

## Difference in memory recall among medical students after reading printed text (hard copy) vs. on screen text (soft copy)

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### Abstract

**Objective:** To compare the difference in "memory recall" among undergraduates (UGs) and postgraduates (PGs) medical students reading printed text (hard copy) vs. on-screen text (soft copy).

**Methodology:** Final year UGs medical students (Group A) were divided into two batches, one batch was given hard copy of 1258 worded text and other group was given a soft copy of the same text. Likewise PGs (Group B) were divided into two batches, each batch was given hard copy and soft copy of the same text material with identical physical attributes. All batches were asked to read the text in 15 minutes. Text was then removed and a proforma containing statements pertaining to recall of the text material was administered to all.

**Results:** The scores of students reading soft copy text were significantly higher compared to student reading text from hard copy ( $p < .008$ ) in the proforma assessing memory recall.

**Conclusion:** The memory recall from reading on screen text is better than reading printed (paper) text, implying that with the advancement of technology and early exposure to computer screen, students are developing the habit of reading on screen text more conveniently.

**Keywords:** Memory recall, Soft vs. hard copy, Paper vs. screen text. (JPMA 71: 1450; 2021)

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### Introduction

The ability to recall involves the process of bringing information stored in memory into conscious awareness during simple expression, narration and comprehension of information.<sup>1</sup> A number of studies have shown that multimodal stimulation achieves higher memory retention and recall than unimodal stimulation.<sup>2-5</sup>

Learning attitudes are changing as e-reading technology is progressively growing faster.<sup>6</sup> Globally, readers are abandoning printed text in favor of on-screen text reading. Research done by Santana<sup>7</sup> concluded that reading printed text lead to better recall. In this study, the participants' who read printed text were able to remember more news stories than those who read the same stories on line of "The New York Times". A couple of other studies derived similar conclusions.<sup>8,9</sup>

Walma Vander Molen and colleagues<sup>10</sup> in a study, attempted to find difference in children's recall of new information presented audio- visually and in print form. The result of a cued recall test showed that children who had watched news on television remembered more than those who received the same text in print regardless of their reading proficiency or expectation of memory test.

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Dillon, in his review article<sup>11,12</sup> stated that there is no difference in comprehension between the two media; however, he found a negative correlation between reading speed and comprehension. Reading speed was much slower and fatigue was more while reading from screen vs. reading printed text material.

Sparrow B et al demonstrated that internet has affected memories; they showed people were more likely to remember having access to a computer and vice versa. As they thought they could later look up the trivia statements they have read.<sup>13</sup>

There is paucity of literature on short term memory retention and recall of information learned through printed text compared to information learned through on-screen text. This study was done to identify the difference in recall among medical students while reading text in two different medium i.e. on screen text vs. paper text. This study was also intended to help in making informed decisions about going paperless or not in an academic environment.

### Methodology

This Quasi-Experimental study was done at Dow University of Health Sciences (DUHS), Karachi, Pakistan in 2016. A total of 125 students [62 students of MBBS final year and 63 Post Graduate (PG)] were included in the Study. Each group was further equally divided into two. All the students knew how to use MS Office and had been

using computer for more than a year.

Students who had no exposure to computers or could not read or type on screen in English were excluded.

A written consent was obtained from all the students. They were briefed about purpose and procedure of the study and were explained proforma which had 20 statements with a Likert Scale to be filled at the end of reading task.

Students were then divided into two groups with equal number of MBBS student and post graduates in each group. Both groups were given text of similar font size, style and background colour and were asked to read the text in 15 minutes. The text used did not relate to the students respective medical curriculum to ensure that level of training has not influenced their learning ability.

Group 1 students were given printed text script (hard copy), whereas Group 2 students were given on screen text (soft copy).

Prior to study, text material was pilot tested on group of senior doctors (N=10, 5 males and 5 females) to determine average time needed to read the text and identify problems in comprehension of text material.

**Data Analysis:** Data were entered on SPSS version-17 and

the responses were combined to create a composite score.

