

Research Article

Screen Reading vs. Paper Reading: Effects on EFL Students' Reading Comprehension

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ABSTRACT

The effect of the shift to screen-based reading versus print-based reading on comprehension has been raised as a concern. This quasi-experimental study investigated the effect of reading modality on the reading-comprehension performance of 111 intermediate students of Iranian university studying English as a foreign language (EFL). Group homogeneity was achieved by administering the TOEFL junior placement test; the participants were randomly chosen and placed in an instructional condition of screen-based ($n = 57$) or print-based ($n = 54$). The two groups were read the same texts and provided with the same comprehension tests in over ten instructional sessions. As shown by independent sample t-test, there was no statistically significant difference between the two modalities, $t(109) = 1.97$, $p = .051$, though the print-based group had a slightly higher mean score ($M = 58.90$, $SD = 16.63$) as compared to the screen-based group ($M = 52.85$, $SD = 15.65$). A small-to-medium effect size (Cohen, $d = .37$) implied a slight practical benefit of print reading. Conversely, the screen-based group said that they had more positive attitudes towards digital reading. The gap between attitudes and performance reflects that a higher level of interest in using the digital platform is not always accompanied by a better understanding. On the whole, this results in the fact that modality of reading does not have a decisive impact on EFL reading comprehension. The combination of digital resources and print-based resources with explicit teaching of metacognitive reading strategies is thus advisable.



Introduction

The rapid adaption of digital technology has transformed the way people do literacy in the world. With the move to screens (computers, tablets, smartphones) as a replacement of paper-based reading (Mangen, 2023), concerns have been raised about the prospect of this change affecting cognitive processing and comprehension. Albeit, the advantages of digital reading environments are obvious (such as accessibility, interactivity, and flexibility), there are concerns regarding their utility in the tasks that are associated with continuously focused attention and profound understanding, which are needed when working within academic settings (Singer & Alexander, 2022).

Moreover, a large amount of the literature has found that there exists a so-called screen inferiority effect, which implies that readers tend to grasp more expository and scholarly text using print as the medium than using screens (Clinton, 2019; Delgado et al., 2018; Kong et al., 2020). Researchers believe that this effect is caused by various factors, such as scrolling requirements, reduced tactile feedback, increase cognitive load, and greater susceptibility to digital distractions (Fujii et al., 2023; Stolee et al., 2020).

Furthermore, the challenges can be even greater in the case of English as a Foreign Language (EFL) learners, who already have to cope with the linguistic restrictions that overburden their processing capacity. Digital interfaces are also capable of affecting key processes of L2 reading, including rereading, text mapping, and metacognitive monitoring (Grabe and Stoller, 2020; Zhang and Zhao, 2021). In that regard, it is still pedagogically important to learn how reading modality can affect the comprehension in EFL situations.

However, the results of the researches that are concerned with EFL learners are inconclusive. Other studies show that there are no significant differences in performance between modalities (Ansarin et al., 2017; Adeli-Jam et al., 2017), although the attitude to digital tools is positive in most cases. Some of them demonstrate the benefits of print, in particular, when it comes to tasks that involve a deeper intellectual engagement (Al-Seghayer, 2024; Freihat, 2024), whereas an increasing number of studies also indicate that even the digital reading can be as efficient in case learners are familiar with a particular device and are digitally literate enough (Kasper, 2022; Noyes and Garland, 2021).

Since the reading comprehension plays a crucial role in EFL education, and the learning environment is becoming increasingly digitalized, especially in the post-pandemic period, additional empirical research is needed. The current study is an addition to this research line since it compares the results of understanding and perceptions of learners presented in digital and print communication among EFL Iranian university students. In particular, it is going to examine (1) the premise that screen-based reading is associated with various levels of understanding as opposed to print-based reading, and (2) how students experience digital versus conventional reading experiences.

