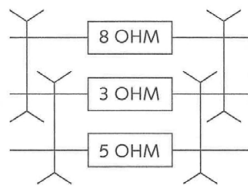
Diagrammatic Format:

Figure 2. Task directions presented by text and by a graphic (Clark & Lyons, 2010, p. 60).

The adages 'show, don't tell' and 'a picture paints a thousand words' both provide useful cues for kaiako to consider when selecting content and media for lessons. When you looked at Figure 2 what was your eye drawn to first? It is likely to have been the diagram. This is because we tend to be attracted to a picture before we read the text. Our propensity to be interested in images over words is supported by consumer research; pictorial advertisements are more effective at capturing attention than text advertisements (Goodrich, 2010). This suggests we are very efficient at 'reading' images and the process requires less cognitive effort. An eye tracking study by Smerecnik et al., on the effects of images used in health education and promotional material, indicates that graphical information enabled greater comprehension because it attracts the eye and holds the viewers' attention for a longer period than words. The results suggest graphics are highly beneficial in communication for two primary reasons. Firstly, they have a natural ability to capture attention. Secondly, when people focus on them, they facilitate extracting information with minimal cognitive effort, ultimately leading to improved comprehension (Smerecnik et al., 2010).

While providing effective visuals can reduce cognitive load, enhance comprehension, and increase long-term memory, it is no surprise that creating images has also been proven to be an effective way to support information processing and memory recall.

Drawing, such as sketching out a process, enhances problem solving, and supports processing information and recall. Fernandes et al. (2018) conducted several cognitive studies, which systematically examined whether drawing pictures depicting information to-be-remembered increased memory recall more than other strategies such as writing did. Their research concluded that drawing improves memory because of how information is encoded. When we draw, we process information in multiple ways; visually, kinesthetically and semantically. They argue that the act of drawing "requires an elaboration on the meaning" and "translating the definition to a new form (a picture)," the learner must reconstruct their understanding in a way that makes sense to them. When a learner draws out an idea, they "must elaborate on its meaning and semantic features, engage in the actual hand movements needed for drawing (motor action), and visually inspect [the] created picture (pictorial processing)"

(Fernandes et al., 2018). When we draw we create synaptic connections, providing robust memory structures or schemas in our long-term memory. Importantly, in the study, memory performance was comparable across different skills and artistic tendencies. In other words, you do not need to have artistic talents to gain the cognitive benefits of drawing.

Learning through 'translating' and 'elaboration' of meaning through visualising is also supported by Tong and Baken (2016). In their research, they found the process of learners visualising abstract data into infographic forms to be an effective method for learning. This is relevant for ākonga grappling with abstract subjects such as mathematics. When we make abstract data visible it becomes more accessible "understandable, improvable and manageable" (Tong & Baken, 2016). Creating graphics of abstract concepts help us understand complex information and assists us in building mental models.

While using visual media and designing visually-led activities appropriate to the learning needs will support learning and engagement, research also shows that the way we present information (images and text) will also affect cognitive load. A well-designed course can easily be undermined by content not being well laid out or organised, and the misuse of colour and fonts.

Graphic design principles effectively applied will enhance communication and engagement of the learning content. While there are variety of definitions of the graphic design principles, the fundamentals include the use of contrast, repetition, alignment, and proximity. These principles are not just a set of arbitrary stylistic rules or aesthetic preferences but firmly grounded in the way we process information visually. Look at the following page layouts. Which layout would you be compelled to read first? What is the difference?

Figure 3. Application of the design principles including proximity, alignment, and contrast (Romney, 2013, p. 6).

The page on the far right appears more readable. This is achieved by the applying the design principles of contrast, alignment and proximity to break down chunks of information and the use of white space to give the text 'room to breathe.' These design strategies enhance accessibility to the information (Lohr, 2008). The navigation and readability of information on a page or screen will also be influenced by other design elements such as a grid structure, visual hierarchy, font choice, and colour.

An eye tracking study by Holsanova et al. (2008) revealed how the layout of image and text affects the reader's eye movements. Their research showed how readers choose entry points and reading paths, and how they integrate text and pictures. The way print and screen-based learning materials are visually arranged and designed impacts not only the reader's initial attention but the reader's sustained interest (Holsanova et al., 2008). Their study focussed on the "spatial contiguity principle" and the "signalling principle" (Mayer, 2005). The spatial

contiguity principle states that readers learn more deeply when pictures and words are presented near rather than apart on the page or screen (for example, applying the proximity design principle). When readers engage with complex information they have to read the text and scan the illustration to derive meaning and mentally integrate the content—if the text and corresponding image are too far apart this can be cognitively demanding process creating "split attention" (Sweller et al., 1998). The signalling principle states that learning occurs more deeply "…when cues are added that highlight the organisation of the essential material" (Mayer, 2005). For example, a visual cue could include a bold headline or a bullet pointed list (for example, applying the contrast and repetition principles). These empirical studies contribute to cognitive research on how we process information and support how the effective application of the design principles in learning materials will significantly impact readers' engagement and sustained interest, ultimately contributing to the learning process.

While the acquisition and effective application of the visual design principles may appear daunting for the novice, like learning to structure a written sentence, the principles form the fundamental 'grammar' which can, with practice and support, be learned by non-designers. A recent study which examined the visual design processes of composing infographics investigated the various strategies used to generate high-, average- and low-quality infographics with an emphasis on formulating visual communication guidelines for a wide range of learners (Kuba & Jeong, 2022). They concluded that providing specific strategies and tools along with learning opportunities has the potential to enhance non-designers' visual communication and visual literacy. As Avgerinou and Pettersson (2011, p. 4) state, "visual literacy skills are (a) learnable, (b) teachable, (c) capable of development and improvement."

CONCLUSION

Visual literacy is much more than just a 'pretty picture' or capability limited to an artistic talented few. It is a learnable set of skills which impact and can enhance learning processes, communication, and cultural competency. It includes the ability not only to select or create effective visual content and present information clearly, but also to analyse images critically to ensure they are the 'best fit' for the learning purpose at hand. In addition, creating effective visually-led learning activities and assessments will contribute to ensuring an inclusive learning environment for all ākonga. These skills need to be actively taught, supported, and integrated into professional development for our educators and the curriculum. Through this proactive approach, we believe that kaiako will be able to embrace the full potential of visual literacy and recognise the integral role it can play in our learners' success and in enabling a diversely literate Aotearoa.

Ana Terry is a learning and teaching specialist with Te Pūkenga | Otago Polytechnic and is currently teaching on the Graduate Diploma in Tertiary Education and Visual Communication in the Postgraduate Certificate in Learning Design. She holds a Master of Fine Arts by research and a Postgraduate Diploma in Science Communication. Ana has been teaching communication design and fine art in New Zealand, USA, Malaysia, Melanesia, Colombia, and China for over 25 years. She advocates visual literacy as an integral skill in developing and supporting inclusive modalities in teaching and learning.

ⓘ https://orcid.org/0000-0001-9437-9522

Lucy Richardson is a lecturer in Communication Design at Te Maru Pūmanawa, College of Creative Practice and Enterprise, Te Pūkenga | Otago Polytechnic. She holds a Bachelor of Arts in Comparative World Religion and a Postgraduate Diploma in Design at AUT. She has over 25 years' design industry experience in publishing, museums, exhibitions and education. Lucy has a passion for books and typography and is committed to expanding the definition of 'literacy' within learning and teaching to include visual media, to enable a more diversely literate Aotearoa.

ⓘ https://orcid.org/0009-0006-4847-0126

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