Experience or Age? Long-Range Changes in Digital Thinking Skills: A Follow-Up Study

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Abstract

In order to investigate the nature of changes in digital literacy through time and the factors that affect these changes, the present paper follows-up on Eshet-Alkalai & Amichai-Hamburger's (2004) empirical study of digital literacy among different age groups, focusing on the question whether changes in digital literacy are age-dependent or a result of experience with technologies. In the present study, the different digital literacy skills of the same participants of Eshet-Alkalai & Amichai-Hamburger, were tested five years later and compared to a new control group. Results indicate a significant improvement in performance in the photo-visual and lateral literacy skills among all age groups, especially with the adults. On the other hand, information literacy of all participants dropped dramatically. Our results suggest that life-long changes in digital literacy probably result from experience with technology and not from cognitive development. Moreover the data suggest that mere exposure to information, without mastering appropriate cognitive tools for critical thinking, hinder the beneficial components of experience with respect to information literacy.

Keywords: digital literacy, literacy, technology, thinking.

Introduction

The proliferation of digital technologies during the digital era confront individuals with situations that require the utilization of an ever-growing assortment of technical, cognitive, emotional and sociological skills that are critical for an effective performance. These skills have been collectively termed in recent literature **'digital literacy'** (Bawden, 2001; Ba and Tsikalas, 2002). Despite its extensive use in the literature, there are only few theoretical models of digital literacy (e.g Bawden, 2001; Ba et al., 2002; Bruce, 2003). The lack of sufficient empirical studies (e.g. Hargittai, 2002) limits our knowledge on the utilization of digital literacy among gender, age or specific social groups. Eshet-Alkalai (2004; in press), and later Aviram and Eshet-Alkalai (2006), published a conceptual model of digital literacy, composed of six literacy skills (i.e. photo-visual, information, reproduction, lateral, socio-emotional and real-time skills), arguing that it encompasses all cognitive challenges that users face in digital environments. In order to reinforce the validity of the model, Eshet-Alkalai and Amichai-Hamburger (2004) tested the performance of three groups of users (high-school students, college students and adults) with tasks that challenged these digital skills. Their major findings were that the younger participants prevailed in the photo-visual and lateral thinking tasks, whereas the adults prevailed in the information and reproduction thinking tasks.

In recent years, there is a vivid debate in the literature, regarding the nature of changes through time in digital literacy. The debate is led by two opposing approaches: the usability approach (e.g. Nielsen, 1993; Shneiderman, 1998; Nielsen & Tahir, 2002), claims that these changes result from experiences acquired throughout interacting with the digital technologies, and the

cognitive approach (e.g. Pappert, 1996; Tapscott, 1998; Prensky, 2001; Snyder, 2007), claims that digital literacy is age-dependent, and that it changes side by side with the life-long and cognitive development. Unfortunately, as mentioned above, the contemporary research literature lacks studies, which investigated life-long changes in digital literacy.

In the present study we confronted those approaches by investigating the contemporary digital literacy of different age-groups and by tracking changes in their digital literacy over a period of 5 years (2002-2007) with tasks that challenged the different digital literacy skills of Eshet-Alkalai (2004). Likewise we compared the performance of a new matched control group, in order to hold constant the factor of age.

Methodology

Participants

Participants were 111 individuals (38 high-school students, 36 college students, and 37 adults older then 30 years). All participants come from agricultural communities in the Galilee and all have good proficiency with computer and Internet applications. 60 of them were tested in 2002 by Eshet-Alkalai & Amichai-Hamburger (results published in 2004). In order to track life-long changes in digital literacy among the same group, 51 of these 60 were tested again, 5 years later, with the same tasks. In order to control for age, education, socioeconomic and geographic variables, new groups of 60 participants (20 high-school students, 20 college students and 20 adults) were assigned the same tasks and served as a control group.

