

## Rapid Communication

# Changes Over Time in Digital Literacy

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### Abstract

The current study is a follow-up on the 2002 empirical study by Eshet-Alkalai and Amichai-Hamburger, which investigated digital literacy skills among different age groups. This study explores changes through time in digital literacy among the same participants 5 years later, and their performance is compared to new matched control groups. Results indicate an improvement over time among all age groups, but especially for the adults, in the tasks that require proficiency and technical control in using technology (e.g., photovisual and branching literacy skills). On the other hand, results indicate a drop in the skills that require creative and critical thinking (e.g., information and reproduction literacy skills), especially for the younger participants. Results show two major patterns of change over time: (a) closing the gap between younger and older participants in the tasks that emphasize proficiency and technical control and (b) widening the gap between younger and older participants in tasks that emphasize creativity and critical thinking. Based on the comparison with the matched control groups, we suggest that experience with technology, and not age, accounts for the observed lifelong changes in digital literacy skills.

### Introduction

DIGITAL LITERACY is described in literature as the ability to employ a wide range of cognitive and emotional skills in using digital technologies.<sup>1-4</sup> Eshet-Alkalai<sup>5</sup> and Aviram and Eshet-Alkalai<sup>6</sup> developed a conceptual model of digital literacy consisting of six skills, arguing that it encompasses all the cognitive challenges faced by users of modern digital environments: (a) *Photovisual literacy* is the ability to work effectively with digital environments, such as user interfaces, that employ graphical communication. (b) *Reproduction literacy* is the ability to create authentic, meaningful written and art work by reproducing and manipulating preexisting digital text, visuals, and audio pieces. (c) *Branching literacy* is the ability to construct knowledge by a nonlinear navigation through knowledge domains, such as in the Internet and other hypermedia environments. (d) *Information literacy* is the ability to consume information critically and sort out false and biased information. (e) *Socioemotional literacy* is the ability to communicate effectively in online communication platforms such as discussion groups and chatrooms. (f) *Real-time thinking skill* is the ability to process and evaluate large volumes of information in real time, such as in computer games and chatrooms. This conceptual model was later validated in the empirical study of Eshet-Alkalai and Amichai-Hamburger<sup>7</sup> in which the

researchers tested the performance of three age groups of users (16-year-old high school students; 26-year-old college students, and 30- to 40-year-old adults) with tasks designed to challenge the six digital skills.

In recent years, a growing amount of research indicates the existence of individual differences in digital skills among different age and gender groups.<sup>2,8,9</sup> Some studies<sup>4,10</sup> emphasize the usability and proficiency perspective in explaining these differences, whereas others<sup>9,11,12</sup> emphasize the role of generation gap and the age of the users.

To contribute to the discussion on the nature of changes over time in digital literacy skills, the present study tracked changes in digital literacy skills over a period of 5 years (2002–2007) among the same participants of Eshet-Alkalai and Amichai-Hamburger's study<sup>7</sup> and compared them to matched control groups.

### Methodology

#### Participants

Participants were 111 individuals (38 high school students, 36 college students, and 37 adults 30–40 years old). All participants came from agricultural communities in the Galilee, and all used computers and Internet on a daily basis. Fifty-one participants (18 high school students from 11th grade, 16

third-year college students, and 17 adults 30–40 years old), were selected from the 60 participants who were tested in 2002 by Eshet-Alkalai & Amichai-Hamburger.<sup>7</sup> To control for age, education, and socioeconomic variables, a new matched control group of 60 participants of the same age and background (20 high-school students from 11th grade, 20 third-year college students, and 20 adults 30–40 years old) were recruited.

