# Learning and Knowledge Application: Electronic versus Printed Material

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## ABSTRACT

Increasing use of computer technologies within teaching has important implications for learning. This study investigated levels of learning for print and electronically presented material. Identical material was presented in printed form or on an Intranet facility. A between-subjects design was used to test correct responses over four sessions. Ratings for confidence and for the nature in which each memory was recalled were obtained. The latter, 'awareness' [1], was used as a known, reliable measure [2] to reflect levels of memory indicating knowledge application. A significantly higher number of correct responses were found for the printed material. Memory awareness scores differed significantly. Age, sex and degree of computer expertise could not account for the between group variation. The findings suggest that computer based material may be cognitively assimilated and processed differently.

## Keywords

Learning, knowledge application, memory awareness, printed and electronic text.

## INTRODUCTION

Research on performance comparisons for electronic and printed text has been undertaken since the inception of computer presented information. Findings have varied [3], but overall they suggest slower reading speed, increased visual fatigue, higher error rates and lower preference for electronic text. Different methodologies, stimuli quality and possible sampling bias [e.g. high use of undergraduates] suggests, however, that such results may not be valid indicators of the degree to which knowledge acquisition may vary in relation to presentational format.

Learning is a complex skill that not only requires acquisition, remembering and recollecting, but also the application of the acquired information [4]. Memory recall scores have frequently been used to assess learning performance. However, it is possible that this form of measurement may not adequately reflect the degree to which retained knowledge can be applied, arguably an essential component of the learning process.

Tulving [1] suggested that the nature of memory recall is indicative of different types of long-term memory. He described two states. 'Remember' is where items are

recalled in association with information about the actual learning episode, e.g. a mental image of a page in a book. By comparison, 'know' is recalled knowledge without recollection, the item is just known, e.g. one's name. It was found that type of learning was dependent upon the nature and presentation of the materials [5]. Higher-grade students gave more 'remember' responses to questions relating to practical classes and more 'knows' for lecture material. In addition, these students showed a greater shift toward 'knows' when re-tested on practical class content. It appears that information needs to be in the 'know' state to allow better application and thus, a higher level of learning. A pilot study supported this view, finding significantly higher levels of accuracy for knowledge in the 'know' state. This study set out to explore learning levels for both electronic and printed material.

## METHOD

Participants [23 males & 28 females] were tested on the same questions four times over three weeks, together with additional questions in the final session. Learning material was consistent in content and visual presentation for both conditions.

## RESULTS SUMMARY

The increase in learning, as measured by score gains between tests 1 and 5, showed a significant difference in favour printed text, $p < 0.05$. 'Know' responses were consistently higher for printed material, $p < 0.01$. The first four test results were:
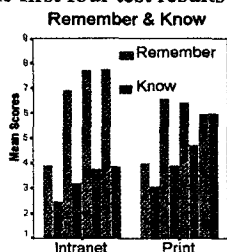


Remember & Know

The differences found could not be explained by variations in age, sex or computer experience [including experts]. No differences in accuracy were found between 'remember' and 'know' responses.

## CONCLUSIONS

Learning was shown to occur from both presentations. Quantitatively there was a lower level of learning for electronic material, however, 'remember' and 'know' were equally accurate. This suggests memory awareness may be indicative of differences in learning processes between electronic and printed material. Rather than lack of accuracy, it may be that findings were the result of another factor, e.g. speed and/or ease of application. This has implications for the presentation of learning material. Research into presentational aspects that may influence learning continues.

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