Literature Review

There are three compatible cognitive theories, which give an understanding of the effect of reading modality on comprehension processes. According to Dual Coding Theory (Paivio, 1991), information is encoded by using interdependent systems of verbal and visual encoding which makes the presentation format a central meaning construction

process. This is indicated by the Cognitive load Theory (Sweller, 2011) which points to the limitations of the working memory and argues that the extraneous load in the form of navigation requirements or interface complexity can undermine learning on the screen. In the same way, the Cognitive Theory of Multimedia Learning (Mayer, 2014) holds that the aspects of design predetermine the effectiveness of the readers to select, arrange, and synthesize information. Together, these structures show that the print platform could potentially constitute an understanding experience, providing visual consistency, predictable spatial indicators, and less cognitive load, whilst digital platforms could present an extra load through scrolling, glare, and broken designs.

Subsequently, the meta-analytic evidence is strong on showing that print reading gives a cognitive advantage as compared to digital reading. There was significant print superiority of expository texts, which Delgado et al. (2018) reported in a synthesis of 54 studies. These findings were supported in a meta-analysis of 33 studies by Clinton (2019), who described that the benefits of print could be observed most in academically oriented reading tasks. Kong et al. (2020) affirmed the same tendencies and explained the modality differences by reduced spatial stability, cognitive fatigue, and distractions that digital interfaces have.

Also, mechanistic studies help in explaining causes of screen inferiority. Space representations of the text are interfered with by scrolling, which causes problems with mapping the location of the information mentally (Mangen et al., 2013). Reading on the screen is linked to the more superficial processing and more skimming, as well as underestimation of the difficulty of the task

(Mangen, 2023). Physical pages, by contrast, offer greater support and encoding with more efficient retrieval based on their tactile and spatial affordances (Mangen and Kuiken, 2014).

Moreover, the effects of modality can be enhanced when it comes to English as a Foreign Language (EFL) learners, whose cognitive capacity is already overloaded with L2 vocabulary decoding, syntactic processing, and inference (Grabe and Stoller, 2020). Such language needs result in a reduced number of resources to navigate online interfaces. L2 metacognitive strategies of the rereading, annotating, and visually tracking texts are better supported by print materials that might be limited in electronic settings (Zhang and Zhao, 2021). There are a number of moderating factors that determine the modality effect on L2 comprehension. The more proficient EFL students seem to be easier to adjust to digital reading as they have more linguistic resources to utilize so that they can devote a larger portion of cognitive load to navigation and interface management. Conversely, the less proficient learners can be served better by the print materials, which can be easier to process, and offer more visual stability (Zhang and Zhao, 2021). There is also a modality effect contingent on the type of task: the deep-processing tasks, including inference and synthesis, are generally better performed in print, but the surface-based tasks of comprehension have little modality variation in outcomes (Mangen, 2023). Also, the properties of the devices are influential. On the one hand, tablets and e-readers are the devices with higher levels of understanding compared to smartphones or laptops, which is attributed to less visual load and fewer distractions on the screen (Fujii et al., 2023).

Besides cognitive and task-related variables, the interaction of individual differences also moderates the interaction of the learner with reading modalities. The stronger digital literacy or more positive views on digital reading tend to result in more persistence and engagement, which partially compensates the drawbacks of the screen-based setting (Kasper, 2022; Noyes and Garland, 2021). Text characteristics also engage with modality: short, well-organized texts with known vocabulary often show a smaller effect of modality but longer, convoluted academic texts, particularly those that require a consistent focus of attention and strategic processing, are all capable of showing stronger effects of print (Clinton, 2019).

Although there is plenty of literature, there are still a number of gaps. Desktop computers are used in many studies instead of modern mobile devices which restrict ecological validity. The studies conducted among EFL students show that they are rarely representative of post-2020 digital learning the conditions based on the prevalence of remote teaching. Little research examines particular digital reading patterns, such as scrolling or zooming and marking, and their effect on L2 understanding. Furthermore, the relations between the reading strategies and medium are under-researched.

To sum it up, the current research aims at filling in these gaps by comparing the efficacy of screen-reading with Iranian EFL students through the use of the latest digital technologies, assessing the performance of comprehension, and the perceptions of the learners.

Objectives of the study

The current research evaluates the level to which screen-aided instruction improves

reading comprehension skills among the EFL Iranian students in comparison with the teaching strategies based on the conventional, print-based materials. It further examines the perceptions of the learners with regard to screen reading environments versus traditional print-based practices.

