

# Literacy, information, and learning - theoretical foundations

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# 1 Introduction

This review investigates information literacy (IL) models and the supporting learning theories. The purpose of this literature review is to identify elements of current literacy models that will be helpful in investigating the concept of metadata-literacy. The review includes a summary of comparative reviews in the field, a survey of current IL models, and a discussion of how the models reviewed contribute to the field of IL research. It begins by defining the field of IL and investigating how different fields such as education and library and information science approach this topic. It continues with an analysis of popular IL models with the goal of identifying a framework for discussing literacies in general. It concludes by pulling together the concepts of literacy as a pedagogical approach and information theory. The resulting evaluative framework is used in the subsequent literature reviews to frame the discussion of metadata literacy.

## 2 What is information literacy and why is it important to study?

### 2.1 Definitions and relationships

Literacy is a widely defined and discussed in the library and information science and education fields. Information Literacy (IL) definitions tend to focus on the series of tasks and concepts related to information seeking and use while educational definitions of literacy tend to focus on the role of various literacies on learning. In general IL definitions span three primary areas. First, many models discuss IL from the perspective of a foundational approach to teaching and learning. From this perspective, IL is seen as a lens that can be used to teach a number of topics and skills. Second, many models discuss IL from the perspective of a set of skills and concepts that form the foundation of an information literate individual. Third, some models view IL as less of a thing and more of a dialogue between individuals, documents, and contexts. Many IL models do not fit neatly into one of these three areas, meaning that it is becoming increasingly

difficult to discuss IL as a unified concept. This literature review explores these three perspectives and generates an IL framework that can be used to discuss the role of metadata and documents in IL. The review pays particular attention to the definition of skills, conceptual knowledge, and contexts of IL for creating this framework.

The concept of information literacy has come out of the work of many organizations. Paul Zurkowski is commonly attributed as the coiner of the term in 1974 and since then, IL has been widely investigated. Many definitions of IL are grounded in the American Library Association's work. Marcum (Marcum, 2002) credits Breivik with creating the first consolidated model of IL in the 1980s. Marcum observes that Breivik's framing of IL from within the context of lifelong learning expanded the concept of IL beyond library instruction and incorporated concepts such as skill-based learning and problem-based learning. One often cited definition from ACRL is based on the 1989 presidential committee report which identified three key components to information literacy: organization, discovery, and use (Presidential Committee on Information Literacy, 1989). This report also identifies a number of skills that have served as the foundation of information literacy programs for the last 19 years. These skills include recognition of information need, ability to locate, evaluate, organize that information, and use information. The report draws parallels between these skills and personal empowerment and points to the divides that impact information literacy including education levels, at-risk students, and socio-economic status. Both Association of College and Research Libraries (ACRL) and the American Association of School Librarians (AASL) use the definition of the ALA 1989 report as their foundation for IL. Other fields interested in this area include education (Johnson & Jent, 2005; Kuhlthau, 1993) and business arenas (Carmel, 2002). While other disciplines are interested in IL research, it is noted that much of the active research in this area is in librarianship (Weetman, 2005).

IL skills are exemplified by ideas such as the ability to discover, retrieve, and use information, the ability to manage information, and the ability to make critical choices about information resources. Conceptual knowledge includes ideas of the relationship of information to ideals like

freedom and personal empowerment. Other relevant concepts include social responsibility and ethical use. Finally, IL definitions include concepts of the context of literacy. In the reviewed models it is shown that context has meaning both in the relationship between the user and the technology and between the user and the social/information environment. As an example of the first type of context, many models include a specific technology or discipline context (such as digital, foundational, or business). As an example of the second type of context, many of these models discuss teaching IL within specific environments such as the roles of a user in a particular social environment or their role as the creator/consumer of information.

Bruce (2002) documents the history of information literacy back to the early 1970s. Bruce's perspective of information literacy is that it is a foundational approach to learning and education and an essential component of the information age. Researchers build on Bruce's (1997) work and the standards tend to introduce concepts such as searching, use, evaluation, synthesis. In contrast to models which focus on 'consumer' oriented information use actions Tuominen, Savolainen, and Talja (2005, p. 332) discuss the social context of IL and emphasize a need to include the influence of the digital environment in which "actors can simultaneously be readers and writers, consumers, and producers of knowledge" (2005, p. 338). Likewise, Sundin's conception of IL positions the acts commonly attributed to IL as existing within a social context (Sundin, 2008) much like other information seeking theories.

Bawden's (2001) review of IL models points to a number of definitions as examples in these areas. Common themes from the definitions he emphasizes include: (a) the ability to read and write, particularly in a specific language, (b) the non-binary nature of literacy; literacy as a continuum, (c) cultural knowledge, societal interaction, and (d) possession of the skills needed to interact with society. These themes are often used as primary perspectives from which to discuss literacy. Crook (2005, p. 510) cites the importance of the cultural foundation of literacy. Campbell (1990) discusses literacy from individual/social perspectives including intended use of literacy, social context, language, and domain expertise. Finally, Clifford (1984), discusses

literacy from the perspective of a continuum as opposed to a binary (literate/illiterate) perspective.

As can be seen in these definitions there is a lack of agreement about the scope of IL. The reviewed literature points to a number of issues of discussion related to the definition and scope of IL. Snively and Cooper (1997) cite inconsistencies surrounding the use of the term including the use of ambiguous terminology, Foster (1993) discusses concerns about the substance of the field, Clifford (1984) focuses on the implications of taking a 'binary' approach to literacy and illiteracy, Hughes and Shapiro (1996) criticize the field for having a pre-occupation with 'skills' approach, and Grafstein (2002) discusses a need for discipline-specific literacy and observes that the field lacks emphasis on tangible evaluation. Conversely, Owusu-Ansah (2005) views these differences as pointing to facets of a unified concept. Owusu-Ansah's position that IL is perhaps too diverse and large of a concept to be represented by a single fixed definition is reflected in the work reviewed here. Many of the definitions of IL define it so broadly that it would be impossible to tie down the specifics to the point of excluding major areas of interest (such as the role of pedagogy, the impact of social context, or the utility of specific skills).

## **2.2 The study of information literacy**

Research in IL has been widespread. Comparative reviews of literature have been completed by Rader (2002), Bawden (2001), Snively and Cooper (1997), Virkus (2003), and Sundin (2008) among others. The ERIC database contains over 1200 articles with the subject heading "information literacy." Likewise, the Library and Information Science database (LISA) contains over 1400 articles in this area. These articles tend to fall into one of four areas: research (Edwards & Bruce, 2002; Miriam, 2007; Sundin, 2008), case studies (Bussert, Brown, & Armstrong, 2008; Corradini, 2007; Mackey & Jacobson, 2004), meta-analyses (Bawden, 2001; Koufagiannakis & Weibe, 2006; Rader, 2002; Snively & Cooper, 1997; Virkus, 2003) and definition or foundation articles (Johnston & Webber, 2003; Owusu-Ansah, 2005; Tuominen, et

al., 2005). A search of Dissertation Abstracts database showed a consistent background of research in this area with eleven dissertations published in 2006 and nine in 2007. Dissertation topics included assessing information literacy programs and educators, impact of information literacy skills on specific learning objectives, and evaluating the role of technology in information literacy.

While interest in information literacy is clear in the library realm, there is also significant work in the following areas: education, psychology, technology, and science. A search of the ACM digital library on the phrase “information literacy” returns 88 articles and a search in PsychInfo returns 57 articles under the “information literacy” subject heading. While topics in these areas mimic the four areas listed here, psychological literature focuses on cognitive aspects of literacy including perceptions (Smith & Oliver, 2005), and literacy in specific contexts (Carolan, 2007). Interest in the education arena is clear given the broad range of results in the ERIC database. While the library and information science field has primarily focused on theoretical and case study research in this area, the education field has completed a number of large scale literacy studies intended to identify the extent of use of specific literacy related technology and skills in schools (Anderson, 2008). Anderson’s review included a number of studies such as the International Association for the Evaluation of Educational Assessment (IEA) Second Information Technology in Education (SITES) studies (SITES, 2006) , IEA’s Computers in Education study, and the Minnesota Computer Literacy Assessment. In the literature several other large scale studies have been reported including education focused assessments such as standards testing by Ontario’s Education Quality and Accountability Office (EQAQ) (EQAQ, 2007) and a skills proficiency test called iSkills offered by the Educational Testing Service (ETS) (ETS, 2007).

In her review of information literacy research from 1973-2002, Rader (2002, p. 242) reviews an active field of research, citing over 5000 articles in the span of time reviewed. She points to both a growth on an international level in interest in IL as partly contributing to this growth in interest. Bawden’s (2001) search of LISA for resources from 1980 to 1998 showed a continued growth in

the ideas of literacy and a gradual emergence of related literacies such as digital literacy, media literacy, and computer literacy. Rader (2002, p. 244) indicates that the majority of IL instruction is occurring in higher education and k-12 environments and asserts that instruction in special libraries, public libraries, and the workplace has been minimal. She further points to limited integration with other coursework and questions the presence of a sufficient foundation of assessment in IL curricula (2002, p. 244). Sundin (2008, p. 28) in contrast points to the work of Kuhlthau (1993; Kuhlthau & Todd, 2007) in bridging the literacy research being done in the education and library fields.