### Tasks

A task-oriented approach, each task requiring the utilization of a different type of digital literacy skill, was used to investigate changes over time in the four digital skills for which Eshet-Alkalai and Amichai-Hamburger<sup>7</sup> found significant results: photovisual, reproduction, branching, and information skills. Similar tasks, with slight modifications and different content, were assigned in 2002 and again in 2007. The tasks were as follows: (a) Photo-visual task: Create a theater stage, using an unfamiliar interactive multimedia computer program that utilizes a graphic user interface. (b) Reproduction task: Using Microsoft Word, modify the meaning of an existing seven-line paragraph (about 100 words) by rearranging sentences, words, and letters. (c) Branching task: Plan a one-week trip to a country that was not visited by the participants, using an Internet tourist site. (d) Information task: Write a comparative, critical report on a news event that was reported in a biased way in five different Internet news resources.

### Grading

Participants' performance was graded by one of the authors, aided by the same list of detailed grading guidelines published in Eshet-Alkalai and Amichai-Hamburger<sup>7</sup> and in Eshet-Alkalai.<sup>5</sup> 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. All referees were blind to participants' age and gender. The close similarity between the referees' grades and the grades given by the authors ( $r = 0.95$ ) suggests a high coherence of the evaluation criteria utilized in the present research.

### Results

Paired  $t$  tests were used to compare the 2002 performance<sup>7</sup> of the original participants (experiment group) with their performance in 2007 and to compare their performance to matched control groups in 2007.

#### Experiment group: Comparing 5-year digital literacy performance

Comparing the scores of the experiment group in 2002 and in 2007 revealed the following trends (Table 1).

**Photo-visual task.** All age groups performed better in 2007 than in 2002. The high school group performance improved from 88 in 2002 to 92 in 2007,  $t(17) = 2.84$ ,  $P < 0.05$ ; the college group improved from 84 to 90,  $t(16) = 5.76$ ,  $P < 0.001$ . The adult group's improvement was very large: from 60 to 85,  $t(17) = 11.07$ ,  $P < 0.0001$ . All changes are significant.

TABLE 1. CHANGES IN DIGITAL LITERACY GRADES AMONG THE SAME PARTICIPANTS BETWEEN 2002 AND 2007

Digital literacy skill	High school		College		Adults	
	2002	2007	2002	2007	2002	2007
Photovisual	88	92	84	90	60	85
	2.52	3.44	6.15	4.08	7.57	2.78
Reproduction	49	46	65	68*	73	79
	4.58	4.57	7.92	3.28	4.38	3.10
Branching	85	94	80	91	57	85
	4.37	2.25	8.14	2.85	4.58	3.51
Information	58	49	70	60	86	87
	6.45	6.14	6.45	4.37	3.68	3.48

Note: Values represent the average grades and standard deviations given by the three referees. The year 2002 refers to the data of Eshet-Alkalai & Amichai-Hamburger<sup>7</sup> 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.

**Branching task.** The same pattern of change over time was found for the branching 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 adult group's improvement was the largest, from 57 to 85,  $t(17) = 13.61$ ,  $P < 0.0001$ . All differences were significant.

**Reproduction task.** Here, patterns of change over time were smaller and less consistent. The high school score dropped slightly, from 49 in 2002 to 46 in 2007,  $t(17) = 3.78$ ,  $P < 0.005$ . The college students improved slightly from 65 to 68,  $t(16) = 1.23$ ,  $P = 0.24$ ; 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 large decline in the performance of high school and college groups and a slight improvement among the adults. The high school group declined from 58 in 2002 to 49 in 2007,  $t(17) = 6.04$ ,  $P < 0.001$ ; the college students' scores declined from 70 to 60,  $t(16) = 8.39$ ,  $P < 0.0001$ ; and the adult group improved very little, from 86 to 87, but this difference was not statistically significant,  $t(17) = 0.1$ ,  $P = 0.92$ .

#### Control group: Analyzing present-day digital literacy skills

An independent  $t$  test, which compared the performance of each age group in 2002 with the performance of the control group in 2007, resulted in the following trends (Table 2).

