LITERACY FOR THE KNOWLEDGE SOCIETY

Vittorio Midoro, Istituto tecnologie Didattiche, CNR,
midoro@itd.cnr.it

Introduction

While there are large areas of the world where many people are unable to read and write (fig 1), in the most economically developed countries there is increasing awareness of the need for a new kind of literacy, called *digital literacy*, reflecting the features of the knowledge society.
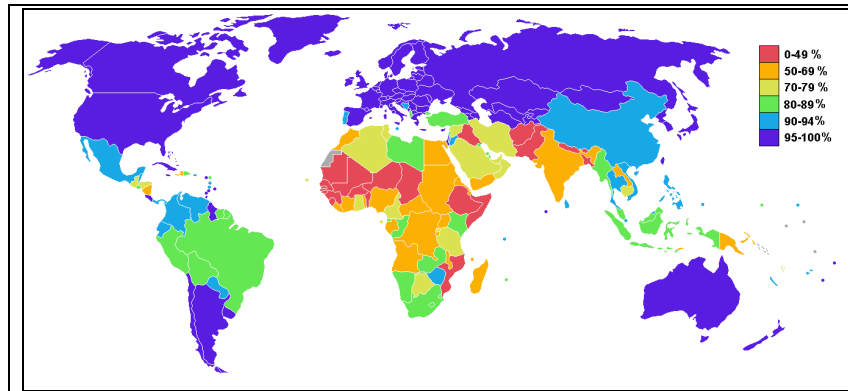

Figure 1. World literacy rates by country (From Wikipedia, the free encyclopedia)

eStart, is an EU-funded project dedicated to the establishment of a Europe-wide network of experts and key stakeholders aimed at providing a communication base for understanding, supporting and promoting Digital Literacy in Primary & Lower Secondary Education across the EU.
The first step in this project is the formation of a partnership to negotiate an operative, shared definition of digital literacy, as a basis for subsequent activities related to teacher education. This paper aims at contributing to this negotiation process.

As in many proposals, the starting point is a reflection on the meanings of the terms involved.

Wikipedia (July 2007) describes *literacy* as follows:

The traditional definition of literacy is considered to be the ability to read and write, or the ability to use language to read, write, listen, and speak. In modern contexts, the word refers to reading and writing at a level adequate for communication, or at a level that lets one understand and communicate ideas in a literate society, so as to take part in that society. The United Nations Educational, Scientific and Cultural Organization (UNESCO) has drafted the following definition: "Literacy is the ability to identify, understand, interpret, create, communicate and compute, using printed and written materials associated with varying contexts. Literacy involves a continuum of learning to enable an individual to achieve his or her goals, to develop his or her knowledge and potential, and to participate fully in the wider society."

This definition covers four main areas
- the context: a literate society
- the scope: taking part in that society
- the specific aims: to understand and communicate ideas
- the skills involved: to read and write, or the ability to use language to read, write, listen and speak

and includes some implicit features:
- scripts pervade a literate society
- illiterate people are excluded from active participation in social life.

Digital is an attribute reflecting one of the main characteristics of ICT, in which programs and data are represented in a binary form.
What does it mean when used to qualify a literacy? the following sections discuss this issue, starting from the meaning of digital documents, which in the knowledge society parallel scripts in the literacy society.

Digitals documents

A technology implies three basic elements: 1. processes (theories, models, methods, techniques, procedures, etc.), 2. systems which implement these processes (tools, machinery, etc.) and 3. a class of products, manufactured by means of these systems.

Writing can be considered a technology that emerged to face different social needs.
Historically, writing processes and systems evolved across the world in different ways, and have developed to the point of pervading almost all human activity.

In addition, in literate society scripts are the class of products of writing technology; in the knowledge society, digital documents are a class of products of ICT and their nature contributes in determining the framework of capacities needed to master them. Let's see then some of the main characteristics of digital documents.

Producing, storing, searching and using

In the case of written scripts, the functions of producing, storing, searching and using are rigidly separate, while for digital documents these functions are strictly linked together, as they are handled using the same digital system..