Perhaps given its wide body of research, it is not surprising to find contrasting opinions with regards to IL. One such area is the difference between IL and information technology literacy (ITL). Bruce (1997) distinguishes between ITL and IL but identifies the relationship of information technology to the IL standard being addressed. For example IT is seen as an outer shell in IL processes, as a mitigating influence between information sources and use. Likewise, ACRL (2000) views information technology as being skill based learning as opposed to the “intellectual framework” learning associated with IL.

Just as there is a lack of consensus on what defines ‘literacy’ there is no single way of investigating literacy. Much of the research addresses classroom environments while other research focuses on theoretical issues such as the role of knowledge in IL processes. Barzilai and Zohar (2008) for example investigate whether or not information technology has replaced the need for traditional information literacy skills by interviewing expert researchers. They focus on issues of distributed cognition and knowledge organization (Barzilai & Zohar, 2008, p. 37), arguing that domain knowledge is a necessary pre-cursor of effective information retrieval and extended learning. Likewise Rowley and Urquhart (2007, p. 1164) observe that IL behavior is tied to factors including domain knowledge, and practices of everyday information seeking behavior. Kirkwood (2006) investigates the impact that Information Communication Technology Literacy has on IL. Other recent literature focuses on faculty/library collaboration and embedded curriculum approaches. Some of these approaches focus on research methods

(Tenopir, Wang, Zhang, Simmons, & Pollard, 2008; Weisskirch & Silveria, 2005) while others focus on tasks specific to certain disciplines (Walczak & Jackson, 2007).

In general, the constructivist perspective is heavily used in research focused IL literature. In particular the influence of constructivist learning models and the tendency to create ‘authentic learning environments’ as part of IL case studies is positively represented in the literature. Rowley and Urquhart (2007, p. 1164) observe that user-behavior in information seeking is impacted the most by intensive research projects or problem-based learning. Hara (2006) observes that curriculum integration levels are influenced by teacher and administrator preferences. These case studies underscore Kuhlthau’s (1993) work on problem based IL practices and suggest that librarians in this field are beginning to bridge into the education field as part of their work with IL concepts. In fact, Sundin’s (2008) research on IL tutorials is grounded in part in the perspective that pedagogy is viewed as a key element to IL in the library field.

Given this wide body of research supporting IL, it is worth asking if IL is still relevant to study in the information science discipline. In Owusu-Ansah’s (2005, p. 373) view, the preponderance of foundational work in this field may not ultimately be working towards common ends and that research in this area should focus on student achievement or the position of the library in the education process. Despite this recognition that the field has been heavily studied, recent articles also call for new research. Studies report the continued relevance of literacy within the context of lifelong learning (Bruce, 2004; Lau, 2006; Walczak & Jackson, 2007, p. 1390) and the need to further define IL from this perspective. Further, recent articles stress the importance of incorporating new perspectives in IL including socio-technical (Tuominen, et al., 2005), and social-software perspectives (Bussert, et al., 2008; Smith, Mitchell, & Numbers, 2007). These areas continue to have relevant questions to ask.

As has been previously stated, the proliferation of IL models and perspectives makes it difficult to examine IL from a holistic perspective, much less to decide how to use IL as a model to

investigate a new information area. In an attempt to build a simplified framework, the next section contains a brief review of more frequently used literacy models.

### **3 Information literacy models**

#### **3.1 Introduction**

The literacy models selected for this review include a balance of skill-centric, conceptual, and meta-models. It includes models from both the information science and education fields and attempts to include models from around the world. This section begins with brief accounts of the literacy models and concludes with a cross-model comparison following the three areas of skills, concepts, and contexts. The analytical section includes an identification of common themes, a discussion the role of skills, concepts, and contexts in IL models and concludes with a discussion of how the reviewed models use elements of information organization and metadata theory.

Information literacy theories included in this review are: Association of College and Research Libraries ACRL (2006), the Big6 (Eisenberg, 2006), the seven pillars model developed by the Society of College, National, and University Libraries (SCONUL) (SCONUL Advisory Committee on Information Literacy, 1999), the Six Frames model (Lupton, 2006), and the United Nations Educational, Scientific, and Cultural Organization (UNESCO) model (Horton, 2007). In addition, three meta-models are reviewed, the Hughes and Shapiro (1996) model, the Socio-technical model (Tuominen, et al., 2005), and Sundin's (2008) perspectives of IL instruction. Finally, three education centric models are included, the International Society for Technology in Education (ISTE) National Education Technology Standards (NETS) (NETS, 2008), the IEA SITES studies (Anderson, 2008) and the expanded Bloom's Taxonomy (Krathwohl, 2002). These models have been selected in part due to their prevalence in literature and in part due to their relevance to this research.

## 3.2 Survey of models

### 3.2.1 The ACRL model

ACRL bases their definition of information literacy on the 1989 ALA presidential report. The ACRL standard breaks information literacy into five main areas: Know, Access, Evaluate, Use, and Ethical/Legal (ACRL, 2007). These broad areas are then broken down into performance indicators which focus on both skill and awareness based indicators. For example, under the area of use, the standards indicate that an information literate student “defines and articulates the need for information (ACRL, 2007).” Specific skills under this directive include ability to speak with others about your information need, ability to develop a research question, ability to identify key concepts, and the recognition that information combined with original thought leads to new information. The ACRL standards discuss curriculum integration from the perspective of adapting general skills such as using structured classification systems to find information to discipline specific skills including the use of LC subject headings in determining search approaches.

While ACRL recognizes the influence of information technology in information literacy, stating that information technology skills are “interwoven with, and support information literacy” (ACRL, 2000), they also differentiate information literacy from technology literacy saying that information literacy is “an intellectual framework for understanding, finding, evaluating, and using information--activities which may be accomplished in part by fluency with information technology, in part by sound investigative methods, but most important, through critical discernment and reasoning” (ACRL, 2000). This model has proven to be relatively durable and continues to be the centerpiece of many IL programs. The ACRL standards have been operationalized but include follow five main areas (ACRL, 2000):

**Table 1 ACRL standards**

<b>Information Literacy elements</b>
The information literate student determines the nature and extent of the information needed.
The information literate student accesses needed information effectively and efficiently.
The information literate student evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system.
The information literate student, individually or as a member of a group, uses information effectively to accomplish a specific purpose.
The information literate student understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information legally and ethically.
The information literate student determines the nature and extent of the information needed.
The information literate student accesses needed information effectively and efficiently.

There are two notable concepts represented in the standards in Table 1. First, the information seeking and use process is key to how IL is conceived. Second ethical use of information is of primary importance. These two ideas point to a recognition of the importance of both skills and concepts in being information literate both of which are seen in many of the other standards. There is little in this model that investigates the role of authorship, technology, or learning in this model.

### **3.2.2 The Big 6 model**

The Big6 model developed by Eisenberg and Berkowitz (2006) focuses on six broad areas: (a) task definition, (b) information seeking strategies, (c) location and access, (d) use of information, (e) synthesis, and (f) evaluation. The Big6 process has been implemented in a number of primary and secondary education environments and has use in higher education as well (Story-Huffman, 2006). While the Big 6 focuses more on processes and skills as opposed to awareness, like ACRL, it has been characterized as a method for enhancing Information Technology

Literacy (ITL) (Johnson & Eisenberg, 2006). As opposed to the ACRL model which is primarily focused at libraries, particularly higher education academic libraries, the Big 6 model was designed with k-12 students in mind. The Big 6 model focuses almost exclusively on IL as an information problem solving approach, one with mirrors in many ways the levels of Bloom's taxonomy. As such, the two models can be directly compared. The following table maps the Big 6 steps (Eisenberg, 2006) with elements of Bloom's taxonomy (Dalton, 2001).

**Table 2 Big 6 and Bloom's Taxonomy standards comparison**

<b>Big 6 Steps</b>	<b>Bloom's Taxonomy</b>
Task Definition (identify problem/need)	Knowledge (identify/describe)
Information Seeking Strategies (determine sources, select best)	Comprehension (re-structure, identify details)
Location and Access (locate, trace)	Application (grouping, development)
Use of Information (engage, extract)	Analysis (categorize, explain)
Synthesis (organize, present)	Synthesis (construct, design)
Evaluation (judge)	Evaluation (judge, recommend)

While each level in Table 2 does not map perfectly, the base levels of task definition/knowledge involve similar cognitive states as do use of information/analysis, synthesis/synthesis and evaluation/evaluation. The Big 6 model differs from the ACRL model in that it describes an information problem solving process but does not delve into legal/ethical issues. Nor does it address the roles of authorship or community that have been important in emerging models.