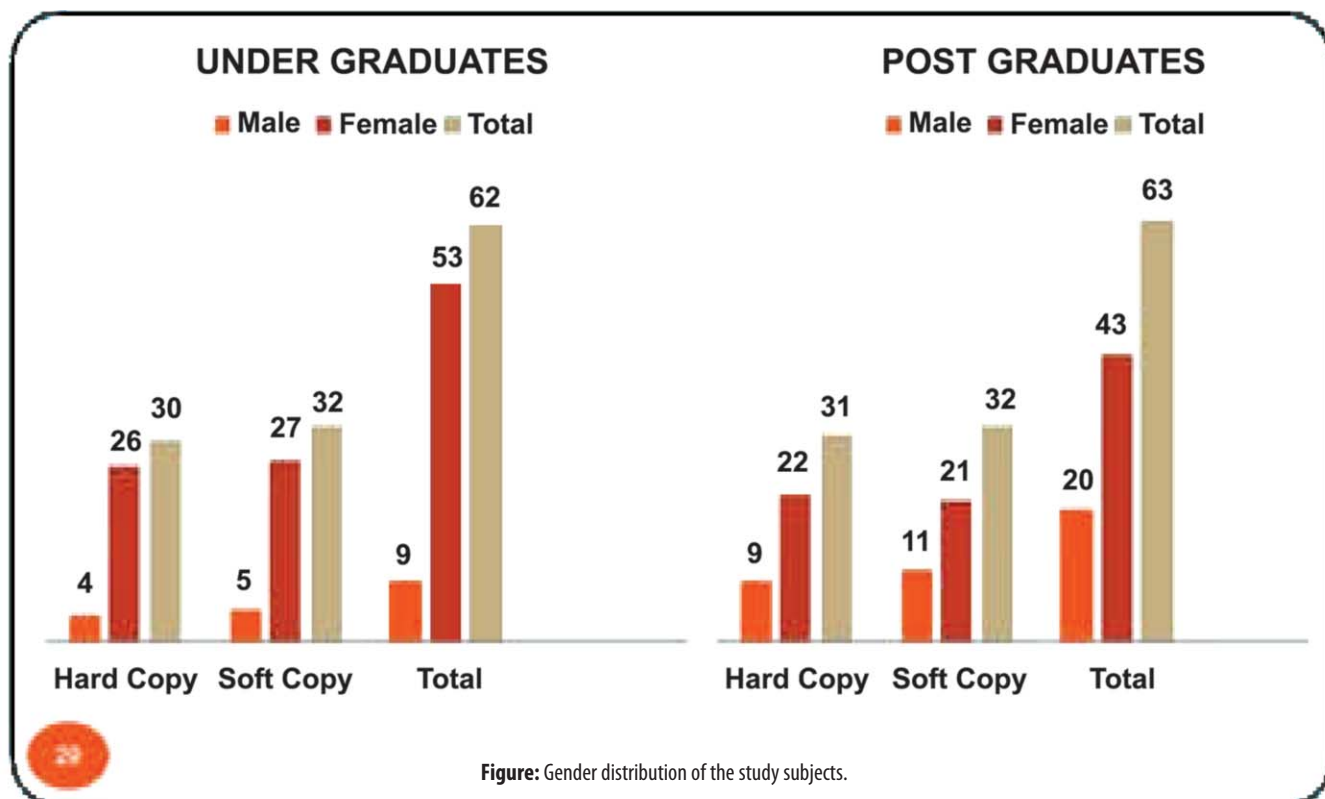
The means of composite score of each group were then compared. Parametric analysis of means of both groups (soft copy vs. hard copy) was done using analysis of variance (ANOVA).

## Results

This study included 125 students; 62 in the hard copy reading group and 63 in the soft copy reading group (Figure). Females predominated in both the groups and were equal in the two groups. Mean age of students in UGs group was  $22.95 \pm 0.64$  years (range 22-24 years). Mean age of students in PGs group was  $27.71 \pm 2.70$  years (range 24-38 years, only one student was 38 years of age, remaining PGs were less than 30 years of age).

Significant difference in memory recall was found between the scores of students who were given soft copy compared to students who were given hard copy ( $p < .008$ ) (Table-1). The mean difference in scores among students reading hard vs. soft copies was significantly better among those who read soft copy. The difference was present among both undergraduates and postgraduate students (Table-2).

The difference in recall among the UG versus PG students



**Table-1:** Details of the difference in scores in items recall among students.

Items	Hard copy (mean)	Soft copy (mean)	F	Sig
Q1	3.37	3.14	.609	.437
Q2	2.08	1.98	.134	.715
Q3	1.62	1.63	.001	.978
Q4	3.46	4.33	9.747	.002
Q5	4.12	4.25	.318	.574
Q6	1.40	2.00	6.95	.009
Q7	1.11	1.17	0.323	.570
Q8	1.29	1.47	1.321	.253
Q9	1.14	1.30	2.296	.132
Q10	2.30	2.73	1.99	.160
Q11	1.22	1.58	4.82	.030
Q12	4.40	4.57	.786	.337
Q13	3.56	4.06	4.57	.034
Q14	3.43	3.25	.429	.514
Q15	4.06	4.17	.234	.629
Q16	1.41	1.69	2.92	.090
Q17	3.03	3.09	.050	.824
Q18	4.51	4.53	.020	.889
Q19	3.08	3.34	.833	.363
Q20	1.29	1.42	.719	.398
	51.96	55.79	7.24	.008

**Table-2:** Mean scores of students reading hard vs. soft copy.

Participants Level	Copy to be read	Mean	N	Standard Deviation	P value
Undergraduate	hard copy	51.2000	30	8.02754	0.590
	soft copy	55.7097	31	7.81108	
Post graduates	hard copy	52.6875	32	6.69828	
	soft copy	55.8750	32	9.23790	
Total	hard copy	51.9677	62	7.34840	
	soft copy	55.7937	63	8.49698	
	Total	53.8960	125	8.14567	

was insignificant (F: 0.292, P <0 .590). The average reliability of the whole test (20 items) was 0.548. The reliability of Hard copy was 0.413 and soft copy was 0.599.

