

Digital Literacy Research

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INTRODUCTION

To be described as digitally literate involves the ability to find, interpret, comprehend, understand, evaluate, restructure and re-purpose the wide variety of media types that can be stored, retrieved and manipulated using a computer.

The 21st century has created an environment where the very meaning of the expression “to be literate” has come to mean much more than it did in the past. Literacy still encompasses the traditional reading, writing, and numeracy, but now includes visual and digital literacies that empower the individual to effectively communicate about, and use information (Jones-Kavalier & Flannigan, 2006). Literacy now incorporates an ability to critically evaluate information, communicate concepts, and express ideas in a variety of media, all mediated by computers. Earlier definitions of digital literacy tended to focus on technological skills (Bruce & Peyton, 1999; Davies, Szabl, & Montgomerie, 2002). However, the current focus has moved to a more pedagogical view that integrates technical, cognitive, and sociological skills (Eshet-Alkalai, 2004). What can the student do with information in digital form? The assumption now is that the student knows how to use the tools, and all that is needed is a focus on metacognitive and pedagogical needs. However, the case study presented in this article suggests that this is not so, and skills need to be integrated with meaningful tasks in order to become part of the lexicon of student learning modes.

Bawden (2001) lists a number of skills and practices that could be used to define digital literacy (referred to as literacy for the remainder of the article). The key element of which was the ability to make informed judgments about online information, irrespective of media used. Key elements included the ability to:

- Distinguish between content and presentation
- Develop understanding from nonlinear hypertext environments
- Evaluate a wide variety of content from different sources, without bias

- Demonstrate well developed search skills
- Filter messages and use Internet agents
- Create a personal information strategy
- Operate in a community of practice
- Define a problem and develop questions
- Judge the completeness of information

Eshet-Alkalai (2004) in an empirical study with high-school students, university students, and adults (over age 30), identifies five literacies that contributed to digital literacy. They are:

- **Photo-visual literacy** (synchronic matching of words with pictures without an understanding of the underlying syntax);
- **Reproductive literacy** (the ability to integrate information in meaningful and authentic ways);
- **Information literacy** (the ability to find and critically assess information);
- **Branching literacy** (the ability to create powerful mental models, concept maps and other abstract representations); and
- **Socio-emotional literacy** (able to engage in digital communication without being conned by those people who misrepresent themselves in cyberspace). (p. 94)

The skills and knowledge suggested by Bawden (2002) and Eshet-Alkalai (2004) need to be developed in preservice teachers (PSTs) in order to train teachers who can engage and motivate the new generation of digital natives (Prensky, 2001). The case study in this article builds upon the evidence that suggests that students who are able to develop complex, well integrated concept maps which involve visual literacy, information literacy, and technical literacy, also engage in deeper approaches to learning and develop a deep understanding of the domain knowledge (Novak, 1990). In effect, students who are more digitally literate are better able to find information, develop better mental models, and represent those models in a concept map, exhibiting a deep understanding of the content domain.

Specifically, the case study aimed to investigate the relationships between two measures of student learning, namely,

1. Profile scores (prestructural to extended abstract) of the structure of observed learning outcomes (SOLO) analysis of students' concepts at various stages in their development of concept maps to represent a specific subject domain (of their choosing); and
2. Students' moderated grades in the module.

The theoretical framework of the case study is grounded in the literature pertaining to digital literacy and the use of visual representations (photo-visual literacy). In this article these literacies will be subsumed into "digital literacies." In addition, as the data was generated in Hong Kong, it became clear that the literature on the Chinese learner was highly pertinent and this is also discussed.

VISUAL LITERACY

Visualization is an important instructional variable [and that] not all types of visuals are equally effective in facilitating achievement of different educational objectives. (Dwyer & Baker, 2001)

The research literature about the nature of images and concept mapping for conceptual understanding has a long history, but current research into the affordances offered by the advent of desktop computers, the quantum increase in computing power, and the ability to manipulate images is still relatively limited. In the study by Eshet-Alkalai (2004) individuals with high photo-visual literacy were better able to engage in meaning making from visual sources. What is less clear in the study was the ability of subjects to separate individual elements. Instead, individuals (particularly the younger ones) tended to adopt a holistic view of photo-visual content, more reflective of the graphical user interfaces favored by modern operating systems in computers, where meaning is understood without a need to focus on the constituent parts (e.g., the graphical user interface and the use of icons).

Howard Gardner proposed that there were seven separate forms of intelligence, and suggested that learning environments should endeavor to engage the differ-

ent cognitive styles represented by these intelligences (Gardner, 1993; Gardner, Kornhaber, & Wake, 1996). The seven domains are 1) linguistic, 2) musical, 3) logical-mathematical, 4) spatial, 5) bodily-kinesthetic, 6) intrapersonal, and 7) interpersonal.

It is the first, third, and fourth components of Gardner's (1993) framework that are of interest in this study in that, in developing concept maps, students manipulate linguistic elements (1) spatially (4) in order to explain concepts in a manner that emphasizes strong logical relationships (3) through the explicit interlinking of concepts. The study required students to develop highly visual concept maps in a content domain that was familiar (usually in either a major or minor subject area of study) to them. For example, the general studies or science students developed concept maps in science, and language students in languages, and so forth. In this way, the development of the visual representations was in a domain that was familiar and nonthreatening. The development of the concept maps was integrated into the learning design of the modules as a hurdle assessment requirement rather than a graded component.

Concept Mapping in Teaching and Learning

The use of concept mapping for teaching and learning is well established in the literature. The development of concept mapping was a logical consequence of Ausubel's learning theory (1968), in which he challenged some of the conclusions of Piaget (Ausubel, 1968; Novak, 1990; Novak & Gowin, 1984) in indicating that Piaget's theory of cognitive development has "only limited relevance to learning in school settings" (Novak, 1984, p. 608). The concept map was originally developed as an evaluation strategy (in place of interviews) for assessing changes in cognitive structure as a consequence of meaningful learning and as a mechanism for assessing the current level of knowledge construction (Novak & Gowin, 1984).

Concept maps link two or more concepts to form propositions. Propositions then become the units of psychological meaning. As such, concept maps incorporate elements of branching, photo-visual, digital, and information literacy. Concept mapping also has the potential to support communication between students, as students discuss their representations with peers. Concept maps can help achieve a congruence

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