### **3.2.3 The Seven Pillars model**

The Seven Pillars model was developed through the work of the Society of College, National, and University Libraries (SCONUL) in the UK in the late 1990s (SCONUL Advisory Committee

on Information Literacy, 1999). The seven pillars model defines two aspects of information skills, the realm of study skills (in which students employ tools for information acquisition) and conceptual skills (in which a student is aware of how information is produced and used). The Seven Pillars model includes the following primary skills (SCONUL Advisory Committee on Information Literacy, 1999):

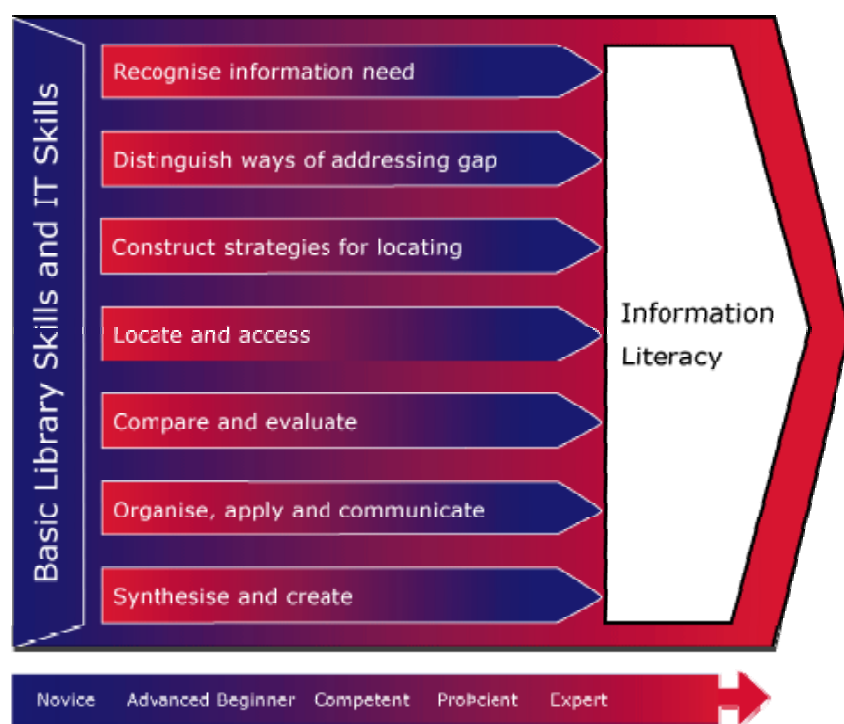
**Table 3 Seven Pillars standards**

<b>Information Literacy elements</b>
The ability to recognize a need for information
The ability to distinguish ways in which the information ‘gap’ may be addressed
The ability to construct strategies for locating information
The ability to locate and access information
The ability to compare and evaluate information obtained from different sources
The ability to organize, apply, and communicate information to others in ways appropriate
The ability to synthesize and build upon existing information, contributing to the creation of new knowledge

It is clear from Table 3 that many of the core skills (recognize information need, identify problem solving strategy, locate and access, compare and evaluate) match the skills discussed in both the Big 6 and ACRL models. The inclusion of the concept of knowledge creation integrates well with the revised Bloom’s taxonomy. Unlike the ACRL and Big 6 models which do not explicitly discuss the impact that the Internet has on information literacy concepts, the SCONUL model include information technology skills as a core part of being IL. This perspective of a solid skill base (basic library skills and information technology skills) as the foundation for these seven areas is not entirely unique to this model but by separating these skills out from more conceptual ideas allows this model to become more granular in its operationalization. The

Severn Pillars model views Library and IT skills as being the foundation on top of which the conceptual literacies outlined in Table 3 are built. The model also views five classes of expertise including Novice to Expert which indicate a non-binary approach to identifying and possessing IL skills. Figure 1 from the Seven Pillars website ([http://www.sconul.ac.uk/groups/information\\_literacy/sp/sp/splancol.gif](http://www.sconul.ac.uk/groups/information_literacy/sp/sp/splancol.gif)) shows how the Seven Pillars model combines the three components of basic skills, conceptual literacies, and developmental levels in defining IL.

**Figure 1 Seven Pillars model**



Similar to the Big 6 model, the primary components of this model follow an information problem solving approach. It does not, for example, discuss abstract goals of increasing information awareness or understanding ethical/legal implications.

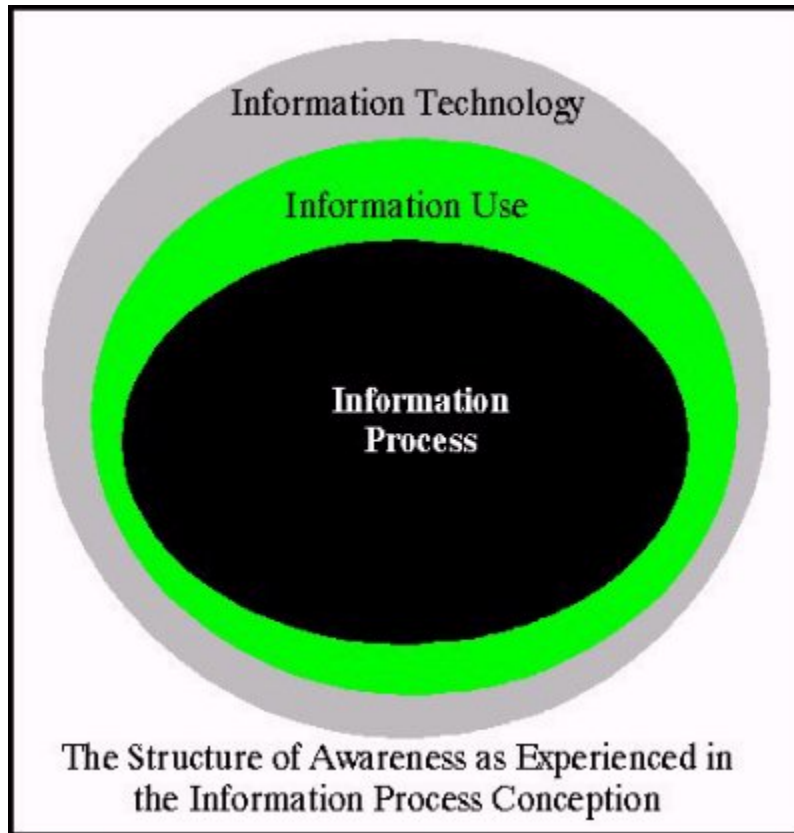
### 3.2.4 Seven Faces of information Literacy

The seven faces of information literacy model extends Bruce's (1997) work on the subject. These faces include information technology, sources, process, control (information management), knowledge construction, knowledge extension, and wisdom (Bruce, 1997). Each of these faces of information existed within the context of technology and use spheres. An example of this is shown in Figure 2 (Bruce, 1997). The Seven Faces model emphasis on the relationship between technology and information in addition to defining core literacies (Bruce, 2002). Bruce's seven faces (1997) are listed in Table 4.

**Table 4 Seven Faces standards**

<b>Information Literacy elements</b>
The relevance of information technology
Sources of information - media/formats
Conception of information - using information to solve new problems
Information control - document management
Knowledge construction - synthesizing information to build knowledge
Knowledge Extension- use of information to create new knowledge
Wisdom - Finding larger contexts in information to create wisdom

**Figure 2 Seven Faces IL model**



The Seven Faces model substantially differs from the ACRL, Big 6 and Seven Pillars models in that it does not follow an information problem solving (IPS) structure. The “faces” employ a faceted rather than linear or iterative structure in describing elements of literacy and instead focuses on broad concepts without predicting the exact relationships between the faces. Despite these noted differences, the Seven Faces model does include many of the same ideas such as the importance of finding and understanding sources, being able to define the structure and scope of an information problem, being able to synthesize and create knowledge but also includes two concepts that are not represented in other models. First, the Seven Faces model views the information process as being embedded in a technological and use context that is inseparable

from the information itself. This, like the Seven Pillars model, places knowledge about the context of the information and the specific skills required to use it in an elevated place. Second, the Seven Faces model more explicitly than other models uses cognitive states (knowledge, wisdom, and understanding) to describe IL states. Although this model does not focus on social contexts as much as it does an individual perspective, its positioning of information within a technological context reinforces the idea that a transition to electronic formats is having a significant impact on how information is used in a technology rich environment.

### 3.2.5 The Six Frames Model

The Six Frames model from Bruce, Edwards, and Lupton focuses on six distinct views of information literacy. In this model, the six frames are defined by six attributes, (a) the individual’s view of IL, (b) view of information, (c) curriculum focus, (d) view of teaching and learning, (e) view of content, and (f) view of assessment) (Lupton, 2006). The Six frames are included in Table 5.

