

Towards a Theory of Digital Literacy: Three Scenarios for the Next Steps

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Abstract

This paper focuses on the discussion of the digital literacy skills that are considered necessary for effective and mindful learning in the emerging digital environments. To date, the discourse on this important subject has been practice-oriented, and lacks a sound integrative framework and theoretical foundation. This grave lacuna in the current discourse on learning in general, and on learning in the digital culture in particular, calls for a clear and theoretically-grounded view of the basic literacies required for effective learning in digital environments. Accordingly, this paper reviews an integrative framework for digital literacy recently suggested by Eshet-Alkalai (2004; 2005) as a starting point for the much-needed theorization. Two basic strategies – the conservative and the skeptical – are considered for this purpose. The first strategy relies on the basic assumption of the current discourse that "digital skills" are indeed nothing but skills. The second strategy, based on doubts concerning this assumption, leads to two different skeptical hypotheses. The first contends that the skill-oriented discourse can be reduced to the older discourses on learning styles and multiple intelligences; the second attempts to reduce it to the much more fundamental discourse on the clash between the modern book-based and the post modern digital cultures.

Introduction

The rapid development of digital technologies in the digital era presents individuals in the emerging information society with situations that require them to employ a growing assortment of cognitive skills in order to perform and solve problems in digital environments. These skills are often referred to as "digital literacy" (Gilster, 1997; Inoue et al., 1997; Lanham, 1995; Pool, 1997), which is presented as a special kind of mindset that enables users to perform intuitively in digital environments, and to easily and effectively access the wide range of knowledge embedded in these environments (Gilster, 1997; Tapscott, 1998; Eshet-Alkalai, 2004; 2005).

Digital literacy is usually conceived of as a combination of technical-procedural, cognitive and emotional-social skills. For instance, using a computer program is conceived as involving procedural skills (e.g., handling files and editing visuals), as well as cognitive skills (e.g., the ability to intuitively decipher or "read" visual messages embedded in graphic user interfaces). In the same way, data retrieval on the Internet is conceived of as a combination of procedural skills (working with search engines) and of cognitive skills (evaluating data, sorting out false and biased data, and distinguishing between relevant and irrelevant data). Effective communication in chat rooms is conceived of as requiring the utilization of certain social and emotional skills. With the increasing exposure to digital working and learning environments, digital literacy has been conceived as a "survival skill," a key that helps users execute complex digital tasks effectively.

The above description is a summary of the numerous current approaches to the concept of digital literacy. Like any other popular catchword, recent uses of the term vary widely, ranging from the purely technical or procedural realm (e.g., Bruce & Peyton, 1999; Davies et al., 2002; Swan et al., 2002), to cognitive, as well as psychological and sociological meanings (e.g., Gilster, 1997; Papert, 1996; Tapscott, 1998). This creates ambiguity and leads to misunderstanding, misconception, and miscommunication among those who design and produce digital environments (Norton & Wilburg, 1998).

In recent years, extensive efforts have been made to describe and conceptualize the cognitive skills that users employ in digital environments (e.g. Burnett & McKinley, 1998; Cothey, 2002; Hargittai, 2002a, 2002b; Wang et al., 2000; Zins, 2000). Unfortunately, these endeavors are usually local, focused on selected skills, and often limited to information-seeking (e.g. Marchionini, 1989; Zins, 2000); therefore they do not provide complete coverage of the scope of digital literacy.

In order to improve our understanding of "digital literacy" and provide professionals, designers of digital environments, and educators working with ICT with better guidelines for design and education, there is a need for a refined framework for the concept that is as exhaustive, coherent, and parsimonious as possible. Eshet-Alkalai (2004; 2005) has proposed a new conceptual framework for digital literacy, which attempts to meet these requirements, at least to the extent possible in light of the given practice-oriented literature. This framework comprises five types of literacy skills: (a) photo-visual literacy; (b) reproduction literacy; (c) information literacy; (d) branching literacy; and (e) socio-emotional literacy.

This list is conceived as a practical framework, derived from years of experience in the research and design of digital environments for youth and adults, as well as an analysis of recent literature on the subject, and based on a pilot study of the performance of scholars in different types of digital tasks (Eshet-Alkalai, 2004; Eshet-Alkalai & Amichai - Hamburger, 2004). Although certainly not the only list of digital skills, (see Gilster, 1997; Hargittai, 2002a, 2002b; Tapscott, 1998), we believe that this framework covers the most meaningful types of skills that users employ while effectively and mindfully working in digital environments.

The practice-oriented literature about digital literacy stems from the experience of designers and educators working with students on ICT, and still lacks a theoretical foundation. In the works of Eshet-Alkalai (2004) and Eshet-Alkalai & Amichai - Hamburger (2004), the very first steps are taken in the necessary direction: the integration of different digital skills into a coherent framework, and their testing in empirical studies. The present paper is an attempt to develop a theoretical framework for the discussion of digital literacy, by considering and analyzing the major topics, questions, and research directions that should be rigorously tackled in order to produce a better-developed scientific and education-oriented approach.

Two main strategies, derived from the current literature on digital literacy, serve as the basis of this

endeavor. The first, referred to as the "naïve" or conservative strategy, takes the view presented in recent literature at face value. It accepts the basic assumption that what we are dealing with is a number of separate skills. Consequently, this approach leads to an outline of the steps to be taken beyond the primary development of a *prima facie* coherent list of skills. These include among other things, a thorough analysis of the skills and their nature, their interrelationships, and the resulting implications for educational and technological developments.