Multimediality

Digital documents support different communication channels. So a digital document can be a text, a still image, a movie, a sound and all possible combinations of these. The possibility to integrate different communication channels makes digital documents intrinsically multimedia.

Hypermediality

Any digital document, or parts of it, can be linked to any other digital document, or parts of it. This fact breaks the boundaries

of a single document and requires us to reconsider the concept of document boundaries.

Reproducibility and reuse

Digital documents, or parts of them, can be easily and cheaply duplicated and reused.

Transmissibility and accessibility

Digital documents are easily accessed/transmitted without time or space constraints.

Dynamic nature, modifiability easy to process

Digital documents are easily to modify, format and, in the case of texts, print. Some documents, such as electronic magazines and newspapers, have an intrinsic dynamic character, which enables instant updating and enrichment with comments from readers. Some digital documents are produced collaboratively and can develop over time, Wikipedia being a prime example. Another example of the dynamic nature of digital documents are dynamic web pages, whereby a human author defines a template and then provides contents as required, while a software system handles the integration of the two. Moreover digital documents can be easily processed by computer programs for a variety of useful purposes.

Computability and interactivity

In computer science, both data and programs are represented as sequences of 0 and 1, the difference lying in their interpretation. Something similar also happens for digital documents and executable programs, where the boundaries between digital documents and executable code is not sharply defined, as in the case of documents produced by word processors, which can embody macros, spreadsheet excerpts, etc. As a consequence, a further characteristic can be added to digital documents: interactivity. The user can interact with a digital document, and the interaction can take different forms. A document can be adaptive, accommodating to the user's be-

haviour according to a user model, and also reactive, reacting to a user input according to some computational model etc.

Context and scope of digital literacy

Scripts are used to perform different social functions:

- Recording. This is one of the first functions of writing (Uruk tablets list sacks of grain and heads of cattle, (1987, Jean)) and consists in recording facts and events in script, saved in suitable archives.
- Coding. Since the beginning of writing, scripts were used to codify commandments, laws and knowledge, as in the case of codes and manuals.
- Communicating. In this case, scripts encapsulate messages and news, supporting mainly unidirectional communication.
- Conversation. Here scripts support a *conversation,* meant not only as the exchange of letters, but also as a record of negotiation processes (Pask, 1975.).
- Expression. Here, scripts refer to all kind of literature production such as poetry, novels and plays.

Of course, there are cases where these functions are strictly linked and cases where a neat classification is difficult.

For each of these functions to be implemented in a literate society, , a complex system is required that has been developed across the ages according to the available technologies. *Recording* requires a system of archives, *Coding* and *Expression* the publishing industry, the book shop and library systems, *Communication* the press and news systems, *Conversation* the mail system.

Conversely, systems for producing and using digital documents (such as electronic mail, database programs etc.) are strictly integrated, distributed in space and usable anywhere anytime.

From its original context of writing and reading, the concept of literacy has now widened to cover different sectors of human and social life. Some of the more commonly cited examples of "new literacies" are visual literacy, media literacy, numerical literacy, technology literacy, network literacy, and ICT literacy.

The evolution of the concept of literacy in each of this sectors can be reconstructed in the same way as for reading and writing . In these cases, literacy means the capacity to satisfactorily operate inside a given community, using the technological repertoire of the considered area; as Belisle (Belisle, 2006) points out,

the concept of literacy has meaning only in terms of its social context.

What is the context of *digital literacy*? The knowledge society, in which ICT supports the main functions of social life. The attribute *digital* is transferred from the technologies used to the literacy required to live in such a society. It would be better to talk of *literacy for the knowledge society*, but since *digital literacy* is currently used, in the following both expressions will be used interchangeably.

In our society, knowledge is the main driving force, continuously increasing by means of a collaborative process. In this society, *digital literacy* can be interpreted as an individual identity (or as the process determining it), which not only allows an individual to effectively operate in society, but also to participate in its development. This participation takes places through the performance of social functions, by means of effective use of the available technologies and resources.