**Table 5 Six frames standards**

<b>Information literacy elements</b>	
Content	Information is objective, IL is focused on teaching content
Competency	Information enhances learning, IL is focused on a set of skills
Learning to learn	Information is internal, IL is an approach to learning
Personal relevance	Information has individual significance, IL skills depend on context of individual
Social impact	Information has social significance, IL is embedded into society
Relational	Information may be objective, subjective or transformational, IL describes complex interactions

The frames listed in Table 5 describe different environments in which the influential attributes (Information, Literacy, curriculum, learning, content, and assessment) help define the context. The authors point to the final frame identified as relational and make the point that “Information literacy is not a set of skills, competencies and characteristics. It is a complex of different ways of interacting with information” (Lupton, 2006, p. 6). This model generalizes each type of literacy and does not address, in the way that the Big 6 or Seven Pillars models do, a specific process or skill. The Six Frames model also differs from other reviewed models in that it focuses more on the impact of information on the individual than on a process or set of skills. For example, it includes three concepts (personal relevance, social impact, and relational) that emphasize the role of information in larger contexts. Second, it includes metacognitive roles (learning to learn) which emphasize the importance of management tasks which focus on regulation of the information experience rather than immersion within a specific IPS process. By redefining literacy in such broad terms however, this model runs the risk of not being applicable in specific IL contexts such as IL instruction or problem solving exercises and likewise points to the idea that IL is a much broader concept than many of the other models indicate. In this sense, the Six Frames model is a context focused meta-model for IL which views the impact of IL in different contexts as opposed to defining what IL should look like specifically.

### 3.2.6 The UNESCO model

The UNESCO model, detailed by Horton describes eleven stages of information literacy (Horton, 2007, p. 8). These stages are listed in Table 6.

**Table 6 UNESCO Information Literacy standards**

<b>Information Literacy elements</b>
Realize that a need or problem exists that requires information for its satisfactory resolution
Know how to accurately identify and define the information needed to meet the need, solve the

problem, or make the decision
Know how to determine whether the needed information exists or not, and if it does not, know how to create, or cause to be created the unavailable information (also referred to as “creating new knowledge”)
Know how to find the needed information if you have determined that it does, indeed, exist
Know how to create, or cause to be created, unavailable information that you need; sometimes called “creating new knowledge”
Know how to fully understand found information, or know where to go for help if needed to understand it
Know how to organize, analyze, interpret and evaluate information, including source reliability
Know how to communicate and present the information to others in appropriate and usable formats and mediums
Know how to utilize the information to solve a problem, make a decision or meet a need
Know how to preserve, store, reuse, record and archive information for future use
Know how to dispose of information no longer needed, and safeguard information that should be protected

While many of these stages match the skills and process approaches from ACRL, the emphasis on store, reuse, record, preserve, and dispose in the final two stages brings a unique perspective. It picks up on the information management ideas expressed in the Seven Faces model but also defines them in more detail. While the UNESCO standard discusses the need for awareness based literacy, the stages of its model does not mention them specifically. What is perhaps most unique about the UNESCO model is the positioning of IL within the context of other literacies:

The family of 21st Century “survival literacies” includes six categories: (1) the Basic or Core functional literacy fluencies (competencies) of reading, writing, oracy and numeracy; (2) Computer Literacy; (3) Media Literacy; (4) Distance Education and E-Learning; (5) Cultural Literacy; and (6) Information Literacy. The boundaries between the various members of this

family overlap, but they should be seen as a closely-knit family. (Horton, 2007, p. 3)

As was seen in the review of research articles on literacy concepts, there is room for interpretation on what skills and concepts constitute IL. Many articles view literacy as an overarching concept which describes a state of familiarity or fluency with a concept or context to the point that a participant could be considered either a novice (non-literate) or an expert (literate). The UNESCO view of IL as a distinct style of literacy separate from computer literacy or media literacy is not entirely in sync with the views of the other models. For example the Seven Faces and Seven Pillars models view technology literacy as essentially a set of skills only within the context of IL and do not ask what other literacies or skills are essential to being literate.

### 3.2.7 The Hughes-Shapiro model

The Hughes-Shapiro model is one of the three meta-models reviewed. By looking at broader themes, the Hughes-Shapiro model attempts to describe a wider view of IL. While the UNESCO model and the Six Frames models could also be meta-models in that they address broader themes beyond IPS issues, the Hughes-Shapiro model keeps its focus on IL as the central element. The model (Hughes & Shapiro, 1996) defines literacy-centric curriculum which includes technological, social, research, and ethical elements. The model is represented in Table 7.

**Table 7 Hughes Shapiro standards**

<b>Information literacy elements</b>	
Tool literacy	The ability to use specific applications for information acquisition and use
Resource literacy	The ability to understand the content, format, and location of information resources

Social-structural literacy	The knowledge that information is seen within the context of a social construct
Research literacy	The ability to use tools to conduct research
Publishing literacy	The ability to format information for distribution
Emerging technology literacy	The ability to adapt to new technologies and use them appropriately
Critical literacy	The ability to evaluate resources

While the Hughes-Shapiro model takes a step back from specific information processes, it also introduces the concept of multiple-literacies seen in current research. This approach is comparable to the meta-literacy models that are being discussed in current literature. Meta-literacy, as exemplified by Hughes-Shapiro (1996), Sundin (2008), Lotherington (2003) and Tuominen, Talja, and Savolainen (2003), is an emerging concept in IL literature which emphasizes common literacies across multiple contexts or models. Lotherington (2003) asserts that meta-literacies can be described through the interaction with postmodern texts which he defines as a text intended to be navigated using internal structures (e.g. a video game). Lotherington defines two meta-literacies as the ability to navigate content across multiple platforms and the ability to recognize uses of information outside of context-centric literacies (2003, p. 315). By focusing on broad content areas, Hughes and Shapiro reinforce the concept that literacy is not a valuable concept outside of the context of a discipline or use scenario.

There are many parallels in this model to previously reviewed models. First, like the Six Frames model, Hughes-Shapiro positions the role of social context centrally in their model. Likewise, this model breaks out specific elements of information problem solving (IPS) environments into different literacies. Resource, research, publishing, and information evaluation/criticism literacies map onto the research processes discussed by ACRL and the Big 6. One point of distinction for this model is the recognition of the concept that technology literacy should have an evolutionary or changing perspective assigned to it. While many other literacies such as

reading, resource evaluation/criticism, or the ability to conduct research have not changed quickly, tool and technology based literacies do change very frequently. Recognizing the rapid pace of change and repositioning the role of the individual to recognize the impact of other contexts (social for example) are two elements of an information-age aware literacy model which seems to be emerging as models are updated.

### 3.2.8 The Sociotechnical practice model

In their article, Tuominen, Savolainen, and Talja (2005) point to current research and practice of IL which focuses on static skills and individual-centric practices. They claim instead that IL and IL education needs to be grounded in a sociotechnical environment which recognizes the impact of community, collaboration, and the current digital environment. Their model includes six suggested areas of literacy which are represented in Table 8 (2005, p. 341).

**Table 8 Sociotechnical literacy standards**

<b>Information Literacy elements</b>
The ways in which documents are, in reality, collected, selected, read, and exchanged in the course of practical activities
How texts, tools, and technologies feature in the practical accomplishment of social actions and social activities; how they are used collaboratively and for collaboration as much as for private absorption of information or for formation of personal meanings
How work practices will not (and need not) adapt to new technologies merely because they entail “obvious” benefits
How practical skills in using new information environments, tools, and technologies cannot necessarily be adopted in formal training and courses, that is, independently of the tasks, knowledge domains, and physical environments in which they are in practice used
People as knowledgeable “learners” who already possess a huge array of everyday skills and

competencies—acquired through experience in using particular texts and tools in practical tasks and contexts

Ideological and economic forces that are intertwined with information production and technologies

The sociotechnical model is another example of a meta-model which emphasizes a specific perspective over a set of skills or philosophical perspectives. While the Hughes-Shapiro and Six Frames models include a social component, the Sociotechnical model takes as its primary stance the social context and asks what impact that has on the other set of skills and experiences which are commonly defined as elements of IL. For example, the Sociotechnical model examines skills not from an ‘expert/novice’ perspective but from a ‘specific/generalized’ perspective. One of the common views of Internet focused research is that participants develop skills in specific contexts which have far-reaching implications in their information and learning experiences (Educause, 2009; Mabrito & Medley, 2008). Much of the work being done investigating the role of gaming in education for example proceeds with this perspective. Likewise, there is research which questions the positive bias with which many instructors view student IL skills because of a perceived expertise with specific information skills such as texting, and social networking (Rowlands, et al., 2008) and still other research which find that the participants being researched have ‘evolved’ well beyond the traditional questions of how people learn from and interact with information (Mabrito & Medley, 2008).