The likelihood of similar responses could be explained on the basis that the two groups of students were very closely matched in terms of computer literacy and cognitive skills.

The internal validity of the study was ensured by balanced representation of participants and situations, pre-testing (pilot testing) of study material, logical/empirical relationship of content tested to achievement domain and understandable, accurate descriptions and interpretations of scores for the students. Credibility and

plausibility was ensured by persistent observation and debriefing of the study group.

## Discussion

Results showed that short-term memory recall among students is significantly better while reading from soft copy as compared to reading from hard copy.

There is an ongoing debate that hard copy paper reading is far superior to electronic text by virtue of its unique tactile quality, portability and reading on one's own time plus intimacy of interaction.<sup>14</sup> However, our study findings are contrary to it. Ted Nelson<sup>15</sup> mentioned that the e-text will soon replace paper in short time of less than 10 years or so we shall all be reading from screens as a matter of routine. Our study favours his point of view and has proven that our participants, medical students, have developed the habit of reading from screen.

Most studies done in 80's and 90's<sup>16-18</sup> supported the argument in favour of printed text; the type and quality of Virtual Display Unit (VDU) may have affected their result. With the improvement in quality of VDUs, the difference was found to be minimal in later studies. McKnight compared two versions of hypertext, a word process file and a paper copy of a document reported no significant difference between paper and word processor.<sup>19</sup>

Although reading from screen is significantly better in our study, contrary to our earlier assumption, there was no difference in recall among various levels of students (under graduate vs. post graduates). One possible explanation was similarity between groups in terms of age, sex and computer literacy. This is in concordance with the study on a group of 266 German medical students from 9th and 10th semesters who were administered test in two versions (paper based and computer based) to determine influence of both on student's performance. There was no difference in test results between both student groups of administered paper-pencil test vs. computer based test. Though the paper-pencil group managed within allocated time but students using computer needed significantly less time to complete the test. In addition, guessing was significantly more among students using computers, most of them were low achievers, and the latter was not explained.<sup>20</sup> Our study has not taken into consideration guessing and time factor to complete reading. One of the major differences between readings from paper versus on-screen is the ease of manipulation of text material between the two media. Manipulation is an intrinsic part of reading process. It is achieved either manually (using fingers to turn pages) as in paper text or through scrolling or use of mouse or key board as in reading on screen.

Earlier studies<sup>21</sup> reported that subjects find text manipulations on screen more difficult than on paper. However, current applications like hypertext, support rapid movement among various sections of text. Students familiar with this innovative technology were more at advantage as readers of electronic text.

Researchers<sup>22</sup> have indicated that outcome and process measures are factors that affect reading behaviour of students. In our study, both factors were given due attention during planning of the study. Outcome measures included accuracy of recall, amount of information retrieved and time taken to read the text (by pilot testing). Process measures included identical setting for all groups, proper illumination of the hall, proper selection of size, colour and background of reading text and avoidance of manipulation of electronic text like hypertext and speed. Egan<sup>20</sup> in a similar study using hypertext version concluded that comprehension could be significantly improved by restructuring the text.

Accuracy of reading i.e. recalling certain sections of text material in number of studies<sup>23,16,24,25</sup> has shown no difference in reading hard copy vs. screen text. Most of these studies had tested individual's ability to identify errors in proof reading. Our study is different as it simply measured short term recall of text read in measured time (15 minutes). Since time factor (not the speed) is controlled in our study, the result is more dependable.

In most studies,<sup>25,26</sup> no significant impact of presentation medium was noted. Bellmore<sup>27</sup> found a significant decrease in comprehension and speed in subjects reading on screen text. However, his further analysis has shown that effect was only found in those subjects who were exposed to computer screen for the first time. Unlike Bellmore study, subjects in our study were regular users of computers and had at least one year of experience of using computer and were familiar with reading on screen text. This might have made the difference in result.

Most of the studies done in the past favouring printed copy over soft copy were done on relatively novice users of computers; it is possible that results were contaminated by subject's negative predisposition towards reading on screen text.<sup>28</sup> However, recent evidence<sup>27,29</sup> suggested that 50% of subjects in comparative study group have expressed preference for screen, implying that preference is now shifting to reading on screen text as screen technology and familiarity with onscreen text is improving. Our study concurred with this, as our study population was found to be more comfortable with computers.

Reliability in our study was 0.548. This low reliability is probably due to similarity of the study groups. One possible limitation of the study was that reading text was simple without addition of figures, tables, algorithms or pictures. This might have affected recall or comprehension. Although our study has applicability within a defined set up and results could be extrapolated, however, generalizability of results is limited.

## Conclusion

There is significant statistical evidence that memory recall from reading on screen text (soft copy) is better than reading paper text (hard copy), implying that students are developing habit of reading text from computer screen. There remain a number of confounding variables needing further exploration like speed of reading, long term memory retention, and impact of image quality on reading speed on both the medium.

**Ethical Approval and Consent for Participation:** The study was approved by the Institutional Review Board of DUHS. Written informed consent was obtained from all students (undergraduates and post graduates students)

**Disclaimer:** None to declare.

**Competing Interest:** The author's declare no conflict of interest

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