The second strategy, in contrast, is skeptical. It stems from doubts regarding the assumption underlying the conservative strategy, and from a hypothesis that beyond the list of digital skills lies something much deeper. In the present paper we present two versions of this skepticism. The first holds that the different sets of digital literacy skills actually represent different learning styles (in terms of Dunn & Dunn, 1993), intelligences (in the sense coined by Gardner (1993a), or personality types (Briggs & Myers, 1987; Cattell et al., 1970). The second, even more skeptical view, contends that there are actually two different categories of "skills," which are logically and empirically incompatible and, in fact, represent two different cultures. It is related to the work of writers such as Tapscott (1998) and Negroponte (1995), who refer to digital culture, on the one hand, and book-based culture, on the other, as comprising different epistemologies and values.

According to the first, moderate skeptical view, the literature on digital literacy should become part and parcel of the body of work on learning styles, multiple intelligences, or personality types. According to the second, it is the tip of the iceberg of literature on the "clash of civilizations," which describes the transition of western societies from book-based, rational, individualistic culture to the digital, audio-visual, culture characterized by saturation or disintegration of the self.

It could be said that while the first naïve or conservative approach is built on unquestioning adherence to the basic supposition of the current discourse, the two skeptical approaches are actually attempts at deconstruction of this discourse and its reduction to more logical basic assumptions.

The present paper does not presume to indicate which of the two strategies or three approaches is correct, or even more probable. Exploring each of the strategies and approaches requires a research project that would extend much beyond the scope of one paper. We simply present these strategies and approaches as possible starting points for transforming the discourse on digital literacy, which until now has been merely practice-oriented, into a source of rich theoretical and empirical research. We leave it to the readers and to future discussion of the issue to decide which path should be followed.

We begin our discussion with a review of Eshet-Alkalai's (2004; 2005) classification of digital literacy into five main groups and the pilot research (Eshet-Alkalai & Amichai - Hamburger, 2004) on these literacies. We believe this to be a good, coherent, and parsimonious (though certainly not the only possible) presentation of the dominant views on this issue at the moment (cf. Gilster, 1997; Ba et al., 2002; Hargittai, 2002a; 2002b; Tapscott, 1998). In the second section, we present and discuss the first "naïve" or conservative strategy and in the third, the two approaches as derived from the skeptical one.

Digital Literacy- An Integrated Model of Skills

This section reviews the conceptual framework of Eshet-Alkalai (2004; 2005), and briefly reports on trends found by Eshet-Alkalai & Amichai - Hamburger (2004) in their empirical study of the performance of users from different age groups of tasks that require the utilization of the five types of digital literacy.

In 2004, Eshet-Alkalai published a 5-skill holistic conceptual model for digital literacy (Eshet-Alkalai, 2004), arguing that it covers most of the cognitive skills that users and scholars employ in digital environments, and therefore provides scholars, researchers and designers with a powerful framework and design guidelines. Today, this model is considered one of the most complete and coherent models for digital literacy (Akers, 2005), and it was also included among the pivotal models for digital learning in the *Encyclopedia of Distance Learning* (Eshet-Alkalai, 2005). The five cognitive digital literacy skills that comprise the model are:

Photo-Visual Literacy - Learning to Read from Visuals

According to Eshet-Alkalai (2004), the evolution of digital environments from text-based, syntactic environments to graphic-based semantic ones (Nielsen, 1993; Springer, 1987) makes it necessary for modern scholars to employ cognitive skills of "using vision to think" (Mullet & Sano, 1995; Shneiderman, 1998; Tufte, 1990) in order to create photo-visual communication with the environment (Margono & Shneiderman, 1987; Nielsen, 1993). This unique form of digital literacy – **photo-visual literacy** – helps users to intuitively and freely "read" and understand instructions and messages that are displayed in a visual-graphical form. Prime examples of utilizing photo-visual skills in digital environments can be found in the deciphering of graphic user interfaces (Opperman, 2002) and playing modern computer games, in which all instructions are provided by means of graphical representation by symbols and icons. Successful photo-visual scholars usually have good visual memory and strong intuitive-associative thinking, which is useful in understanding visual messages.

Reproduction Literacy: The Art of Creative Duplication

The modern digital technologies provide scholars with new possibilities for creating art and academic work by reproducing and editing texts, visuals, and audio pieces (Benjamin, 1994; Gilster, 1997). Besides the ethical and philosophical questions regarding the limits and criteria for legitimate genuine use of digital reproduction, the digital reproduction technologies require modern scholars to master a special kind of digital literacy, which Eshet-Alkalai (2004) calls reproduction literacy. Digital reproduction literacy is defined as the ability to create new meanings or new interpretations by combining pre-existing, independent shreds of information in any form of media – text, graphic, or sound (Gilster, 1997). Reproduction literacy is essential in two major fields (Mason, 2002): writing, where pre-existing sentences can be reorganized and rearranged to create new meanings; and in art, where pre-existing audio or visual pieces can be edited and manipulated in order to create new works of art (as in the case of the pop art or of the Internet artist, Darko Maver, 1998). Labbo et al. (1998) describe problems that learners face in digital reproduction of text in a variety of work situations, and contend that digitally reproduction-literate scholars have good syncretical and multidimensional thinking that helps them discover new combinations for arranging information in new, meaningful ways.