The Sociotechnical Model proves to be important in the discussion of IL models not only because it focuses so squarely on the social context but because it includes many elements being identified as IL models are updated. First, the model uses the concept of the document as a central element of inspection in IL. Where traditional IL models could look at a set of fixed documents including printed newspapers, books, and journals, the preponderance of document models in use in electronic environments means that the way in which participants think about, understand, and use these documents is central to discussing their view of literacy. Second, the

Sociotechnical views information skills as an emerging set of specific/practical abilities which are directly tied to the information context in which they are used. Third, the Sociotechnical model views the information participant not in a linear novice/expert line but rather as possessing a set of distinct skills which interact in complex ways to inform their ‘literacy.’ This concept of fluid, emerging literacy contrasts with the linear skill accumulation view in IPS focused models. While both perspectives contribute to the concept of IL, the non-linear perspective is more in line with the constructivist model which is often employed in IL teaching classrooms.

### 3.2.9 Sundin’s Literacy Approach Framework

Sundin’s (2008) work focused on identifying meta-models based on a review of 31 web-based information literacy tutorials. This meta-model is different from the other models reviewed given that it abstracts the views represented in the models reviewed above and creates a taxonomy with which to classify them. Sundin looked at many of the above models in and used them as an evaluative framework. In summarizing the approaches, he identified four foundational approaches to teaching information literacy. These approaches are represented in Table 9.

**Table 9 Sundin's Information Literacy standards**

<b>Information literacy elements</b>	
Source Approach	In the source approach, literacy is from within the context of the use of specific types of information resources. In this model resources are often grouped as genres (reference resources) and format (print/electronic), information scope are seen as a primary determinants of inclusion/exclusion in a category (Sundin, 2008, p. 31)
Behavioral Approach	Sundin viewed tutorials which taught the user a specific way to seek information as falling into this category. Some examples of content

	included detailed search technique instruction, recommended databases, and emphasizes practical 'skills' (Sundin, 2008, p. 34)
Process Approach	In process based literacy instruction, Sundin's perspective is that the research process is the focus of instruction. Sundin ties this approach to constructivist teaching framework, emphasizing that the literacy communicated is not skill based but rather teaching the student to be aware of a generalized information seeking/research process (Sundin, 2008, p. 35)
Communication Approach	Sundin's final category combines literacy instruction techniques emphasizing a group/community approach to information seeking. As opposed to focusing on specific skills/techniques, instruction focuses on social practices such as using social structures in information seeking and evaluating authors by their relationships which occur during an information seeking process (Sundin, 2008, p. 36)

Sundin's model is in some regards less critical and more descriptive of IL approaches in that it primarily seeks to document each approach. His stance, that each category fills a specific type of role in IL teaching and learning gets to Owusu-Ansah's (2005) view of a set of models which are non-competitive and mutually supportive. For example, Sundin's observation of 'Process' based approaches work well with IPS oriented models such as the Big 6 and Seven Pillars models. Likewise, Sundin's communication approach are descriptive of the socio-technical model and of elements of the Hughes-Shapiro model (1996).

### 3.2.10 ISTE NETS Standards

In addition to the library and information science centric models mentioned above there are a number of models that are created and maintained by educational organizations. The National Educational Technology Standards (NETS) project sponsored by the International Society for Technology in Education (ISTE) uses six broad categories to define their concept of literacy broken into student (NETS, 2007) and teachers (NETS, 2008). These six categories are (from the student standard): (a) learning and creativity, (b) communication and collaboration, (c) research and information fluency, (e) critical thinking, problem solving, and decision making, (f) digital citizenship, and (g) technology operations and concepts.

The teacher oriented standard takes a slightly different perspective, modeling the categories as directives towards student development (NETS, 2008): (a) facilitate and inspire student learning and creativity, (b) design and develop digital-age learning experiences and assessments, (c) model digital-age work and learning, (d) promote and model digital citizenship and responsibility, and (e) engage in professional growth and leadership.

The way in which these standards are defined focus more on educational outcomes such as the ability to apply knowledge, create new ideas, plan strategies, and identify problems; but at high level include many of the concepts seen in the ILS focused models. While part of the models are IPS directed focusing on topics such as research and information fluency, other elements incorporate the ethical issues mentioned in the ACRL model in addition to learning and education centric concepts. Two key points of distinction include the compartmentalization of traditional library research skills into the area of research and information fluency and the inclusion of “technology literacy” concept which emphasizes the ability to work with technology through a broad understanding of how it works. The view of technology literacy here is comparable to the view of the Seven Pillars model and perhaps even the Hughes-Shapiro model. Perhaps because these models seek to define a wider range of performance indicators for students and teachers the fact that they do not align directly with other models is more a sign of a

difference in focus rather than philosophy. For example, the definition of teacher and student oriented standards underscores the need for both sides of a teacher-student interaction to possess specific skills.

### **3.2.11 International Association for the Evaluation of Educational Achievement (IEA) SITES Assessment Framework**

The International Association for the Evaluation of Educational Achievement (IEA) is a literacy framework in that it uses a grid-based framework to identify and assess levels of knowledge in literacy areas. The SITES 2006 program conducted international research in primary and secondary schools with the goal of discovering the extent to which these schools employed Information and Communication Technology (ICT) in science and mathematics classrooms (SITES, 2006). This study included an assessment framework which identified specific ICT skills and types of related ICT tools. These skills/tools share many common elements with the other information literacy models reviewed. The following list of IEA SITES ICT skills have been adapted from a review of models by Anderson (Anderson, 2008, p. 73): (a) ICT Knowledge management competency, (b) knowledge construction, (c) critical thinking (analyze data, interpret evidence), (d) collaboration and problem solving, (e) effective presentation and discourse, (f) find, assemble, restructure knowledge, and (g) understand principles of ICT.

Likewise, the ICT tools required to facilitate the development of these skills include (Anderson, 2008, p. 73): (a) knowledge construction toolkit, (b) semantic organization tools, (c) dynamic modeling tools, (d) interpretation tools (visualization/search), and (e) communication/presentation tools.

This analytical framework places an emphasis on the role of structure of the underlying information and documents in these skills. There is a specific lack of focus on traditional literacies and research skills found in other models reviewed in this document. For example, some specific ICT skills mentioned include the ability to use data mining tools to obtain new

combinations of data, use visualization tools to create specific perspectives of data, and create concept maps and represent evidence in an appropriate way. While the primary goal of this analytical framework is to identify broad goals in ICT skills, many of these supposedly technology related skills map onto the core elements of literacy identified in other models including analytical thinking, research skills, and collaborative authorship. Just as some of the research centric models elaborate on the tasks associated with research, this model breaks ICT skills down into more granular parts for analysis.

### **3.2.12 Bloom's Taxonomy**

A brief discussion of Bloom's taxonomy is included here not because it is a specific information literacy model but because it has been used as an analytical framework to relate IL skills and concepts with states of knowledge and understanding. Bloom's taxonomy was initially generated from the work of a group in the 1950's and resulted in a pyramid shaped model which demonstrated the role of different states of knowledge and understanding in the learning process. This pyramid places knowledge at the base level, and progressively moves through the states of comprehension, application, analysis, synthesis, and evaluation (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). This model has been used in education to identify student achievement and define learning objectives in the education field. In 2002 Anderson and Krathwohl updated Bloom's taxonomy to reflect the changes over time and to re-define the sub-components of each level. For example in the original taxonomy, knowledge was discussed in terms of specifics which they refer to as facts, means including methods, conventions, and classifications, and abstractions including theories, principles, generalizations. In the updated model these areas are re-grouped into factual, conceptual, and procedural categories and a new category of metacognitive structures is added which includes strategic, analytic, and self-knowledge (Krathwohl, 2002, p. 214). The updated model changes the basic categories to remembering, understanding, applying, analyzing, evaluating, and creating (Churches, 2008b). The impact of this change has been widely discussed in education literature. Some of the key points that have

received attention are the switch from noun based descriptors to verb based descriptors (Churches, 2008a) the definition of four knowledge dimensions (factual, conceptual, procedural, and metacognitive) (Cochran & Conklin, 2007) and the addition of the creating category at the top of the pyramid (Kash, 2008). An adapted table from Krathwohl (2002, p. 216) representing this matrix is included as Table 10.

**Table 10 Cognitive Process Matrix**

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
<b>Factual Knowledge</b>						
<b>Conceptual Knowledge</b>						
<b>Procedural Knowledge</b>						
<b>Metacognitive Knowledge</b>						

The matrix represented in Table 10 provides a consistent way of representing observations about a participant’s interaction with a task. These noted shifts are consistent with the evolution of information and literacy models in education, information, and library science fields. While these taxonomies are more often used as evaluative and guiding structures to help teachers frame questions and assess student learning, they are also descriptive of the emerging literacies discussed in this review including the ability to assemble and create knowledge, collaboration, ethical use of information.