But what are the functions and the characteristics of the knowledge society relevant for understanding the features of this identity? The functions include all those mentioned above when examining literacy in its entirety (recording, coding, communicating, conversation and expression), but with essential differences due to the different nature of scripts and digital

documents, to the different underlying technologies and to different organisations. In the knowledge society we are witnessing the emergence of <u>new functions</u>, that differ from those typical of the *material economy*, as well as <u>new ways</u> of developing knowledge.

In the *material economy* the engine generating value has been technology, markets and decisions on resource allocation, while in the knowledge society the engine is knowledge (Rullani, 2005)

An approach is required which allows us to explore the new, giving meaning and value to possible experiences. This can be done by means of the **knowledge economy**, in which value is produced by building the world of possibilities and creating shapes and values which are not necessarily a response to immediate need, but are a result of **imagination**, **communication** and **sharing**.

Knowledge becomes the true engine of society and the economy. Let us examine some of its more relevant features so as to detect the characteristics of a literacy suitable for the knowledge society, where knowledge growth is accelerating at a tremendous pace, not only due to ICT development, but above all to emerging ways of accessing, sharing and producing new knowledge.

Accessing knowledge

The web is becoming the predominant place for finding information and knowledge. Because everyone can make their own information available on the web, the issue of being able to find the right information for a given task has become a crucial one.

Sharing knowledge

The widespread diffusion of software and hardware tools for sharing music, video, pictures, links, etc. is a reflection of web users' strong interest in sharing not only commodities but also

ideas, feelings and knowledge embodied in digital documents. The huge development of the blogsphere testifies this desire to share parts of one's inner world. This wish is the essence of what is called Web 2.0.

Creative Commons are another example of this wish to share knowledge. Here a new conception is growing of what constitutes value on the web: not immediate financial revenue, but visibility, measurable by means of number of accesses to given documents.

A further example is the MIT OpenCorseWare project, which is aimed at providing free, searchable access to MIT's course materials for educators, students, and self-learners around the world, while at the same time extending the reach and impact of the "opencourseware" concept itself. Other examples include the EU eContent programme, and the project initiated by the UK's Open University to make all its materials available through the web.

Sharing knowledge, ideas, feelings across the web makes the prospect of a collective distributed intelligence, as described by several authors like Levy and Seely Brown, a very real one .

Collaborative production of knowledge

Collaborative production of knowledge inside a community of practice is not a new process, but nowadays knowledge is increasing exponentially by means of the Internet, which connects people and ideas easily. The web has catalysed the birth of many virtual communities, which cooperatively develop new knowledge, as real communities of practice. Examples are the open software community and the free software movement.

An exemplar case of this new willingness to be involved in a collective development of knowledge is that of the mathematician Grisha Perelman. He made available a solution of a very

important topological conjecture, the Poincaré conjecture, not bothering about the fact that someone might steal his idea:

> If I made a mistake and somebody used my work to arrive to a correct solution, I am happy, since I don't care to be the only solver, but that the Poincaré is solved.

The last example, taken from Wikipedia, is Commons-based peer production

Yochai Benkler describes Commons-based peer production as a new model of economic production in which the creative energy of large numbers of people is coordinated (usually with the aid of the internet) into large, meaningful projects, mostly without traditional hierarchical organization or financial compensation.

The digital literacy dimensions

In a literate society, the objective of literacy is to understand and communicate ideas adequately by means of scripts. In the knowledge society, literacy should take into account new needs and available technologies. Two new interrelated levels are built on the foundations of traditional literacy:

1) The capacity to operate in the world of digital documents, to tackle tasks and solve problems. As in a literate society, it is important to know how to read and write, but in the knowledge society it is <u>also</u> important to know how to produce and use digital documents.
2) The capacity to participate in the process of knowledge building. As in a literate society, it is important to be able to listen and speak but in the knowledge society it is <u>also</u> important to access, share and collaboratively produce knowledge.

Let us briefly discuss these 2 points

Operating in the world of digital documents

Operating within the knowledge society, an individual faces tasks requiring the production and/or use of digital documents to perform social functions. Therefore, s/he has to be familiar with the intrinsic characteristics of digital documents, which may differ according to the different tasks. In addition, the individual has to know how to choose the most suitable documents (and related production and use programs) according to different needs, and also to know how to use these programs to produce and use digital documents.

