

RESEARCH ARTICLE

Cognitive effects of varied media platforms

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ABSTRACT


Background: Recent technological advances and constant digital innovation provided society various electronic media platforms as convenient alternatives to costly printed materials. **Aim and Objective:** This study aimed to determine whether the type of media platform influences the cognitive ability of an individual to construct and extract meaning from written texts. **Materials and Methods:** Using a randomized completely block design, students were assigned to one of the four media platforms: printed material, desktop computer, tablet, and smartphone in viewing a standardized reading comprehension test. Mean scores were compared using two-way analysis of variance with media platform and sex as factors. **Results:** Mean scores in the different media platforms ($P = 0.82$), effect of sex as a blocking variable ($P = 0.35$), and the presence of interaction effect between factors ($P = 0.33$) on the reading comprehension abilities were not statistically significant. **Conclusion:** Cognitive effects in constructing and extracting meaning from written texts across varying media platforms and sex groups do not significantly differ suggesting that technology can be utilized as an alternative by students and teachers to advance reading outcomes.

KEY WORDS: Reading Comprehension Ability; Media Platforms; Computer; Printed Material; Smartphone; Tablet

INTRODUCTION

Reading has a significant role in education and has a critical part in our lives as it spells survival and better opportunities in the literate world. Over time, our way of reading progresses from simple recognition of individual words to making complex inferences out of the text, and this involves processing and understanding of the text's linguistic message - which is

comprehension. Reading comprehension is the ability to understand and actively construct meanings of what is read, and an interactive process wherein the reader uses reasoning to bring about meaning and draw appropriate inferences from the text.^[1] The construction of meaning happens as people read, and comprehension is central to reading.^[2] However, although comprehension always attends to what is coded or written in the text, the created meaning is greatly influenced by the reader's world knowledge and background experiences.^[3] This is a product of two equally important skills: the ability to decode and the ability to understand the linguistic content.^[4] Decoding is the ability of readers to recognize and to process written information which involves locating and recalling information, phonetics, and individual word identification.^[2] On the other hand, linguistic understanding refers to the ability to comprehend the semantic content of a language,^[5] dependent on the reader's grammatical skills, which includes

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syntactic and morphological knowledge, inference skills, and narrative visualization.^[6] In this component, the reader integrates, interprets, and critiques the information. If either is deficient, reading comprehension suffers. The process of comprehending is developmental and multifaceted, involving the orchestration of multiple skills.^[2]

The ability to extract and construct meaning from written text involves reading, reasoning, and drawing conclusions from a text, which in current day encompasses both its printed and electronic forms.^[7] Electronic books (e-books) first rose to popularity in the 1970s and became a more permanent fixture in people's lives during the 1990s.^[8] In the realm of research, the educational use of technology is particularly focused on because of its growing attractiveness to educators as a medium of instruction. The constant digital innovation offers a wide variety of media platforms, such as personal computers, tablets, and smartphones, but the downside of the rapid advancement is the escalating challenge of determining which media platform works best in the field of education.^[9] Many educational institutions rely on print materials to give students necessary information. However, ever since the introduction of digital text, educators became skeptical as to whether these are still suitable for students' use.^[10]

With the conflicting findings and no parallel conclusions from previous studies regarding the impact of technology on reading comprehension and the ongoing debate on printed material versus digital media along with available researches on either two or three media platforms, this study was conducted to determine possible differences on the reading comprehension abilities of students when varied media platforms, namely, printed material, desktop computer, tablet, and smartphone were employed. Further, the study also aimed to compare the performance of each sex group across the different media platforms and the possible interaction effect of these two factors.

Knowing whether the media platform affects a student's reading comprehension ability can be beneficial to students and teachers in determining whether to use new technology in school or not. Researches involving variations of reading platforms usually assessed outcome measures such as reading speed, readability of text, and efficacy or convenience of reading from electronic screens than its effects on the reader's comprehension ability or learning.^[10] As technology develops, computers are already able to very closely mimic the fonts and formatting of reading paper materials, appearing as if one is looking at a real piece of paper. Although visually similar, the question of electronic platforms allowing as much comprehension to readers as the paper version remains.

MATERIALS AND METHOD

Sample Size Determination and Selection of Participants

The sample size computation was based on the effect of e-books on reading level, reading behaviors, and attitude of second-grade students,^[11] with 5% level of significance, 80% power, with mean (standard deviation [SD]) values of 76.05 (10.29) and 61.67 (6.20), the desired sample size per treatment group was computed to be six. However, researchers decided to increase to seven, four males and three females, within each treatment group due to the availability of volunteer participants. This study population consisted of 1st-year college students enrolled in a specific degree program, assumed to be homogenous with regards to their intellectual capability based on their entrance credentials into the program and familiarity with the four media platforms. The study did not consider the reading behaviors of the participants as a factor in their reading. The participants were given proper orientation and were requested to accomplish the consent form before taking the test. This study protocol adhered to the existing institutional ethical guidelines.