**Photo visual task.** All the control age groups performed better compared to the 2002 groups. The high school group improved from 88 in 2002 to 95 in 2007,  $t(36) = 3.9$ ,  $P < 0.001$ . College students improved from 84 to 93,  $t(35) = 5.88$ ,  $P < 0.001$ . The adult group improved the most, from 60 to 82,  $t(37) = 11.16$ ,  $P < 0.0001$ . All changes were significant.

**Branching task.** The same pattern of change was found here: improvement from 85 to 92 in the high school group,

TABLE 2. COMPARISON OF THE PERFORMANCE OF THE CONTROL GROUP (2007) WITH THE PERFORMANCE OF THE SAME AGE GROUP IN 2002

Digital literacy skill	High school		College		Adults	
	2002	2007	2002	2007	2002	2007
Photovisual	88	95	84	93	60	82
	2.52	2.86	6.15	2.59	7.57	3.43
Reproduction	49	46	65	66**	73	77
	4.58	4.10	7.92	4.06	4.38	4.09
Branching	85	92	80	89	57	82
	4.37	2.75	8.14	3.63	4.58	3.45
Information	58	45	70	55	86	83
	6.45	2.81	6.45	4.06	3.68	3.29

Note: Values represent the average grades and standard deviations given by the three referees (data from Eshet-Alkalai & Amichai-Hamburger<sup>7</sup>).

\*The year 2002 refers to the data of Eshet-Alkalai & Amichai-Hamburger<sup>7</sup> collected in 2002; 2007 refers to the data collected in the present study with the control groups, using similar tasks.

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

$t(36) = 5.62$ ,  $P < 0.001$ ; improvement from 80 to 89 in the college group,  $t(36) = 3.29$ ,  $P < 0.001$ ; and improvement from 57 to 82 in the adult group,  $t(37) = 11.19$ ,  $P < 0.001$ . All differences were significant.

**Reproduction task.** Data was less consistent for this task, and only minor changes were found between the control groups of 2002 and 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 adult group improved from 73 to 77,  $t(37) = 3.37$ ,  $P < 0.01$ .

**Information task.** A striking decrease between the 2002 experiment group and the 2007 control group was found in the 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 to 55,  $t(36) = 8.8$ ,  $P < 0.0001$ . The adult group showed the smallest drop, from 86 to 83,  $t(37) = 2.72$ ,  $P < 0.05$ . All differences were statistically significant.

## Discussion

In this study, significant changes in digital skills through time were found after 5 years (Table 1). Despite that differences between the age groups retained the same pattern, their magnitude after 5 years changed significantly. The older participants improved significantly more than the younger participants and almost closed the gap between them in the tasks that emphasize experience and technical control (photovisual and branching tasks).<sup>4,10</sup> On the other hand, for the tasks that emphasize creativity and critical thinking (reproduction and information tasks),<sup>4,8</sup> the performance of the younger participants decreased significantly, whereas the adults improved slightly. Consequently, the gap between the two groups widened for these skills in favor of the adults.

Adding new control groups, identical in age and composition to the experiment groups tested in 2002<sup>7</sup> (Table 2), enabled us to hold constant the age. Because the control group (2007) performed significantly different from the experiment

group of 2002 and similar to the experiment group of 2007, we can conclude that neither the age factor nor the fact that it was a retest can explain the observed changes through time in digital skills. On the other hand, comparing the performance of each age -group in 2002 and the equivalent control group in 2007 reveals a significant difference for all age groups and in all literacy skills. This clearly suggests that the 5-years' experience and familiarity with technology gained by the participants between 2002 and 2007 is the main factor responsible for the significant changes over time in digital literacy skills found in this study.

Results have implications to educators: on one hand, they illustrate the potential of experience and training in improving users' performance with digital technologies, but on the other hand, for the more critical and creative skills (i.e., reproduction and information), experience and exposure to information seem to have a negative effect on the users' performance, as illustrated by the sharp decrease over time among the young participants in both the 2007 and control group.

## Disclosure Statement

No competing financial interests exist.

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