Understanding the characteristics of digital documents
As digital documents are intrinsically multimedia and hypermedia in nature, a digital-literate individual needs to have a strong grasp of these characteristics.
Multimediality involves being able to operate with documents (decoding, producing, using, etc.) supported by different communication channels (*media literacy).*
Hypermediality implies being able both to navigate purposefully in the digital world without getting lost, being able to reach the aim which generated the navigation, and to produce hypermedia documents, with meaningful links to other documents.
These processes require continuous reflection on one's cognitive activity (metacognition).

Choosing the right applications according to the task (function) to be accomplished
Digital literacy involves being able to choose the most appropriate digital documents and related applications for performing the different functions of social life (e.g. recording, coding, conversing, expressing).

Mastering the different applications
This area of mastery concerns the technical capabilities to produce, store, transmit and use digital documents using the available technology (hardware and software) (*ICT literacy*).
By doing this, the individual is able to fully exploit the charac-

teristics of reproducibility, reusability, modifiability, computability and interactivity typical of digital documents.

Participating in knowledge construction

To be involved in the construction of new knowledge, an individual should be able to access and share knowledge, as well as be able to cooperate in the construction of new knowledge.

Accessing information and knowledge
Accessing and navigating information and knowledge is so important that some authors identify it as the new literacy.

> *What I want to suggest, though, is that the new literacy, the one beyond just text and image, is one of information navigation. I believe that the real literacy of tomorrow will have more to do with being able to be your own private, personal reference librarian, one that knows how to navigate through the incredible, confusing, complex information spaces and feel comfortable and located in doing that. So navigation will be a new form of literacy if not the main form of literacy for the 21st century (1999, Seely Brown).*

This competence area is often referred to as *information literacy:*

> *…knowing when and why you need information, where to find it, and how to evaluate it, use and communicate it in an ethical manner (Irving and Crawford, 2007)*

This capacity requires a number o different abilities (Caviglia and Ferraris 2007). First of all, being able to focus the information requirement, to formulate the problem and to identify the available resources. Then, knowing how to search for information on the web, formulating hypotheses, translating the information problem into a web search. Moreover, knowing how to use the results found, integrating the information in the framework of personal beliefs and knowledge. Finally, being able to reflect on one's own process of information searching, and to evaluate its reliability (metacognition).

Sharing knowledge

This competence area involves the exchange of digital documents of various kinds (text, music, videos, photos) so as to make one's own experience available to others and to draw directly on their personal experience. As such, it does require a certain level of technological know-how in order to use a range of tools and artefacts effectively. However, knowledge sharing involves much more than this. It presupposes strong motivation to share ideas, feelings and artefacts. It also involves the ability to participate in the life of interest communities that can form through the use of tools such as blogs, calling on the capacity to attract attention and the ability to respect the community's participation codes. The willingness to open up one's own document repositories to others is a key factor in fostering the sharing of knowledge.

Cooperative production of knowledge
The cooperative construction of knowledge on the web takes place mainly within virtual communities of practice, often supported by Computer Mediated Communication (CMC) systems. A community of practice implies a common enterprise, a set of mutually related individuals and a shared conceptual and procedural repertoire. The capacity to operate in relation with the other members of the community along with the mastery of the repertoire are prerequisites for full participation in the practice of the community. During this practice, individuals create new objects (documents, concepts etc.) and new procedures, which enrich the shared repertoire and the knowledge distributed within the community.

Summing up, digital literacy involves several dimensions and, according to the approach outlined above , the following operative scheme has been assumed:

- *Understanding the characteristics of digital documents (**media literacy**)*
- *Choosing the right applications according to tasks (functions) to be accomplished (**problem solving in an ICT environment**)*

- *Mastering the different applications (**ICT literacy**)*
- *Mastering information problem solving, using methods and tools for accessing information and knowledge (**information problem solving, information literacy**)*
- *Being able to share information and knowledge in an ICT environment (this capacity is a prerequisite for building a **distributed collective intelligence**)*
- *Capacity to participate in the life of virtual communities of practice by constructing knowledge in virtual environments in a cooperative manner (**cooperative work, cooperative learning in an ICT environment**)*

All these dimensions are interdependent and strictly linked .