Tasks

To investigate the utilization of digital literacy by computer users under different digital circumstances, a task-oriented research approach (Wiggins, 1993), in which participants were required to perform with real-life authentic tasks, was implemented. A set of four tasks was assigned to each participant. Each task required the utilization of a different type of digital literacy skill. The same tasks, with slight modifications and different content, were assigned, both in 2002 (Eshet-Alkalai and Amichai-Hamburger, 2004) and again in 2007. The tasks were as follows:

- **Photo-visual thinking task:** Create a theatre stage, using the unfamiliar software *Stage Struc*k
- **Reproduction thinking task:** Assign a new meaning to a "neutral" 100-words paragraph, by rearranging the order of words and adding no more than 10 words.
- **Lateral thinking task:** Planning a trip in the Internet to an unknown country.
- **Information thinking task:** Making a critical analysis of the same news-item, that was published in 5 different news resources.

Grading

Participants' performance in each task was graded by one of the authors, aided by a list of evaluation guidelines. The reliability of the grading process was validated by a random selection of 20% of the participants' reports which were graded by two independent referees who used the same guidelines for evaluation. The close similarity between the referees' grades and the grades given by the authors (r= 097) suggests a high coherence of the evaluation criteria utilized in the present research.

Results

Analyzing changes through time in digital literacy skills

In order to shed light on the life-long changes in digital literacy, paired t-tests were made, comparing the performance of each age-group in 2002 and in 2007 (Table 1).

Table 1. Life-long changes in digital literacy

Digital literacy skill	High school		College		Adults	
	Year*		Year*		Year*	
	2002	2007	2002	2007	2002	2007
Photo-visual	88	92	84	90	60	85
Reproduction	49	46	65	68**	73	79
Lateral	85	94	80	91	57	85
Information	58	49	70	60	86	87

* 2002 refers to the data of Eshet-Alkalai & Amichai-Hamburger (2004) that were collected in 2002. 2007 refers to the data collected in the present study, on the same participants, with similar tasks.

** Except for the performance of college students in the reproduction task all other differences were significant.

Photo-visual task: All age-groups performed better in 2007 compared to their scores in 2002. The high-school group performance improved from 88 in 2002 to 92 in 2007 – $t(17)=2.84$, $P<0.05$), and the college group improved from 84 to 90 – , $t(16)=5.76$, $P<0.001$. The adults group improvement was very dramatic: from 60 in 2002 to 85 in 2007-, $t(17)=11.07$, $P< 0.0001$. All changes are significant.

Lateral task: The same pattern of performance was found for the lateral task. The high school group improved from 85 in 2002 to 94 in 2007 – $t(16)=12$, $P<0.0001$, the college group improved from 80 to 91 – $t(16)=6.38$, $P<0.001$. Again, the adults group's improvement was the largest, from 57 in 2002 to 85 in 2007 – $t(17)=13.61$, $P< 0.0001$. All differences were significant.

Reproduction task: Here, patterns were less consistent: The high school score dropped from 49 in 2002 to 46 in 2007 - $(17)=3.78$, $P<0.005$. The college students improved from 65 to 68 – $t(16)=1.23$, $P=0.24$., and the adults improved from 73 to 79, $t(17)=5.83$, $P< 0.001$. Except for the college group, all differences were significant.

Information task: The most striking differences between 2002 and 2007 were found for the information task, with a great decline in the performance of high-school and college groups, and a slight improvement among the adults: The high school group declined dramatically, from 58 in 2002 to 49 in 2007 – $t(17)=6.04$, $P<0.001$. The college students scores declined from 70 to 60 – $t(16)=8.39$, $P< 0.0001$. The adults group improved very little, from 86 to 87, $t(17)=0.1$, $P= 0.92$. Except for adults, all changes are significant.

Analyzing present-day digital literacy skills

In order to identify whether the observed changes in digital literacy are age-dependent or a result of experience with technologies, we conducted an independent t-test that compared the performance of each age-group in 2002 with the performance of a control group in 2007. The comparisons are shown in Table 2.