Branching literacy: Hypermedia and thinking or multiple-domain thinking

The non-linear nature of modern hypermedia technology has introduced computer users to new dimensions of thinking, which are necessary in order to make educated use of this elaborate technology. In the past, the limited, non-hypermedia-based computer environments enhanced a linear method of learning, which was dictated by the inflexible operating systems, and by the fact that users were used to

books, and expected to work with digital environments in much the same way as they read books. The modern hypermedia environments, such as the Internet, multimedia environments, and digital databases, provide users with a high degree of freedom in navigating through knowledge domains. At the same time, however, they present users with problems that involve the need to utilize non-linear information-seeking strategies and to construct knowledge from independent shreds of information that were accessed in a non-orderly and non-linear way (Burnett & McKinley, 1998; Jansen & Pooch, 2001; Schank, 1984; Zins, 2000). Spiro et al. (1991) and Rouet and Levonen's (1996) cognitive flexibility theory describes the importance of branching, multi-dimensional thinking skills in constructing meaningful understanding of complex phenomena. According to Eshet-Alkalai (2004; 2005), this thesis led to the evolution of a new kind of digital literacy skill, termed "branching literacy," or "hypermedia literacy skill." Branching-literate scholars are characterized by good multidimensional spatial orientation - the ability to remain oriented and avoid getting lost in hyperspace while navigating through complex knowledge domains, despite the intricate navigation paths they may take (Daniels et al., 2002; Horton, 2000; Piaciano, 2001). They also have good metaphoric thinking and the ability to create mental models, concept maps, and other forms of abstract representation of the web's structure, which help branching-literate scholars overcome problems of disorientation in hypermedia environments (Lee & Hsu, 2002).

Information Literacy: The Art of Always Questioning Information

Today, with the exponential growth in available information, the consumers' ability to assess information by sorting out subjective, biased, or even false information has become a key issue in training people to become smart information consumers (Kerka, 1999; Salomon, 2000). Information assessment is made in almost every work we do in the digital environment, such as data queries or navigational decisions in the web. It is the users' awareness of their decisions that determines the actual quality of the conclusions, positions, opinions, or models that they construct from the information. According to Eshet-Alkalai (2004; 2005), the ability of information consumers to make educated, smart, information assessments requires a special kind of literacy skill, which he calls information literacy. Unfortunately, most studies on information literacy skills focus on the information-seeking strategies and habits of users (e.g. Dresang, 1999; Morahan - Martin & Anderson, 2000; Zins, 2000), and only a few stress the cognitive and pedagogical aspects that are relevant to this skill (e.g. Burnett & McKinley, 1998; Minkel, 2000; O'Sullivan, 2000; Salomon, 2000). Information literacy acts as a filter: it identifies false, irrelevant, or biased information, and avoids its penetration into the learner's cognition. Information-literate consumers are critical thinkers – people who always question information, and never take it for granted (Mardis, 2002). It is true that information literacy is not unique to the digital era; it has always been a crucial trait of successful scholars, even before the information revolution. However, in the digital era, with the unlimited exposure of humans to digital information, it has become a survival skill that enables learners to make informed use of information.

Socio-Emotional Literacy

The expansion of the Internet and other platforms of digital communication has opened new dimensions and opportunities for learning through knowledge-sharing and discussion groups, knowledge communities, chat rooms, and many other forms of collaborative learning (Mioduser & Nachmias, 2002; Scardamalia & Bereiter, 1996). However, in order to take advantage of these new opportunities, users need sociological and emotional skills that enable them to "understand the rules of the game" and survive the hurdles awaiting them in the mass communication of cyberspace (Wallace, 1999). According to Eshet-Alkalai (2004; 2005), these skills include the ability not only to share formal knowledge, but also to share emotions by means of digital communication, to identify pretentious people in chat rooms, and to avoid Internet traps, such as hoaxes and malicious Internet viruses. Users must acquire a relatively new kind of digital literacy, which he calls socio-emotional literacy, since it primarily involves emotional and social aspects of working in cyberspace. Among all the types of digital literacy described here, Eshet-Alkalai (2004; 2005) describes socio-emotional literacy as the highest-level and most complex one. It requires users to be highly critical and analytical, very mature, and have a good command of information, branching, and photo-visual literacy skills.

A wide range of studies focus on efforts to portray a sociological and psychological profile of the literate cyberspace user (e.g. Amichai - Hamburger, 2000; Amichai - Hamburger & Ben Artzi, 2003; Mundrof & Laird, 2002). On the basis of their results, Eshet-Alkalai (2004; 2005) describes socio-emotionally literate users as being willing to share their own data and knowledge with others, and possessing the capabilities for evaluating data, abstract thinking, and designing knowledge in collaboration with others.

The conceptual model of Eshet-Alkalai (2004; 2005) was reinforced by two separate empirical task-based studies (Eshet-Alkalai & Amichai - Hamburger, 2004; Eshet-Alkalai & Chaiut, 2005) that investigated the performance of learners from different age-groups with real-life authentic tasks that required the utilization of the different digital literacy skills of the model. Each of the two studies had 120 participants: Forty 11th grade high school students, forty 3rd year college students, forty 30–40 year old adults who are college or university graduates.

Similar tasks were assigned in each study. These tasks were:

- For photo-visual literacy: Decipher the graphic user interface and use a multimedia program to construct a theatre stage.
- For reproduction literacy: Manipulate a given digital text in order to assign a new meaning to it.
- For Branching literacy: Design a tour to an unknown country through surfing the Internet in a non-linear way.
- For Information literacy: Write a critical comparison of the same piece of news that was published in seven different Internet news sources.
- For socio-emotional literacy: Content analysis of inputs of participants in a chat session.

Results from the two studies clearly indicate that digital literacy is not equally shared among all age groups and that the commonly used notion that the younger generation is more digitally literate than the older one (Tapscott, 1998) should be examined with care. The findings emphasize the importance of the refined conceptual framework for digital literacy discussed in the present paper as a powerful tool for improving our understanding of how different users perform tasks that require the utilization of different digital literacy skills.

