A Holistic Model of Thinking Skills in the Digital Era

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INTRODUCTION

The fast development in digital technologies during the digital era confronts individuals with situations that require the utilization of an ever-growing assortment of technical, cognitive, and sociological skills that are necessary in order to perform effectively in digital environments. These skills have been termed in recent literature **'digital literacy'** (Gilster, 1997). Digital literacy is more than just the technical ability to operate digital devices properly; it comprises a variety of skills that are utilized in executing tasks in digital environments, such as surfing the web, deciphering user interfaces, operating video games, searching in databases, and chatting in chat rooms. In the modern era, digital literacy has become a "survival skill": a key that helps users to work intuitively in executing complex digital tasks. In recent years, extensive efforts are made to describe and conceptualize the cognitive skills that users employ in digital environments (e.g. Burnett & McKinley, 1998; Zins, 2000; Cothey, 2002; Hargittai, 2002; Marsh, 2005). Unfortunately, these efforts are usualy local, focusing on a selected and limited variety of skills, mainly information-seeking skills (e.g. Zins, 2000), and, therefore, they do not cover the full scope of the term digital literacy. Eshet-Alkalai (2004) has established a holistic conceptual model for digital literacy, arguing that it covers most of the cognitive skills that users and scholars employ while working in digital environments and, therefore, providing researchers and designers of digital environments with a powerful framework and design guidelines. This framework was derived from the analysis of large volumes of empirical and qualitative information regarding the behavior of users in digital environments and was studied empirically by Eshet-Alkalai & Amichai-Hamburger (204), who tested the performance of different groups of computer users with tasks that require the utilization of different digital skills. The publication of Eshet-Alkalai's model of digital thinking skills has led to an extensive debate within the community of instructional technology designers, researchers and educators, as to its validity and completeness,. This debate (Aviram & Eshet-Alkalai, 2006) confirmed the validity and value of the model, but indicated that it lacked a sixth thinking skill: the **Real-time thinking skill**, which relates to the ability of users to perform effectively in advanced digital environments, mainly high-tech machines, multimedia games and multimedia training environments, that require the user to process simultaneously large volumes of stimuli which appear in **real-time** and at **high-speed**.

BACKGROUND

The present paper presents an updated version of the holistic model of Eshet-Alkalai (2004), adding to it the real-time thinking skill. The paper discusses the value of these skills in refining our understanding of how people interact with digital environments, and examines their application in improving communication among users, scholars and designers of digital environments. The digital thinking skills that are discussed in the paper are the, photo-visual, reproduction, branching, information, socio-emotional and real-time thinking skills . It is suggested that these six digital thinking skills exist in every learner, but their "volume" or "magnitude" differ from person to person.

Photo-Visual Digital Skills

The evolution of digital environments from text-based, syntactic to graphic-based semantic environments (Nielsen, 1993; Shneiderman, 1998), requires users of modern digital environments to employ cognitive skills of "Using Vision to Think" (Mullet & Sano, 1995) in order to create an effective photo-visual communication with the environment. This unique form of digital thinking skill – the **photo-visual skill** – helps users to

intuitively and freely 'read' and understand instructions and messages that are presented in a visual-graphical form. Good examples of digital environments that require the utilization of photo-visual digital skills can be found in the design of graphic user interfaces (Shneiderman, 1998; Opperman, 2002) and in children's modern computer games - in both, all usage instructions are provided through a graphical representation of symbols and icons. Successful photo-visual scholars usually have a good visual memory and strong intuitive-associative thinking that are useful in understanding visual messages. Eshet-Alkalai and Amichai-Hamburger (2004) discovered that young users (school children) of graphic digital environments perform much better then adults in tasks that require the utilization of photo visual skills, as deciphering graphic user interfaces.

Reproduction Digital Skills

The modern digital technologies provide scholars with new possibilities for creating art and academic work by reproducing and editing existing texts, visuals and audio pieces (Benjamin, 1994; Gilster, 1997). Besides the ethical and philosophical questions regarding the limits and criteria for legitimate-ingenuine use of digital reproduction, the digital reproduction technologies require modern scholars to master a special assortment of cognitive skills, termed here '**Reproduction digital skills**. Reproduction digital skills are defined as the ability to create new meanings or new interpretations by combining preexisting, independent shreds of information in any form of media (text, graphic, or sound) (Gilster, 1997). These skills are essential in two major fields: In writing, where preexisting sentences can be reorganized and rearranged to create new meanings, and in art, where preexisting audio or visual pieces can be edited and manipulated in order to create new art works (as in the case of Pop Art and the case of the faked Internet artist Drako Maver, 1998: http://www.kapelica.org/maver/main.htm). Labbo, Reinking and McKenna (1998) described problems that learners face in the digital reproduction of text in a variety of work situations. According to them, scholars who have a high level of digital reproduction skills also have a good, synthetical and multidimensional thinking that helps them in discovering new combinations for arranging information in new, meaningful ways. Opposite to their findings findings for the digital photo-visual skills, Eshet-Alkalai and Amichai-Hamburger (2004) found that adult scholars own a higher level of digital reproduction skills compared to younger school children, when performed with tasks that require the utilization of digital reproduction skills, as text re-arrangement.

Branching Digital Skills

The non-linear, branching nature of the modern hypermedia technology introduced computer users to new dimensions of thinking that are necessary in order to make an educated use of this elaborate technology. In the past, the limited, non-hypermedia-based computer environments enhanced a more linear way of learning that was dictated by the non-flexible operating systems, and by the fact that users were used to books and expected to work with digital environments in much the same way they read through 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, but at the same time, confront them with problems that involve the need to utilize non-linear and branching 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;; Rouet, 2000; Zins, 2000; Jansen & Pooch, 2001; Balcytiene, 20003). Spiro et al. (1991) presented the Cognitive Flexibility Theory that described the importance of branching, multidimensional thinking skills in constructing meaningful understanding of complex phenomena. According to them, the hypermedia technology led to the evolution of new types of digital thinking skills, termed here 'branching digital skills,' or 'Hypermedia skills.' Branching digital skills require scholars to have a good spatial-multidimensional sense of orientation - the ability to stay oriented and avoid getting lost in the hyperspace while navigating through complex knowledge domains, despite the intricate navigation paths they may take (Lazar et al., 2003). As shown by Eshet (2004), they also have a 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-skilled scholars to overcome disorientation problems in hypermedia environments.

Information digital skills: Today, with the exponential growth in available information, the consumers' ability to assess information by sorting out subjective,