### 3.3 Observations

Each of the reviewed models takes a different approach to discussing the roles of skills, conceptual knowledge, and context of literacy. The models reviewed focused both on specific IL skills and on broad themes. The focuses of the models can be grouped into three broad areas: (a) information seeking process models, (b) participant behavior models, and (c) meta-models which focus on overarching themes as opposed to specific skills and actions. Widespread adoption of process models such as the Big 6 model and the ACRL models have occurred in the US while the SCONUL and UNESCO models have been more widely implemented in international realms (Horton, 2007; Johnston & Webber, 2003; Kuhlthau & Todd, 2007). For example, American K-12 school systems have widely adopted a three tiered information literacy standards model based on ALA's IL model which focuses on literacy, independent learning, and responsibility. This model includes references to the access, evaluation, and use theories prevalent on their website today (American Association of School & Association for Educational Communications and, 1998). In analyzing these different approaches, three main themes emerge. These three themes are the *role of skills in literacy models*, *the role of conceptual learning in literacy*, and *the notion that literacy exists in a variety of contexts*. One theme which did not emerge in this review was an overt discussion of the role of the digital document and metadata in these skills, concepts, and contexts. There was in fact an absence of discussion of the impact of metadata and information organization in the digital environment in which these literacy models exist. The following three sections discuss each of these areas with the goal of identifying themes which emerged

#### 3.3.1 Information literacy skills

IL skills are defined as specific tasks or procedures which serve an information need. In the models reviewed there is a growing but still core set of skills that can be directly tied to information seeking, use, management, and preservation. The models which included a granular focus on skills also focused on information problem solving (IPS) style problems (e.g. modeling

a research process, mapping the advancement of states of knowledge). In other models, such as the updated Bloom’s Taxonomy, skills were abstracted from the core model as a way of operationalizing broader concepts. Of the models reviewed, particularly ACRL, AASL, SCONUL, and UNESCO, the following skills were mentioned multiple times. The skill elements in Table 11 were adapted from m (ACRL, 2000; American Association of School Librarians, 2007; Horton, 2007; SCONUL Advisory Committee on Information Literacy, 1999).

**Table 11 Information Literacy skills**

<b>Information literacy element</b>
Identify an information need
Define methods for solving that need
Identify possible sources of information
Identify and select information retrieval systems and methods
Access information
Ability to select appropriate information
Employ appropriate search strategies
Compare found information
Extract and manage information from systems
Synthesize and evaluate information
Create, apply, and communicate information

While IPS focused models used skill definitions as a primary organization structure, meta-models such as Blooms revised Taxonomy and Hughes-Shapiro grouped IPS skills into a broader category. Bloom’s Taxonomy for example tends to identify these skills as procedural knowledge which is defined as “How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods” (Krathwohl, 2002, p. 214).

### 3.3.2 Literacy as a conceptual knowledge

IL concepts in the context of this review are thought of as abstract knowledge (e.g. Ethical use of information) which serves as a foundation for IL. The review of models found that there is a perceived usefulness, although often a lack of specificity, regarding the utility and relationship of conceptual and metacognitive knowledge in addition to skill based knowledge. In some cases, this is demonstrated as the difference between learning technology skills and being able to think analytically about found information such as in the Seven Pillars model. In other cases, it is represented as the ability to think about different types of literacy (e.g. cultural, media, technology, publishing, etc) or to think metacognitively about an information process (e.g. administer, manage, plan). In particular, both Bloom's Taxonomy and the Hughes-Shapiro models include a metacognitive element.

The theme of social empowerment and responsibility is seen both in the ALA model and in more recent UNESCO publications on IL. The ALA report observes that "It allows people to verify or refute expert opinion and to become independent seekers of truth (Presidential Committee on Information Literacy, 1989)." Similarly, UNESCO connects IL and social impact saying that IL "empower[s] people in all walks of life to seek, evaluate, use and create information effectively to achieve their personal, social, occupational and educational goals" (Horton, 2007). Again, both ACRL and AASL suggest specific social and ethical concepts related to IL. The concepts represented in Table 12 are concepts that are common in the reviewed models. Concepts have been adapted from the ACRL (2000) model, AASL model (American Association of School Librarians, 2007), and UNESCO Models (Horton, 2007). Horton calls on the two concepts of self-empowering and self-actualizing to represent these ideas (2007, p. 3). These metacognitive perspectives are good examples of the outcomes sought in the updated Bloom's Taxonomy metacognitive facet (Krathwohl, 2002).

**Table 12 Information Literacy concepts**

<b>Information literacy element</b>
Recognizes the need for information for decision making
Employs IL as a mechanism for being an independent learner
Uses IL as a mechanism for creativity
Recognizes the importance of information in democracy
Respects intellectual freedom
Respects intellectual property
Uses information responsibly
Shares information with and respects others' ideas
Collaborates with others

### **3.3.1 IL context and learning environments**

Information literacy has been analyzed in a wide range of contexts and learning environments. Snaveley and Cooper detail 34 areas including library literacy, mathematical literacy, political literacy, workplace literacy, environmental literacy, and Amish literacy (1997, p. 12). Bawden groups skill based literacies into specific contexts of media (interacting with mass media) and computer/IT literacy (2001, p. 10). Eshet discusses digital literacy from the context of photo-visual, reproduction (ability to copy and paste), lateral (ability to link between resources), and information (ability to critically evaluate) literacies (Eshet, 2002). In fact, this contextualization of types of literacies in part has also led to the disagreement about the meaning of the term 'information literacy.'

Horton defines IL in terms of core literacy (reading, writing, arithmetic), computer literacy (both hardware and software), media literacy, and cultural literacy (2007, p. 7). The 1989 ALA report discusses cultural, civic, computer, and global literacy as specific incarnations of information literacy (Presidential Committee on Information Literacy, 1989). A recent search of the ERIC thesaurus returned over 20 different types of literacy including scientific literacy, visual literacy (the ability to interact with visual media), and workplace literacy (skills required in the workplace) (ERIC, 2008). While it is possible to perform an analysis on the components of each type of literacy, it is obvious from a simple accounting of literacy forms that the core concepts of information literacy have propagated to many specific areas.

The fragmentation of IL into context dependent models (e.g. digital literacy, media literacy, environmental literacy) in part is based on the idea that IL is a teaching and learning methodology which focuses on the role of IPS in gaining domain knowledge. Other models including UNESCO (Horton, 2007) define these contexts as a way of compartmentalizing specific IL skill and conceptual knowledge. The idea of context is relevant to this literature review in that the impact of the digital environment and digital documents are of key to understanding the role that metadata plays in the reviewed IL models. Section 3.4 discusses this role.

### **3.4 The role of metadata in literacy models**

While many of the models include organizational elements such as awareness of information organization structures, document management, document representation and surrogation, the importance of these elements is rarely addressed with specific skills or concepts. Much in the way that the models that have evolved over time now include “technology literacy”, the models reviewed peripherally refer to but do not directly address the impact that the current information environment has on digital document structure. Nor do the models directly address the role that metadata plays in their models. As the literature review on the role of metadata in digital

environments demonstrates, digital forms of information and of interaction regularly employ elements of information organization at the level of the common information participant. As such, the participant is likely to hold a set of skills related to the categorization and classification, representation, and surrogation of information, an understanding of the role of document structures and metadata, and the changing focus from passive forms of literacy including knowing and understanding to active forms of literacy such as creating and sharing. A central focus of the literature review on metadata is how metadata and information organization contribute to these conceptions of literacy. For the purpose of this discussion, this phenomenon will be called metadata literacy.

Metadata literacy is of emerging importance given both the increasing complexity of information environments and the widening definition of documents and information participants' roles in document creation and use. The creation of new information spaces in online environments which emphasize collaborative authorship, creation of new types of documents, and personal management of information resources is placing information consumers/authors in the role of context-generator. The extent to which they utilize metadata and information organization techniques in these environments has a significant influence not only on their personal information space but on the larger information environment. A full investigation of what impact metadata has on IL is left to the review on metadata literacy. The remainder of this review focuses on creating an analytical framework that will allow a guided investigation of the role of metadata in IL environments in the subsequent reviews. Section 4 identifies supporting theories and models for this framework and section 5 pulls together these ideas with the models reviewed to create the framework.

## 4 Supporting theories for an IL framework

As this review indicates, IL is not an area of research confined to a single goal or discipline. The emphasis in IL models on learning and cognition means that there are relationships to educational theory while the grounding in information seeking, processing, and management tie into library and information science. Further, the presence of technology skills and computer science inspired issues such as the impact of digital environments on literacy and the use of information communication technology (ICT) in IL instruction create a connection to computer science. This section reviews these three areas and discusses an analytical framework based on the reviewed models.

### 4.1 IL as an pedagogical approach

Many of the models reviewed included a discussion of specific teaching methodologies that are best suited to create literacy. For example, Sundin's use of a teaching perspective to provide context shows different ways in which literacy is used in information environments. Likewise, the elements of the sociotechnical model assume a social/interactive context and not an isolated research process context. The ALA presidential report (1989) points to a gap between the need for an information literate population and the integration of information literacy into education. "Most current educational and communication endeavors---with their long-standing history of pre-packaging information---militate against the development of even an awareness of the need to master information management skills (Presidential Committee on Information Literacy, 1989)." Further the report calls for a (then) new type of classroom that is more student and information driven, less prescriptive, and more open-ended. UNESCO points to the ideas of IL informed learning as being process rather than product driven and that IL requires both a focus on practical and conceptual skills (Horton, 2007, p. 16). Some of the approaches described for creating these environments include the integration of IL concepts into other areas of the curriculum, problem-based learning, action-learning, and authentic learning. While a review of

all of these techniques is outside of the scope of this literature review, many of the techniques described in the education and school media literature are being adapted for use in higher education environments, sometimes under the concept of blended and embedded librarianship (Matthew & Schroeder, 2006; Story-Huffman, 2006). Many of the arguments of those who advocate for integrated or embedded curricula are based on the concept that IL techniques are necessary precursors to effective learning.