Despite the fact that the two studies were conducted on different groups and in different times, results showed similar trends as follows: (1) In both studies, the younger participants were found to be superior over the older ones in tasks that investigated photo-visual and branching literacy skills. (2) In both studies, the older participants were found to be superior to younger ones in tasks that investigated reproduction and information literacy skills. There was no clear pattern in the results for socio-emotional literacy tasks in both studies.

Similar findings were reported in other studies that were conducted independently, in different times and places, on children (Ba et al., 2002) and adults (Hargittai, 2002a; 2002b). These findings support the trends described by Eshet-Alkalai & Amichai-Hamburger (2004) and Eshet-Alkalai & Chaiut (2005); they suggest that Eshet-Alkalai's conceptual model of digital literacy skills might have a universal significance, and therefore can be used as the basis for the discussion on clash of cultures in this paper.

Rethinking Digital Literacy: The conservative Strategy

The recent research that has identified the main digital skills, integrated them into a coherent and parsimonious framework of digital literacy and tested the validity of this framework (Eshet-Alkalai, 2004, 2005; Eshet-Alkalai & Amichai - Hamburger, 2004) can be considered a first step towards the formation of an integrated conceptual theory of digital literacy. We believe this to be a fair, up-to-date representation of the state of the art on the issue. This achievement notwithstanding integrating the various skills mentioned in literature into a coherent framework is only the first step on the long road from a set of practice-oriented rules of thumb to the formation of a conceptually and empirically sound theory of digital literacy.

Given the utmost importance of (what is now taken to be) digital literacy for effective functioning, learning, and teaching in digital environments, the initiation of progress in this direction is vital to our ability to deal rationally with the challenges of digital culture. Therefore, the following is an effort to outline the next steps required for such progress, that is, the set of questions to be asked regarding the list of digital skills suggested and, in some cases, hypotheses in response to these questions.

As discussed earlier, the sets of questions may stem from two major strategies toward the state of the art and the subsequent list of types of literacy. The first, the naive or conservative strategy, is based on the widely accepted assumption that digital literacy represents a set of skills. Accordingly, after the first step of developing a typology of skills, research should proceed with examination of their interrelationships, operational definitions, and implications for educational and technological design. The second strategy, referred to above as "skeptical," is derived from skepticism towards the above-mentioned assumption and based on the hypothesis that there is something much deeper beyond these emerging lists of digital skills.

In this section, we delineate the main questions that constitute the core of the conservative strategy; in the second, we present the skeptical strategy and the two approaches stemming from it.

In light of the basic supposition that digital literacy does consist of basic cognitive and socio-emotional skills, a few questions naturally arise (as in any other new emerging theoretical empirical field). Most of them have not yet been seriously discussed or researched. They can be divided into several groups.

The Theoretical Questions

There are four general theoretical questions:

1. Is the suggested list of skills in the proposed digital literacy framework indeed an inclusive one?

In other words, do the skills included in it exhaust the relevant area? Are there perhaps other skills – cognitive, perceptive, or emotional skills – that are also essential for the effective and mindful use of the new digital media? Although some efforts have been made recently to portray the literacy profiles of digital users (e.g. Amichai - Hamburger, 2002; 2003; Burnett & McKinley, 1998; Cothey, 2002; Dresang, 1999; Hargittai, 2002a; 2002b; Wang et al., 2000; Zins, 2000), the definition of digital literacy is still incomplete, and more research on the performance of effective users of digital media is required.

2. Are the skills independent of each other?

The above skills have been discussed and presented in literature (including in the above list) as independent, but are they? Aren't some of them conceptually, or at least empirically, connected? Can a user score high on socio-emotional skills and low on branching skill or on information literacy? Similarly, might some people score high on reproduction literacy skill but not on photo-visual skill?

3. Are the skills compatible?

While our discussion has focused on "positive relations" between skills and the concepts representing them, obviously there is also a possibility of "negative relations," that is, either empirical or logical contradictions between different skills or their definitions. Actually the research (Eshet-Alkalai, 2004; 2005; Eshet-Alkalai & Amichai - Hamburger, 2004) does suggest that while children score higher than adults on photo-visual and branching literacy skills, adults score higher on information and reproduction literacy. Furthermore, these differences are consistent and gradual, that is, high-school students score higher than adults in photo-visual or branching literacy, but elementary-school children score higher than both, and the other way around: adults score higher than high-school students in information literacy, but the latter score higher than elementary school children on this literacy.

Despite the fact that these findings were obtained by various and independent empirical studies, we believe that they are insufficient as a conclusive evidence of trends regarding groups of skills. However, they do indicate that there is good reason to suppose that this is indeed the case. Further, large-scale research is needed in order to test this hypothesis. If corroborated, this will lead to three salient questions: (a) a theoretical question, concerning the explanation of the observed contradictions; (b) a value-oriented question, concerning the decision of which set – "adult skills" (reproduction and information literacy) or "children's skills" (all the other) – or a combination of the two is educationally preferable; (c) a didactic question, concerning how to best implement the answer to the value-oriented question, whatever it may be.^[1]

Serious discussion of these question leads, in fact, to the second strategy - the skeptical one. Thus we return to these questions later, in the next section.

4. What is the explanatory power of digital literacy variables?

Assuming that the above framework of digital skills is found to be exhaustive, and the skills are shown to be independent and not contradictory, we still face a major task. We have to seriously answer the questions: To which extent can these skills meaningfully explain the extensive range of the differences between effective and mindful and ineffective or mindless learners? Only if rigorous valid and reliable statistical methods show that they explain a large extent of such differences will it be worthwhile to invest in their further research and operational and didactic development.