The multidimensionality of digital literacy seems to be a shared understanding. For example, Tapio Varis proposes the following dimensions (Varis 2005):

> *Technology Literacy:* The ability to use new media such as the Internet to access and communicate information effectively.
> *Information Literacy*: The ability to gather, organize and evaluate information, and to form valid opinions based on the results.
> *Media Creativity:* The growing capacity of citizens everywhere to produce and distribute content to audiences of all sizes.
> *Global Literacy:* Understanding the interdependence among people and nations and having the ability to interact and collaborate successfully across cultures.
> *Literacy with Responsibility:* The competence to consider the social consequences of media from the standpoint of safety, privacy and other issues

Moreover, Allan Martin proposes (Martin, 2006) the following dimensions:

a. awareness of the ICT and information environment;
b. confidence in using generic ICT and information tools;
c. evaluation of information-handling operations and products;
d. reflection on one's own e-literacy development;
e. adaptability and willingness to meet e-literacy challenges.

There are large areas of intersection among these definitions. However, whatever conceptualisation we may choose, deep

understanding of the abilities required by each of these dimensions remains a theme for further research.

Becoming digital literate

What is the process of becoming digital literate?

José Manuel Pérez Tornero (2003) states:

> *digital literacy is not just a simple operative and technical consciousness that is made up of nothing more than technical knowledge. Digital literacy is the complex acquisition process of an individual of humanity combined with their abilities and intellectual competencies (perceptive, cognitive, emotive) and practical competencies physiological and motor). These correspond to the technological transformation of the last decades in the twentieth century – the technological change of the Information Society. To reduce digital literacy exclusively to the skills of using a computer is a crude simplification and a loss in meaning. Using a computer requires diverse and complex previous knowledge. It also introduces the individual and humanity to new contexts, which demands mental, intellectual, profound and complex changes. In essence, digital literacy is a complicated process that consists of acquiring a new tekne. This Greek term means the ability of art or craft by an individual or humanity. We are facing the transformation of the most profound tekne that humanity has ever experienced.*

This process should start at the very beginning, in primary school, and, as personal identities are linked to the dynamics of the knowledge society, should last all life long. Hence the importance of all those forms of formal and informal learning called Life Long Learning.

The eStart project focuses on digital literacy, seen as a process, in the first years of formal learning and aims at promoting a community of practice whose common enterprise is supporting and promoting digital literacy in primary and lower secondary school.

Key ideas

As in the literate society knowing how to read and write is a pervasive prerequisite for all educational activities and the starting point for any formal education, so, in the knowledge society, digital literacy is becoming an essential prerequisite in learning processes and a necessary starting point for formal education. Accordingly, given that in a literate society children learn how to operate with scripts (reading and writing) from the earliest years, so, in the knowledge society, they should learn to operate with digital documents, using and producing them. This implies an enormous change in education systems, involving a complete rethink of school contents, methods and structures.

Contents
Contents are related to the six dimensions mentioned above (media literacy, problem solving in ICT environments, ICT literacy, information literacy and information problem solving, knowledge sharing, cooperating in a community of learning and/or practice). These dimensions are strictly interconnected and, at least at beginning, the learning process should involve all of them in a integrated way. Reading and writing abilities should be developed in learning environments permeated by ICT, in situations in which (multimedia and hypermedia) digital documents are used and produced. This implies rethinking how children are expected to learn reading and writing; it also means developing learning methods and techniques aimed at extending the capacity to understand and express ideas beyond scripts, encompassing the use and production of multimedia and hypermedia digital documents.