Table 2. Comparison of the performance of the control group (2007) with the performance of the same age-group in 2002 (data from Eshet-Alkalai & Amichai-Hamburger, 2004)

	High school		College		Adults	
	Year*		Year*		Year*	
	2002	2007 (Control group)	2002	(2007 (Control group)	2002	2007 (Control group)
Photo-visual	88	95	84	93	60	82
Reproduction	49	45	65	66**	73	77
Lateral	85	92	80	89	57	82
Information	58	45	70	55	86	83

* 2002 refers to the data of Eshet-Alkalai & Amichai-Hamburger (2004), which were collected in 2002. 2007 refers to the data collected in the present study, on the control groups, with similar tasks.

** Except for the performance of college students in the reproduction task all other differences were significant.

Photo visual task: All the control groups performed better compared to 2002 groups. The high school, group improved from 88 to 95 – $t(36)=3.9$, $P<0.001$. College students improved from 84 to 93 – $t(35)=5.88$, $P<0.001$, and the adults group improved the most: from 60 to 82 – $t(37)=11.16$, $P< 0.0001$. All changes were significant.

Lateral task: The same pattern of change was found: Improvement from 85 to 92 in the high school group, – $t(36)=5.62$, $P<0.001$. 89, improvement from 80 to 89 in the college group – $t(36)=3.29$, $P<0.001$, and improvement from 57 to 82 in the adults group – $t(37)=11.19$, $P<0.001$. All differences were significant.

Reproduction task: As for the previous t-test (Table 1), also here, data for the reproduction task was less consistent, and only minor changes were found between 2002 and the control group in 2007. The high school score was 49 in 2002 and 46 in 2007 – $t(36)=2.96$, $P<0.01$. 66, the college group scored 65 in 2002 and 66 in 2007 – $t(36)=0.27$, $P=0.98$., and the adults group improved from 73 to 77 – $t(37)=3.37$, $P< 0.01$.

Information task: As for the previous t-test (Table 1), also here, a striking decrease was found, in the in performance of all age-groups: The high-school group dropped from 58 to 45 – $t(36)=7.6$, $P<0.001$. 55, and the college group dropped from 70 in 2002 to 55 in 2007 – $t(36)=8.8$, $P< 0.0001$. The adults group showed the smallest drop: from 86 to 83. – $t(37)=2.72$, $P< 0.05$.

Discussion and conclusions

In the current study we tried to shed light on the nature of life-long changes in digital literacy. The significant improvement among all age-groups and their matched control group, in the "operational" literacy skills (i.e. photo-visual and lateral skills according to Shneiderman,1998), suggests that usability and experience, and not cognitive development, has a central role in determining the nature of the observed changes. This notion is further supported by the finding that the cognitive-demanding skills of information and reproduction decreased significantly or didn't change with time. In other words the identical patterns of change between the control age-groups and the research age-groups (Tables 1, 2) suggest that the changes are probably a result of experience with technology and are not age-dependent.

From the age perspective, the adults group seems to be the one that made the biggest improvement, mainly in the photo-visual and the lateral literacy skills. This finding can be

explained by the fast penetration of digital technologies to the "adults' world" in recent years, whereas these technologies were already established among the high-school group. In the more "critical/cognitive" skills (i.e. information and reproduction, according to Snyder, 2007), the adults were found to be more proficient then the high-school or college groups.

Besides the improvement Through time in photo-visual and lateral literacy skills, as found in the present research, the most significant and interesting change uncovered, is the dramatic decrease in the information skill among all groups. This finding suggests that a mere exposure to information, without mastering appropriate cognitive tools for critical thinking on it, doesn't guarantee a "wise consumption" (Bawden, 2001; Eshet-Alkalai & Geri, 2007), thus illustrates the pivotal role of educational systems in training educated information consumers. Despite the striking findings of the present paper, the small size of the tested group should be noted. More research, in larger groups, is required in order to validate the results.

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