Most research (including Eshet-Alkalai, 2004; 2005) refers to some of these basic theoretical questions, but only partially – for certain types of groups, users, materials, ICT programs or functions, or specific

skills. We still lack a comprehensive analysis that will allow us to say with a reasonable level of confidence that all relevant digital literacies are included in the list, that the literacies included in it are indeed independent, and that they explain differences among learners to a meaningful extent.

Various earlier studies (e.g. Jonassen, 2000; Mayer, 2001) used terms such as "meaningfully explain," "extensive range of differences," "effective learning," and "mindful learning" in completely different ways. In order to examine the explanatory power of the available definition of digital literacy, we need a large-scale, systematic conceptual discussion of the meanings of the terms basic to the research. We are also very far from having a sufficient empirically sustained explanation, compatible with the conservative strategy, for the difference found between adult and children's literacies. The most probable explanation seems to lead to the second skeptical hypothesis, discussed later, which is essentially incompatible with the conservative strategy.

The Operation-Oriented Questions

The digital skills reviewed above have been defined in very general terms, usually by means of general and abstract descriptions of their end results. For example, branching literacy is described as the capacity to mindfully create complex and intricate paths of navigation in non-linear, chaotic digital environments. But what does this mean in concrete operational terms? This question can be subdivided into three:

1. *The behavioral question:* How do individuals that are recognized as endowed with this literacy actually behave; given a specific goal what is the flowchart of their behavior in the digital chaos?
2. *The psychological-neurological question:* What cognitive, emotional, and neurological processes are involved in performing tasks that require each kind of digital literacy?
3. *The psychological-profile question:* What personality characteristics are most common to each group of individuals?

Only after we have a robust body of research on these three questions will we be able to understand the operational meaning of each of the discussed skills. Needless to say, this is not the case today.

The Didactic Questions

We have identified three basic didactic questions, in the following logical sequence:

1. In Plato's dialogues, the discussants are often troubled by the question: Is virtue ("arête," in Greek) learned or innate? The same question must be asked concerning literacy skills: *Can the desired skills be developed in individuals, or are they innate?* Or, put in more reasonable terms, what is the innate core of those skills (if there is any), and which elements are learned? And, obviously, to the extent that they can be developed, how should this be achieved?

Now, we suppose – in contradistinction to some of the discussants in Plato's dialogue – that to some extent, these skills can be developed by learning or training, even if some innate tendencies may facilitate such learning or render it more difficult. Actually, this supposition derives directly and inevitably from the conservative strategy. The contrasting, skeptical strategy, in its two versions, is based on the opposite view, that the (alleged) literacies are nothing but innate personality characteristics (first version) or the product of belonging to different cultures (second version). Both versions are incompatible with the assumption that they can be learned.

2. Even if we adhere to the supposition concerning the learned nature of literacies, we must still tackle the cost-effectiveness aspect of the didactic question: *What are we to gain (in skill development) through extensive investment of educational resources? Is this investment educationally and economically worthwhile?*

The answer to this question, in turn, depends upon the answers to several other questions, including the previous one about the explanatory power of specific digital literacies vis-à-vis each other and – of all of them regarding other possible explanatory variables. In so far as the answers to these and other relevant questions justify investment in the development of digital literacies, we must search for the best, most effective ways to develop the discussed skills.

Needless to say, dealing rationally with these questions requires much more knowledge than we have today, and hence, much more research is required.

3. One issue that might already be raised at this stage, which has never been raised in such discussions before, is: *who will be in charge of the development of these skills?* In other words, who should the teachers be? This question arises in light of the fact noted earlier, that in some of the literacy skills, children seem to be *prima facie* much more developed than adults (Eshet-Alkalai, 2004; Eshet-Alkalai & Amichai - Hamburger, in 2005). If further research supports this finding, it may be, at least for some of these literacies, that it is the children who should teach the adults.

The Development and Design Questions

Two complementary design questions emerge from the above discussion, when referring to ICT-based environments:

1. Usually, when relating to any desired skill or other personality characteristic in the context of the digital environment, the obvious question raised is: How can we develop this characteristic in students? Before discussing this question, we would like to focus on a much less-discussed – although no less important – issue: *How can we help individuals who are not equipped with the necessary navigating skills to get around the ICT-based environment as effectively and mindfully as possible?*

The rationale behind this question is quite simple: assuming the possession of these skills is shown to significantly explain differences between effective and non-effective ICT-based learning, the subsequent line of thinking should not be restricted to how to develop these skills in those who are lack or are weak in them, but also how – if possible – to help users who haven't acquired them yet, or cannot acquire them (because their dominant learning styles clash with these skills, they are too old to effectively acquire some skills, or for other reasons) compensate for the lack of these skills?

2. The second question concerning design is more conventional: *How can we help individuals who are not sufficiently endowed with the necessary skills to develop them?* This question leads to two sub-questions: (a) how to enhance direct development of these skills; and (b) how to enhance their indirect (or tacit) development. It is possible to help student acquire skills in two ways: *directly*, by developing courses in the relevant skills, or *indirectly*, by designing the learning environment or the curriculum in such a way that

the necessary skills are acquired "naturally" while acting and learning in the environment for other purposes (what sociologists of education call in other contexts: the "hidden curriculum," as opposed to "explicit curriculum" (Dreeben, 1968). Obviously, some combination of both approaches is possible, as well.