Given the wide variety of information literacy models and the emphasis on teaching and learning in these models, it should be no surprise that there is also a wide body of literature focused on information literacy teaching approaches. Two examples of this include Maybee's (Maybee, 2006) student-centric approach based on students perception of how information is used and Kuhlthau and Todd's (2007) Guided Inquiry approach which focuses on creating inquiry frameworks which both guide students and promote independence. Maybee expresses concern that, "rather than enhancing learning, the current efforts of information literacy programs are often limiting the potential for student learning" (2006, p. 84). In her 2000 UNESCO paper, Bruce discusses four required components of a successful information literacy program (2002): (a) resources to facilitate the learning of specific skills, e.g. Web-based information skills enhancement packages and other point of need, or self paced instruction, (b) curriculum that provides the opportunity to learn specific skills, either early in a course or at point of need, (from self-paced packages, peers, lecturers, librarians) [integrated], (c) curriculum that requires engagement in learning activities that require ongoing interaction with the information environment [embedded], and (d) curriculum that provides opportunities for reflection and documentation of learning about effective information practices [embedded].

There is also literature which views IL as a teaching approach that works in any discipline. Bruce observes that "information literacy is conceivably the foundation for learning in our contemporary environment of continuous technological change" (2004, p. 1), and presents Breviks' idea that we "need to move away from the dominant paradigm of prepackaging information for students in the form of textbooks, lectures and even artificially constrained

multimedia resources, to facilitating active learning using real world information resources” (Bruce, 2004, p. 6). Story-Huffman (2006) comments that the existing ACRL standards provides an easy method for faculty to integrate information literacy into the curriculum.

The idea of IL as a pedagogical approach is supported by the meta-literacy models reviewed and is supportive of the idea that overarching themes such as metadata literacy are relevant outside of specific IPS situations. Further, the methods used for teaching IL both as an end as a means for learning in other domains is an important component of an IL framework. The role of pedagogical theory in conveying these skills are expanded on in the following sections.

## **4.2 Information seeking and learning theory**

While not always explicitly defined, the IL models reviewed and of interest in the subsequent reviews are grounded in learning theories that emphasize individual and social construction of knowledge through interaction with information resources. Although many of the skills defined in these models are based consumer-driven process-based literacies such as the ability to locate a book on a shelf, there are elements of each model which focus on skills and processes in which participants create knowledge and information. Some models focused on individual generation of knowledge (Lupton, 2006) while others focused on the role of social structures in this process (Tuominen, et al., 2005). Because the IL framework being developed takes the perspective that participants create information in a community-based digital environment the constructivist perspective of information creation/use and the implications of social information use need to be considered. These two concepts are investigated here through the theories of constructivism, social constructivism, and social constructionism.

A specific debate surrounding the meaning of the terms constructionism, cognitive theory, cognitivism, and social constructivism is represented in Information Science literature (Hjorland, 2002; Ingwersen, 1992; Talja, Tuominen, & Savolainen, 2005; Tuominen, et al., 2005;

Tuominen, et al., 2003). While the specifics of these views are outside the scope of this literature review, it is helpful to define these concepts as they inform the research design.

#### **4.2.1 Constructivism and cognitive constructivism**

Talja, Tuominen, and Savolainen (2005) use Gergen's definition for constructivism as "a view in which an individual mind constructs reality but within a systematic relationship to the external world" (2005, p. 81). They agree with Gergen's identification of constructivism with theories of Piaget and Kelley and equate this position to the Cognitive theory of Belkin in information science literature (Talja, et al., 2005). The implications of this view are that knowledge is an individual reaction to a complex external environment which is heavily defined by that environment. This is the view held by many information seeking theories which focus on the role of the individual in information seeking. In contrast social constructivist and constructionist theories emphasize the impact and role of social structures in driving information creation and use. In the digital environment, the implications of this element is magnified as socially created information is captured, enhanced, and made available in new forms.

#### **4.2.2 Social constructivism**

Talja, Tuominen, and Savolainen (2005, p. 81) propose a definition of social constructivism which emphasizes both the fact that an individual constructs reality and the concept that the individual is heavily influenced by social and environmental factors. Their association with the work of Bruner and Vygotsky in this area is consistent with Hjørland (Hjørland, 2002, p. 258). While in the education realm, there is less distinction between constructivism and social constructivism, the significance of the social and community versus individual perspectives can be seen in related articles on conversation theory (Scott, 2001) and the relationship of social constructivism and other cognitive theories (Holland, 2006). Social constructivism is apparent in the theory of outsiders by Chatman (1996) and in the information encountering theory of Erdelez (2006). These theories position concepts of information relevance, information tasks, and

knowledge within complex social environments which both expand and constrict individual behavior and beliefs.

### **4.2.3 Social constructionism**

Under the view of social constructionism, Talja, Tuominen, and Savolainen (2005, p. 81) indicate the primary focus of the theory is on the concept of discourse as the method for constructing and understanding the individual. Social constructionism emphasizes the discourse between individuals and information objects which create social and material relationships (Tuominen, et al., 2003, p. 564). The constructionist view informs collaborative creation of information in digital by placing more emphasis on fluidity of the interactions in an information environment. Holland (2006) proposes supplementing both models with the Extended Mind model to discuss the interaction between individuals, social dynamics, and information. The Extended Mind (EM) model (Clark & Chalmers, 1998) suggests that individuals cognition is not only impacted by internal/external environmental factors but are also supplemented by technology tools such as pens/paper, personal computers, etc (Clark, 2001; Clark & Chalmers, 1998; Holland, 2006, p. 93). This perspective is important in the formation of the information literacy analytical framework in that it describes the complex interaction between individuals, digital environments, and surrounding social context and influence of those environments. An example of a EM influenced environment is Del.icio.us (<http://del.icio.us>). This website serves storing, remembering, and aggregation roles for individuals as well as social and community roles such as rating, sharing, and suggesting.

### **4.2.4 A working definition of constructivism**

The importance of the constructivist/constructionist perspective to this work relates to the perspective that digital environments, and by extension the literacy tools required to operate in them, are decreasingly individual in nature. Within the confines of this literature review, constructivism and social constructivism is viewed primarily from an information science and

education-centric perspective which poses the idea that knowledge is personally developed in reaction to the external world (Bruner, 1968). This perspective is informed by Vygotsky (1977) who observes that knowledge was directly tied to language which is in essence a classification system of social norms. Social constructionism differentiates itself from social constructivism in placing the emphasis on relationships over things (verbs over nouns) and is reflected in the work of Dervin (1998) on verb-based information environments.

IL literature draws heavily on constructivist approaches, particularly in regards to its use in educational circles. While it can be argued that the dynamics of social constructionism are not adequately reflected in popular IL models (Tuominen, et al., 2005), both theoretical and practical literature reference the use of both constructivist and social constructivist approaches to IL. In the educational domain, constructivism is based on the idea that students learn best in environments where they are challenged to not only solve the problems that they are given but to also construct the problems in the first place. Constructivism is based on the theories of Bruner (1968), Dewey (1924), and Vygotsky (1977) and is represented in recent works by Brooks and Brooks (2001), Lajoie and Azevedo (2006), and Siemens (2004). Lajoie and Azevedo define constructivist teaching as “the active construction of knowledge in the context of solving realistic problems where learners build knowledge and organize it in a personally meaningful form”(2006, p. 804). This is often referred to as problem-based or inquiry-based learning and typically includes both cognitive and affective aspects. There are a number of studies that investigate the application of constructivist, and active research approaches to information literacy. These studies include research on programs employing embedded authentic research problems (Wopereis, Brand-Gruwel, & Vermetten, 2008), librarian/faculty collaborations (Fosmire & Macklin, 2002; Mitchell, 2007; Weisskirch & Silveria, 2005) and discipline based information literacy approaches (Sharkey, 2006; Walczak & Jackson, 2007).

While a complete discussion of constructivist based approaches to learning is outside the scope of this literature review, it is worth mentioning Kuhlthau’s (1993, p. 6) constructivist based approach to information literacy. In Kuhlthau’s approach the IL teacher should: (a) present an ill

formed process – introduce the students, (b) engage the students through interesting items, (c) include brainstorming, (d) cover mechanics, keep student moving, (e) introduce information search process, encourage exploration, (f) have the students focus their research topic and (g) have students organize ideas for presentation.