Methods
In accordance with the above-mentioned contents, digital literacy should, at least initially, be developed in the context of cooperative learning projects. In these projects learning takes place within a learning community, by sharing a common task aimed at creating a product, a service or a solution to a given problem. These products or solutions take the form of digital

documents. The practice of the learning community takes place in a learning environment embedding ICT. While operating within a learning community, children face problematic situations, which may require them to search the web and share ideas and feelings with other children, as well as to use and create hypermedia digital documents. This cooperative approach embodies several pedagogical models such as social constructivism, situated learning, cognitive apprenticeship, anthropological theories of communities of practice, activity theory, etc. Working within a learning community, any child can express their own personal learning needs, which depend on personal learning style, affective needs and motivations. Here an important feature of the digital literacy process emerges: personalisation. There is no conflict between cooperative learning and personalisation, since one complement the other, as in a learning community there is a difference in roles and cognitive identities. It should be noted that the present assessment system does not appear suitable for evaluating the higher order competencies implied by digital literacy such as critical thinking, respectful minds, the ability to construct new knowledge and so on. New formative evaluation tools such as personal portfolios, peer reviews etc. should replace traditional techniques and tools for assessing learning.

Structures
To fulfil the requirements posed by the above-described approach, the classroom needs to have structural and organisational characteristics supporting the practice of the community of learning. The space should be configurable according to the activities to be accomplished. This implies, for example, that all the objects in the classroom should be easily movable and configurable to create either common work areas or personal spaces for individual work. In this classroom organisation, desk and seats can be easily moved and assembled in different ways, computers (possible one per child) should be small and portable, with no electrical cables (fast, wireless connections and sets of batteries available), print, copy and projecting devices available etc. Of course, further learning

spaces should be available for the children in the school, so that they can express themselves in forms other than those involving ICT, such as physical activities, theatre, games, etc.

Conclusions

The aim of this paper is to present an operative definition of digital literacy, to contribute in defining the requirements of contents, methods and structures needed for implementing it in the classroom and to define a related professional profile for teacher education.

Starting from the analogy (similarities and differences) between scripts and digital documents and from the features of knowledge growth in the knowledge society, the characteristics of a literacy suitable for this kind of society (digital literacy) have been discussed.

According to many authors, digital literacy can be described as a multidimensional concept. Herein, six dimensions are proposed, namely media literacy, problem solving in ICT environments, ICT literacy, information literacy and information problem solving, sharing knowledge, cooperating in a community of learning and/or practice.
Each of these competence sectors is a research area, and the proposals of frameworks and actions should take into account the related state of the art.

Finally, content areas, learning methods and classroom organisations have been briefly mentioned, in relation to primary and lower secondary education.

Thus far, no mention has been made of the issue of the *digital divide*, a very important issue related to digital literacy. In the knowledge society, those who have no access, or are unable to effectively operate in a digital environment, are in the same position as illiterate people in a literate society. Digital literacy does not guaranty happy lives, but being digitally illiterate ex-

cludes individuals from many social activities and deprives them of an important source of empowerment.

References

Belisle C., 2006, "Literacy and the digital knowledge revolution", in Digital Literacies for Learning, edited by Allan Martin and Dan Madigan, Facet Publishing, London

Caviglia F. and Ferraris M., 2007, Rete e apprendimento:utenti esperti di fronte a un problema informativo, atti DIDAMATICA.

Irving C. and Crawford J., 2007, A National Information Literacy Framework Scotland, www.caledonian.ac.uk/ils/framework.html (last access July 2007)

Jean G., 1987, "Writing, the story of alphabets and scripts", Thames and Hudson.

Martin A., 2006, "The landscape of Digital Literacy" Glasgow DIgEuLit project, www.digeulit.ec

Pask G., 1975, "Conversation, Cognition and learning", Elsevier, Amsterdam e NY.

Rullani E., 2005, L'Economia della Conoscenza: intervista ad Enzo Rullani - 16/09/2005 (last access July 2007)

Seely Brown J., 1999, Learning, Working And Playing In The Digital Age, http://serendip.brynmawr.edu/sci_edu/seelybrown/ (last access July 2007)

Tornero P., Manuel J. (2003), "Understanding Digital Literacy" Promoting Digital Literacy, Final report EAC/76/03

Varis T., 2005, New Literacies and e-Learning Competences, http://www.elearningeuropa.info/directory/index.php?page=doc&doc_id=595&doclng=6