It is generally accepted that the hidden curriculum (or indirect learning) is more effective than the explicit one. However, this is a very rough generalization. Concerning the issue at hand, further research should guide the decision of whether, and to what extent this is the case for digital literacies. On this basis, the optimal combination of direct (content-oriented or explicit) and indirect (environment-based or hidden) curricula for the development of digital literacies should be developed.

Rethinking Digital Literacy: The skeptical strategy

The questions discussed above derive from the conservative strategy, which stems from the assumption concerning the necessity of a certain set of skills for effective and mindful ICT-based learning. The skeptical strategy, in comparison, involves deeper, more critical questions. They stem from the suspicion that there is no such "thing" as digital literacy or digital skills, or more precisely, that what we consider "literacies" or "skills" are actually something else, which is conveniently disguised by their denotation as "skills." In our analysis of the subject we have come across two different skeptical hypotheses. According to the first, the so-called digital literacies are just the tip of the iceberg of sets of personality traits known as "learning styles," "intelligences," "capacities," or "personality types". According to the second, the digital literacies are just the tip of the iceberg of much deeper cultural tendencies and revolutions. According to this hypothesis, the list suggested above reflects (and perhaps conceals) a deeper "clash of civilizations" (to paraphrase Huntington), that is, the clash between the contemporary post-industrial, digital culture and the previous industrial or book-based one. In the following section, we will elaborate on these hypotheses. Before doing it we would like to emphasize what we already clearly stated at the outset (p.4): we do not claim these hypotheses to be well substantiated or even substantiated. It is much too early to make such a claim. We are still at the early stage, which is called the "context of discovery" as distinguished from the "context of justification" or substantiation in Philosophy of Science. The first context allows for, and even requires open-ended creative thinking, which is needed for the formation of hypotheses necessary for the explanation of some known facts. Only after the hypotheses have been formed, the second stage that refers to the context of justification can begin.

The trigger for our thinking process in the context of discovery was the combination of five basic facts:

- The common use of the term "digital literacy" in educational discourses.
- The fact that it serves for the design of curricula, didactics and various learning platforms.
- The fact that it emerged from practice without any clear theoretical and empirical foundations.
- Our conviction that in order to be used productively and mindfully, this concept has to be founded on sound empirical research and a rational and theoretical discourse.
- Empirical research needs (at least) "thin" theory or hypothesis to trigger and sustain it; the interpretation of the findings stemming from the research, in its turn, "thickens" the theory and creates the rational scientific discourse

Given this state of affairs, we wish to point to three such "thin" theoretical frameworks or hypotheses, the first of which is suggested by practice, and some interesting and thought evoking, though primary, findings we had.

We are fully aware of the fact that this is only the first step, and we hope to have a chance to examine these hypothesis in larger-scale researches, and that others will do the same, so where now there is only practical discourse, productive and mindful rational one will emerge (to paraphrase Freud's expression of his desire to replace as much of the unconscious and irrational *id* with the conscious and rational *ego*).

The First Skeptical Hypothesis: the Concept of "Digital literacies" is Reducible to Various Pluralistic Conceptions of Learning

The first hypothesis is based on some clear similarities between some aspects of the different pluralistic theories of learning (if we unite for the sake of this argument the quite different theories on learning and learners to be mentioned immediately, ignore the meaningful differences among them and relate to all of them under the terms "pluralistic views of learning"), such as learning styles, multiple intelligences, or different theories of personality types on the one hand, and aspects of the concept of "literacies" described by Eshet-Alkalai (2004; 2005) on the other hand.

For example, the tension between the photo-visual and symbolic literacy as described by Eshet is strikingly similar to the tension between audio-visual and the more analytical or conceptual learning styles as described by various learning styles theories (e.g. Dunn & Dunn, 1993), and to the distinction among different kinds of intelligences in multiple intelligence theory (Gardner, 1993a, 1993b, 2000). Other examples are the possible parallel between the contrast between branching and linear literacies as depicted in digital literacies views, and the difference between inductive and deductive learning styles as conceived of in learning styles theory (Dunn & Griggs, 1988), or the distinction between analytical- logical intelligence and all the others in multiple intelligences theory (Gardner, 1993a, 1993b).

These are few examples, but they suffice to lead to the (still primary and tentative) hypothesis that different literacies reflect different learning styles or intelligences or personality types. If this would indeed be found (upon much further research and analysis) to be a probable hypothesis, then the theory outlined above and in earlier work (Eshet-Alkalai, 2004; 2005), and its implications for helping individuals function in the modern computerized environment must be adjusted.

First, the integrated set of skills that is presented, by the conservative strategy, as something anyone can acquire, may be revealed as reflecting personality characteristics, that are perhaps innate, not easily acquired by everybody, and certainly not to the same extent.

Then, if this emerges to be the case, the didactic recommendation derived from the current literature on digital literacy, namely, that everybody should acquire these skills, seems somewhat problematic. In fact, the parallel pluralistic approaches to learning lead to a very different conclusion: first and foremost, individuals should be encouraged to follow their personal strengths (described differently in terms of "learning styles", "intelligences", or "personality types") and invest in acquiring or improving other strengths only insofar as such an investment seems personally worthwhile. Advocates of the pluralistic views of learning might even say that it is not individuals that have to adapt to computers, but computers that have to adapt to individuals. Such recommendation can draw support from the extensive discourse on the adaptability of ICT environments, individualized ICT-based learning, and personal learning (Lazzaro, 1993).

This skeptical hypothesis gives rise to four questions, on three different levels:

Two ontological-psychological questions

- Are "digital skills" really independent characteristics in their own right, or just derivatives of deeper personality characteristics?
- If the latter is true, are these derivatives of learning styles, of intelligences, of personality types, or of some combination of the above?