Selection of Test Instrument and Outcome Measurement

Current measures of reading comprehension have already been standardized to suit the supposed mental levels of the readers. In test standardization, types of questions are narrowed down into categories - inferences, tone and author's purpose, and objective questions. The subject of the text may be unpredictable, but it will not matter if the reading skills and techniques are rooted in the reader.^[12] In this study, the assessment of reading comprehension ability was based on a standardized multiple choice reading comprehension test designed by the Department of Education and Training of the State Government of Victoria, Australia. This test was presented to the participants based on their assigned treatment groups. The answer key for the test was also acquired.

Technological Devices and Equipment

Identical units of the electronic platforms were used in the execution of the experiment. This study utilized seven identical units of tablets (Apple iPad Mini), seven identical units of smartphones (Apple iPhone 5S), and seven desktop computers.

Data Collection and Statistical Analysis

The password-protected portable document formats (PDFs) files of the test were copied to the electronic devices used in the study. A copy of the test was displayed depending on the assigned treatment. Treatment 1 had all test copies printed on single-sided 8.5 × 11-inch plain white bond paper. Treatment

2 had all test copies viewed on the Adobe reader installed in the computer units. Test copies were viewed on iBooks, an Apple application, for the treatments 3 and 4. A separate answer sheet was provided to the participants, and these were submitted at the end of the 30 min time allotted for the test. The researchers checked the participants' answers based on the answer key also provided by the Department of Education and Training of the State Government of Victoria, Australia. After all the answer sheets were checked and the scores counted, statistical analysis was done on the collected data using a two-way analysis of variance to determine if the observed mean scores differ significantly among the different platform media, between sex group, and a possible presence of an interaction effect between these factors. Statistical analysis was carried out at 5% level of significance using Bill Miller's Open Stat software with values reported as means with their respective SD.

RESULTS

Among the 28 participants, the overall mean was 63.71% with an SD of 11.43% (Table 1). The scores ranged from 34.00% (in the tablet platform) as the lowest to 84.00% (in the print platform) as the highest. The highest mean of 67.14% was identified in the printed platform, whereas the lowest mean of 61.43% was found in the tablet platform (Table 1). Further, the overall mean reading comprehension scores across different platform media among females was greater than those of the males (Table 1).

Possible interaction regarding the two factors employed in this study was also assessed; it was in tablet as the medium platform where female participants noted to have the highest mean score in reading comprehension as compared to the male participants having the extremely low mean score (Table 1). The mean scores of the students across the varied media platforms did not differ ($P = 0.82$). Likewise, the mean scores of the participants between two sex groups did not significantly differ ($P = 0.35$). Further, assessment of the possible interaction between the two factors considered

in this study showed that no such interaction exists between these factors ($P = 0.33$).

DISCUSSION

Since technology has become a vital part of every aspect of our lives and is used by almost everyone nowadays, we can use it for educational purposes to provide new learning experiences and content.^[13] It can now bring structural changes that can be used to attain significant improvements in productivity. Technology has many uses in enhancing both the teaching and learning process. Digital learning tools can support learning 24/7 as well as add new course offerings and experiences to the average classroom. Technology also gives way to a new method of teaching called connected teaching. In fact, with the use of technology, 48 US states and the District of Columbia now support virtual or online learning.^[14] Moreover, mobile phones and internet connectivity are now important parts of a typical student's life. A 2013 survey has shown that 60% of students are using their mobile phones for research. The survey showed that students also use their mobile phones for other academic-related tasks such as playing educational games, collaboration with peers, schoolwork reminders, and taking photos of assignments or notes, among others.^[15] Since many of today's information comes in PDFs and other electronic formats, students need to be well versed with technology to fully appreciate and use these new sources of information.^[16] Aside from helping students, technology can also aid teachers with their jobs. Technology helps teachers give individualized instruction to students since each student acquires knowledge at a different rate. Integrated learning systems are computer networks which teachers can use to give each student a different learning method.^[16]

Another major benefit of using technology in education is the ability to use videos. Videos benefit both teachers and students. Teachers can use these videos during lessons to explain lessons more thoroughly. In fact, a survey showed that 46% of teachers used videos in the classroom. Students can also use videos to help them in their homework. YouTube is now a popular site for students who use channels such as "Crash Course" and "Khan Academy" to help them with their learning.^[15] Technology is present everywhere, especially in education. Our educational system is being challenged to make a change using technology to further improve learning and help both the teacher and student improve.^[13]

Although prior studies in determining the difference between a liquid-crystal display monitor and a traditional paper format in reading performances of teenagers showed that teenagers scored significantly higher on the paper reading comprehension tests than on the electronic ones, it was reported that it took longer time to read passages and answer questions on the screen.^[17] It was also observed that reading speed on paper was nearly 12% faster than computer screens,