Two other ideas in constructivist teaching that are relevant to this discussion are the connectivist approach discussed by Siemens (2004) and the collaborative focus discussed by Lutz and Huitt (2004). Siemens sees ‘Connectivism’ as extending constructivism by realizing that “learning (defined as actionable knowledge) can reside outside of ourselves (within an organization or a database), is focused on connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing” (2004, p. 4). Siemens emphasizes a common theme, that constructivist learning techniques are geared towards teaching ‘how to learn’, viewing learning and knowledge being as much about knowing how to access information as it is about memorization.

A final component of constructivist approaches is a focus on collaborative work. Lutz and Huitt (2004, p. 10) point to four required components of collaborative learning: (a) there must be cooperative interaction among groups, (b) group incentives must be provided, (c) there must be individual accountability, and (d) there must be an equal opportunity for all students to earn high scores and contribute to the group effort. The necessary inter-relationship between understanding and categorization/organization means that, as part of each of these detailed stages, students are encountering information and making decisions about keeping, organizing, and re-finding it. When perceived within the context of a social learning environment, collaborative digital libraries can be used as a place to collectively participate and share information where other learning platforms cannot. Constructivism both informs the view of the participant as an active contributor and socially-embedded actor in the IL framework and serves as the foundation for discussing the role of metadata in supporting learning and cognition in the reviews on metadata and metadata literacy. The following literature reviews will return to the concept of Extended Mind as a way of investigating the role of metadata in IL.

### 4.3 Digital culture's influence on IL

As stated in the ACRL, AASL, and Seven Pillars models, information technology (IT) skills are essential components but not the core components of IL. These models adopt the perspective that technology skills are descriptive in nature and do not influence the core skill sets of definition, refinement, synthesis, and evaluation which represent the more conceptual elements of IL.

In the traditional world of print-based information systems, a relatively static set of library research skills easily served the skill-need of an IL environment. A 1936 IL publication on using the library included into ten sections: The Card Catalog, the Dewey Decimal Classification, Document elements, Tables of contents/indexes, and six areas focused on resource specific access (Broening, Law, Wilkinson, & Ziegler, 1936). Since this publication, a number of conceptual and technological developments related to information organization, classification, and use has had significant impact on IL issues. Two major thinkers who are often cited in research to help us conceptualize the new information environment are Vannevar Bush (1945) and Buckland (Buckland, 1991). In recent years, Internet search engines, Online Catalogs, and folksonomies have all had significant impacts on how information is conceptualized, created, used, and preserved.

While some IL models sought to abstract themselves from technology, others viewed technology as a central element. In the Big6 model for example, Johnson and Eisenberg found that information and computer literacy work well together when they “(1) directly relate to the content area curriculum and to classroom assignments, and (2) are tied together in a logical and systematic information process model” (2006, p. 1). They continue, observing that “there is increasing recognition that the end result of computer literacy is not knowing how to operate computers, but to use technology as a tool for organization, communication, research, and problem solving. This is an important shift in approach and emphasis.”

More significantly, the advent of digital information has also led to a re-conceptualization of documents and data structures. One example of this change is the growth of the concept of metadata from the field of document representation. Metadata in the library world began as bibliographic records on index cards and has grown into complex standards with content, context, and encoding guidelines. Another example is the shift in the web environment from static HTML pages to collaborative authoring spaces. These resources are significantly different from the documents that they are replacing. As a result, it can be expected that the IL skills required to find, use, preserve, and evaluate these documents must also be different. In recognition of these developments, the Educational Testing Service (ETS) has recently revised their technology skill test to better evaluate participant's abilities in data use and analysis. The iSkills test evaluates student's abilities to use their critical thinking skills in a technology rich environment.(ETS, 2007). The iSkills test has been mapped onto ACRL's information literacy standards by the ETS (ETS, 2008). This mapping document maps three metadata activities related to harvesting and extraction onto ACRL skill 5 "The information literate student extracts, records, and manages the information and its sources" (2000).

The theme of the impact of technology on IL approaches is readily seen in the IL models reviewed. Bruce's (1997) seven faces of information literacy, Tuominen, Savolainen, and Talja's (2005) sociotechnical model, and Hughes and Shaprio's (1996) model emphasize the relationship of technology to literacy. As was mentioned in section 4.2 on the connection between IL and learning theory, this connection is being realized in education practices which emphasize student interaction with technology in authentic environments during learning. Mitchell for example (2007) investigated student use of digital libraries as learning tools, Lotherington (2003) posed a postmodern model for IL based on digital documents, and Skarkey (2006) discusses a technology informed IL curriculum. The use of these approaches provides insight into how to employ IL models in classroom environments.

## 5 A theoretical framework for investigating IL

Keats and Schmidt (2007) observe in their article on the formation of 'Education 3.0' that the integration of emerging technology, education models, and emerging learner perspectives will create "cross-institutional, cross-cultural educational opportunities within which the learners themselves play a key role as creators of knowledge artifacts that are shared"(2007, p. 2). This supports the ideas expressed in this literature review and represents a vision towards an education environment in which control over the learning process is distributed equitably. This review has investigated both the background of IL research and identified ongoing areas of interest which are relevant to the subsequent reviews. It has probed connections between IL theories and learning, assessment, and information technology. Throughout this review, one major gap that was found was a lack of attention on how to think through a "new" element of or form of literacy. For example, a simple framework does not exist that allows the instructor to design content that includes both the elements the current context of the student and the IL objective.

In concluding this review it appears that despite the substantial research in this area that there are gaps in the research of IL. First, there is an emphasis on expert opinions over user-defined perspective in defining IL models. While some studies created IL models from limited interviews, no studies took as a foundation the work done by the Pew Internet Trust or OCLC (to name to recent examples) which have investigated student perspectives in information use. Second, while the studies reviewed showed awareness of existing models, there was a lack of overall agreement on how to define skills versus concepts in the models. Whether or not a unified theory of IL or metadata-literacy is attainable is unsure. Regardless, none of the models reviewed showed fundamental incompatibilities with each other which would suggest that further research in this area may be fruitful. Finally, while there is a great interest in technology and the impact that technological tools have on IL, there is little research which focuses on the impact of technology informed core information practices. There are, for example, several

models which mention the utility of information organization knowledge in IL frameworks but there was little research which showed that these concepts had been introduced into practice. By addressing the need to more extensively define how information organization and metadata practices inform system design and use in IL environments, this proposed research seeks to identify an approach for thinking about the role of literacy in this environment which will be able to more completely inform the technology-enriched IL curricula that are popularly reported in the literature.

The themes identified in the review of models includes the three facets of skills, concepts, and context and the broader elements of pedagogical roles, information and learning theories, and the impact of digital environments on IL models. By taking as its base the three elements of skills, concepts, and context and viewing the roles of pedagogical style, information/learning theory, and the impact of digital documents and their metadata structure, a simple framework can be designed which will help consider the elements of metadata work with literacy concepts. This framework focuses on three teacher and three participant perspectives within the information literacy area. Teacher focuses tend to be on pedagogy, information and learning theory, and the role that a learning environment plays. Participant or student perspectives tend to focus on specific skills and conceptual knowledge, both of which are related to the context in which these skills and concepts are used. Figure 3 shows the relationship between these concepts by creating a matrix and posing questions at each intersection between the IL categories of skills, concepts, and context and the information/learning categories of pedagogy, theory, and environmental role.

**Figure 3 Information Literacy framework**

	<b>Pedagogical theory</b>	<b>Information and Learning theory</b>	<b>Environmental role</b>
<b>Teacher</b>			
<b>Participant</b>			
<b>Skills</b>	How are skills taught or	What is the underlying	What types of specific skills are

	conveyed?	theory of the value of specific skills?	employed?
<b>Conceptual knowledge</b>	How does the teacher convey concepts?	What role does the concept play in informing a learning or information theory?	What conceptual or generalized knowledge is required in this environment?
<b>Skill/concept context</b>	What are the necessary elements to teach this literacy concept or skill?	Are the assumptions of the theory valid in this given context?	What role does this environment play in this literacy context?

The framework illustrated in Figure 3 works in conjunction with the revised Bloom’s Taxonomy matrix as an evaluative instrument for participant responses to specific examples, making it possible to both define a literacy element and evaluate levels of learning in the application of that element. This framework will be used in subsequent reviews to inform the investigation of the concept of metadata literacy.

What appears clear from the research that has been completed to date is that despite the wide interest in IL as a platform for thinking about how individuals interact with information and learn from that interaction, there is the absence of a single approach for this process. While few researchers emphasized traditional non-electronic approaches to literacy, there was also a notable lack of unification of the concepts of digital environment, organizational structure, and participant interaction. Further, there was a lack of integration between information theory on the one hand and learning theory on the other. In order to move forward with IL research and

fully develop existing models, it is crucial to study technology informed core information practices including specifically the conception of metadata and information organization practices. This topic is addressed in the following reviews by examining the role of metadata in review two, the elements of participation and user perspective in review three and an investigation of a unified metadata-informed model in review four.

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