The educational question

If "digital skills" are simply derivatives of personality traits, what are the educational implications? Should we still follow the recommendation of digital literacy literature concerning the need for universal acquisition of these literacies, or the pluralistic recommendation based on the other theories mentioned?

The design question

If we adopt the pluralistic recommendation, that is, that individuals should focus on their inclinations and strengths, what is the task of the designers – to facilitate the acquisition of the digital literacies, to help individuals who are not endowed with such skills function in digital environments without them (by adapting the environment to the profile of the user), or both?

Naturally, we have to start by tackling the ontological-psychological questions. Without an answer to these questions, we are also unable to respond to the three other categories of questions.

The Second Skeptical Hypothesis: The List of Digital Literacies Reflects the "Clash of Civilizations"

The second skeptical hypothesis is more radical than the first one. It emerges in response to the prima facie contradiction among the empirical findings on digital literacy presented by Eshet-Alkalai (2004). As noted, these results indicate that while young children perform much better than adults in the three first literacies, adults perform much better than the children in the fourth.

This suggests that the list of five skills, which are presumed to be neutral, actually embodies a "clash of civilizations" (to use the name of Huntington's well known book in altogether different context from the one to which it refers), or the difference between two contrasting cultures. Specifically, these are the "old" modern, rationalistic, linear, conceptual, book-based culture of Western societies in the last few centuries (since Gutenberg), and the new emerging post modern, branching, multimedia-based, reproduction-oriented culture that has been developing in the last twenty years, largely (albeit not exclusively) due to the spread of the different electronic media and recently, the Internet.

This radical skeptical strategy relies on three types of analysis: conceptual, theoretical, and empirical.

The conceptual analysis

A quick conceptual analysis of the list of five skills discussed in the paper's first part quite easily reveals that the first four belong to two different "families" (at this stage, we do not understand the last one well enough to know which "family" it belongs to). While the first three literacies (photo-visual skill, reproduction skill and branching skill) are consistent with the new multimedia tendencies and help individuals adapt to them, the fourth – requiring critical treatment of the material being processed through ICT – contradicts these new tendencies.

Being critical requires, among other things, being rational, which involves the ability to think linearly (since rationalism is based on logic, which is linear through and through) (Baron, 1985, Perkins, 1993)^[2]. Thus it is reasonable to assume that emphasizing the critical attitude is contradictory to emphasizing the importance of branching thinking and the other literacies that are connected to it (photo-visual and reproduction literacies).

The theoretical analysis

Once one has reached the conceptual analysis described above – that there may be a contradiction between these two groups of skills – one should naturally look for discourse or literature that can support or substantiate this hypothesis. This is not a difficult task. This hypothesis is supported by a very extensive body of theoretical literature and discourse, dating as far back as the extensive literature on the transformation from the "second" to "the third wave," to use Tofler's (1980, 1990) terms; from the "Gutenberg era" to the multimedia era," to paraphrase McLuhan (1962, 1965) or, more recently, Postman (1984, 1992); or from "modern" to "post-modern culture," to quote Harvey (1990).

This already extensive and steadily growing corpus, incorporating numerous subcategories leads us in various ways to same conclusion: in the last few decades, Western culture has gone through a revolutionary change from a modern, second-wave, industrial, book-based ("Gutenbergian," in McLuhan's terms) society to a post modern, third-wave, post-industrial, digital society. These two societies are opposed to each other in all basic aspects of human existence.

For one thing, while the first society was based on linear modes of processing information (stemming from book reading) and hence was totally linear in all respects (from linear organizational structures to conceptions of human life as expressed in different developmental theories), the second is based on lateral modes of processing information and hence it is branching in all its other aspects (including organizational structures and developmental conceptions) (Peters, 1994; Tofler, 1981, 1990).

Furthermore, the first society was based on the conception of the individual as an independent, enduring entity and hence of conceptions of independent "ownership" and "authorship." The second, on the other hand, is based on the "death of the individual," as put by postmodernists such as Derrida, (1998); Gergen (1992); and Foucault (see also: Haber, 1994), and hence, on the "death of the author" and legitimization of reproduction and the like.

This large and complex corpus of theoretical literature provides a clear explanation of the opposition between the first three and the fourth digital skills, in terms of the two (still) clashing cultures: one modern, book-based, linear, individualistic, and the other post modern, multimedia-based, branching and much less individual-oriented.

The empirical analysis

We began with a conceptual analysis, which revealed the probability of a clash between the two above

groups of skills. We then moved to the theoretical level, and upgraded this hypothesis to reflect not just a trivial clash but, in fact, the dramatic clash between the modern Gutenbergian culture and the post modern digital culture. Having defined the two opposed tendencies in terms of cultural clash, we can then further support it with our findings on the empirical level, which actually led us to this intellectual journey in the first place.

The empirical evidence stemming from Eshet-Alkalai (2004), as reported in the previous section, corroborates the above hypothesis, and acquires a new meaning in light of it. As reported, it has been found that while young children fare much better than teenagers and teenagers do better than adults in the three first literacies, adults fare much better than teenagers and children do in the fourth. This is exactly what we, on the basis of this hypothesis, would have expected. Now, this is not the only empirical evidence supporting this hypothesis; other research also indicates a similar direction (Oppenheimer, 1997; Tapscott, 1998). When we first formed this hypothesis – in a leap of imagination as hypotheses are often formed – we had very slim empirical evidence to support it. But the recent empirical studies of Eshet-Alkalai & Amichai - Hamburger (2004) and Eshet-Alkalai & Chaiut (2005) (described above in detail), which were supported by other equivalent studies on children (Ba et al., 2002) and adults (Hargittai, 2002a; 2000b), clearly illustrated the differences in digital literacy between age groups and suggested the merit of Eshet's list of literacy skills as a reliable holistic framework for digital literacy.