Table 1: Mean scores of participants in the different media platforms

Media platform	Sex group, Mean±SD		
	Males	Females	Combined
Printed material	68.50±13.70	65.33±7.02	67.14±10.64 ^b
Desktop computer monitor	61.00±14.83	64.67±11.55	62.57±12.58 ^b
Tablets	53.50±14.27	72.00±4.00	61.43±14.32 ^b
Smartphones	64.50±9.00	62.67±12.06	63.71±9.48 ^b
Combined	61.88±13.07 ^a	66.17±8.72 ^a	63.71±11.43

SD: Standard deviation, Maximum score=100. Values denoted by the same superscript letter are not statistically significant: ^a $P=0.35$, ^b $P=0.82$

and the paper-based rate of comprehension, grounded on test scores, was approximately 15% more than online reading.^[18] Although students significantly scored better on reading comprehension tests after reading printed books than e-books, they showed increased satisfaction and interest toward e-books. This study even concludes that e-book technology, despite being more flexible and accessible than printed books, do not yet equal the readability and richness of printed books.^[6]

In some instances, results showed that despite significantly slower reading speed in computers, comprehension scores did not significantly differ across presentation mode, and the participants under computer condition had higher scores of overall recall.^[19] For the participants who were given a choice during instruction hours to both use e-books and paper books, they displayed significant reading level gains compared to those who used traditional books only.^[11] On comprehension using an essay examination tool, subjects who used the hypertext (on screen) version scored significantly higher marks than those who used the paper book, and the ability to restructure text (highlight, increase font size, etc.) with technology can improve comprehension.^[5]

In this study, however, results were found to be similar in the previous findings^[10,20] as reading comprehension is not significantly affected by the variations in the media platforms. However, a study comparing the reading comprehension across computers, e-readers, and paper indicated that these three modes of text presentation did not significantly affect the participants' comprehension of narrative and expository text.^[10] Furthermore, when readers were asked to immediately answer questions about a short story read either on paper or screen reported no significant comprehension difference between readers using either media.^[20] Apparently, these prior researches regarding the impact of technology on reading comprehension have not yet reached parallel conclusions. The medium of presentation affects the reading process but it is extremely challenging to quantify and establish such differences empirically.^[21] Situational changes through technological advancements may be the reason why findings differ from one study to another.^[18] These issues would be addressed as our understanding of the reading process gradually improves.^[21]

E-reading was first introduced for personal use, and it is now a fast-growing trend that reflects a larger story of shifting from printed to digital material. By February 2012, 21% of American adults have reported the use of an e-book. However, e-reading is not just limited to e-books, as long-form content of magazines, news articles, and journals have also been made available by other digital formats viewed on an e-book reader, tablet, computer, and cellphone. In December 2011, 43% of Americans age 16 and older have been recorded to have used these alternatives. E-reading has also proven its

convenience and use to 41% of tablet owners and 35% of e-reading device owners, as they claim to have read more since the start of the e-content trend.^[22]

E-books, being authenticated replications of books in digital format, have dramatically increased in terms of supply and demand during the past several years, whereas e-reading has penetrated the educational setting with electronic textbooks being an alternative to high-priced traditional textbooks. The usage of e-books among researchers and librarians has been developing, with e-books being a growing part of collections among academic libraries. As a testament to this rapidly expanding industry, new publishers, such as Freeload Press, have started to offer cost-friendly and free e-textbooks to students.^[23]

Results of the present study showed that there is no significant difference in reading comprehension scores across the different media platforms. Hence, reading using electronic platforms can be established as an alternative to traditional reading using printed materials. Students and teachers, therefore, may be encouraged to view and give, respectively, reading assignments on these platforms instead of utilizing consumable resources such as paper.

For over a century, educational instruction has been carried out with the use of printed material. Reading materials are usually found in periodicals or books.^[10] With the advent of new technological tools, more and more students are turning to computers, tablets, and phones for the reading materials that they need.^[15] Studies have also shown that using technology can help with improving students' reading comprehension ability. E-books can be used to assist beginning readers achieve their goals, the visual and auditory elements of the e-book can give these beginners more motivation, and higher levels of interest for these elements can help reluctant readers enjoy reading more than if read on paper.^[24] It was also found that the use of interactive books on computer screens gave students more interest in reading. It was found more enjoyable, exciting, and meaningful by the students. The e-book gave even the most reluctant readers more motivation.^[25] Research has also shown that using computers for reading instruction can give teachers more time to focus their attention and effort on their students.^[2]

CONCLUSION

Findings of this study pointed out that there is no significant difference in the cognitive effects of the four identified and employed media platforms. In general, many studies have shown that technology has the potential to advance reading outcomes and more studies should be done to know more about helping students and teachers use these available technological advances.

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