Thus, although we are still in the context of discovery, the radical skeptical hypothesis set in a leap of imagination looks now as a serious candidate for leaving this initial context, and for being subjected to further and more extensive, hopefully inter-cultural, sharper examination/refutation in the context of justification.

If this hypothesis is further substantiated, it might mean that we would not be able to continue speaking of enhancing "digital skills" and refer to all the first four literacies (as noted, we ignore the fifth here) as if they were part of the "same package" and lead in the same direction. We must choose. The choice, in this case, is not just between two categories of skills or literacies; it is rather a choice between two cultures, (a) one favoring rationality, continuity, criticism, abstract thinking, individuality, authenticity, systematic planning, and thinking; and (b) the other favoring fragmentation, spontaneity, concrete visual processing of knowledge, connectedness, reproduction, and branching associative thinking.

In light of the possible need to make this crucial choice, we will not be able to avoid the fact that from considering "neural" skills or "literacies," we have quickly been drawn into a discussion of the central aims and values of Western education. If such a scenario come true, we will need tackle the most fundamental questions:

- Should education strive to achieve the enhancement of post modern values, or rather the preservation (as much as possible) of modern values?
- Should the aim, instead, be some combination of the two?
- If so, what combination (Aviram, 2005; Dator, 1993; Postman, 1992, 1995)?

A discussion of prima facie neutral skills can turn, if this scenario is realized (by the further substantiation of the radical skeptical hypothesis), into a basic dilemma about the ultimate cultural educational values. The resolution of this dilemma should not necessarily be an "either-or" one; we should be able to strive for an optimal balance. First, however, we will need to recognize the dilemma for what it is, and then consciously make the decisions, which will necessarily have impact on the most fundamental educational policies.

Examination of the second skeptical hypothesis, and certainly of the dilemma that will inevitably emerge if it is found to be true, is beyond the scope of the present work. We leave it (hopefully) to future discussions.

Conclusion

This paper relies on previous work, in which the fragmented literature on digital literacy was integrated into a taxonomical framework of five basic digital literacies. While this was a first necessary step in transforming an important emerging discourse, until now mainly practice and intuition-oriented, into a more productive, integrated, theoretical discourse, it is far from being adequate.

We dedicated the paper to making the first few steps necessary for the enlargement, deepening, and theorization of this extremely important discourse, which should ultimately guide us in the most basic policy decisions concerning education for the future.

We have done so by pointing to two possible basic strategies for the theorization of the discussion about digital literacy. The first, rather conservative, strategy is based on taking the assumption basic to the prevailing discourse at face value; we assumed that what are generally called digital literacy "skills" are indeed nothing but skills or literacies, and raised questions that arise from this conservative starting point.

The second, a skeptical strategy, is based on an essential questioning of the above assumption. It stems from the hypothesis that the "skills and literacies talk" hide much deeper layers in individual personalities than just the rather narrow and technical cognitive layer implied by talk of "skills" or "literacy". In this context, we raised two different hypotheses, one relatively moderate, and the other, quite radical:

- According to the first hypothesis, the prevailing practical literature terms "literacies" or "skills" are actually reducible to certain learning styles, intelligences, or personality types. This hypothesis, if true, might lead to much more pluralistic educational and design recommendations relative to the "monistic" ones now suggested by the digital literacy literature (that every student must acquire the same digital literacies).
- According to the second hypothesis, "literacies" and "skills" actually include two incompatible sets of skills, and more importantly, these two sets are just a tiny aspect expressing two cultures and sets of values that are now clashing in the West, in general, in the foundations of Western education, more specifically. If this hypothesis is true, the allegedly neutral and "naïve" discourse about skills is transformed into a thoroughly ideological discussion about the basic values that should guide education.

We have neither expressed nor defended a view concerning which of the three basic possibilities (the conservative one or one of the two more radical skeptical ones) emerging from the digital literacy discourse is the correct one. We simply don't know at this stage. We did not even present a concrete research design, which might enable us to decide among them (or their various combinations). It is too early to be able to do even that.

Still, the digital era is not going to disappear, and the need for education to respond to the growing digital

tide is rapidly increasing. The educational response to digital culture may vary from full adaptation to compromising with it or opposing it. It is a forced choice (to use a term coined by William James) – a decision we cannot avoid. "Avoiding" a decision among the three above possibilities means actually deciding to passively and fully adapt to the new reality. This is indeed the probable default scenario. If that is so, and if the radical hypothesis about the civilization clash is true, it is likely that photo-visual skill, branching skill and reproduction skill will be powerfully enhanced, while the ability for criticism, or indeed, rational thinking of any kind, may deteriorate. Some might take it to be a desired scenario, but if it is, it calls for a conscious decision, rather than being dragged towards it blindly.

[1] This question becomes especially problematic if we opt – in answering the previous one- for some combination of the two kinds of skills. Given the prima facie contradiction between these two sets of skills, it is reasonable to suppose that an educational process leading to the enhancement of one set might suppress the other. If we want to enhance some combination of the two, we must carefully design didactic ways that will prevent a "zero-sum" process from taking place.

[2] It is true that the formation of hypothesis may, at the "discovery stage," include creative branching thinking. However, while one can certainly be rational without having a high capacity for branching thinking (that is, rational without being creative), one cannot be rational without being capable of linear logical thinking. In other words, logical-linear thinking is a necessary and maybe also sufficient condition for rationality, while branching thinking is only a "helpful condition."

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