In this prospect, the study objectives are the following:

1. To make a comparison on the effectiveness of using the screen-mediated supplementary tools on the reading comprehension of the Iranian EFL students with the one of similar non-digitized, print-based, instruction tools.

2. To examine the attitude of EFL learners towards screen reading as compared to the traditional print-based reading modalities.

Methodology

Research Design

This was a quasi-experimental, between-subjects design that was used in the study in order to establish the impact of screen-based versus print-based instructional modalities on the performance of reading comprehension.

Research questions and Hypotheses

RQ1: Does reading through the screen affect the reading comprehension of EFL students compared to print based reading?

RQ2: How does EFL learners' attitude towards the screen-based and the print-based reading differ?

H0: There is no statistically significant difference between reading modality and comprehension performance of EFL students.

H1: The reading modality produces a great influence on the EFL students to comprehend the performance.

Participants

The sample population of the first sample consisted of 190 volunteer students. Out of this population 111 intermediate-level EFL Iranian university students were chosen on the basis of their TOEFL Junior scores with the range of scores under one standard deviation

of the mean assumed to be homogeneous. The assignment was random with each group consisting of 57 participants in the experimental (screen based) and 54 in the control (print based) group.

Table 1

Participants and Baseline Proficiency

Major	Biochemistry	Biotechnology	Biology	Microbiology	Translation	Genetics
Participants.	20	15	20	20	11	25
Age	18-20	18-20	18-20	18-20	18-20	18-20
Gender	85% female					
First Language	Turkish					

Instruments

TOEFL Junior Standard Test

The testing of group homogeneity was done by the administration of the TOEFL Junior Standard Test. The test has 84 items among them are Listening Comprehension (20 items), Language Form and Meaning (42 items), and Reading Comprehension (22 items). The measure of reliability that is reported is above $r = .90$ (ETS, 2014).

Reading Passages

Mahboudi and Javdani (2010) provided ten expository texts (250400 words), and these were suitable to intermediate learners (CEFR B1B2). Some of the topics included science, culture, and technology, as well as social problems. The Flesch-Kincaid reading values were between 5.6 and 9.1.

Hypermedia Reading Program

The experimental group used a custom digital platform, with multimedia glosses (L1/L2 definitions), audio pronunciation, hyperlinked dictionary and encyclopedia tools, in-text search, and visual information (images, diagrams and color-based highlighting). The system was web-based and could be reached through the use of laptop computers and therefore did not need a lot of

training and the system had simple distractions.

Comprehension Tests

Comprehension tests were created by the researcher and given after every passage:

- True/False questions (4-5): literal understanding.
- Multiple-choice questions (5-6): inferential understanding.
- Sentence completion questions (3-4): integrative understanding.

The scoring was done in a dichotomous way (1 point), resulting in 1215 items per test. The mean test-retest reliability was $r = .76$ (.71 to .82).

Attitude Questionnaire

An experimental group was provided with a five-point Likert scale (1 -Strongly Disagree; 5 -Strongly Agree) comprising 25 items available after the intervention. It measured perceived usefulness (7 items), ease of use (5 items), motivation and interest (6 items), perceived learning outcomes (4 items) and preference and future use (3 items). The instrument proved to be reliable with a value of $r = .87$ and went through the validation of the expert review by three EFL teachers and one expert in educational technology.

Background Questionnaire

The questionnaire captured data on demographics, history of learning the English language, ownership of digital devices and previous experience of digital reading.

Procedure

The experiment was carried out in three consecutive stages. In the initial stage, all the 190 volunteers were administered with the TOEFL Junior Standard Test which was used as a baseline of proficiency test. After scoring, the samples were selected based on the fact that only those with test scores one standard deviation around the mean would be considered homogeneous and could be included. One hundred and eleven intermediate EFL students matched this requirement and were then randomly allocated to either experimental (screen-based instruction) or control (print based instruction) group.

Also, the intervention period was ten weeks. They both were taught the same set of instructions and the same overall lesson plans with weekly two-hour sessions. The control group was reading traditional printed materials: printed texts and printed dictionaries and conducting pre-reading vocabulary exercises, reading silently, reading aloud and post-reading comprehension tasks using any printed media only. They also done note taking and vocabulary exercises in line with the traditional classroom practice. The experimental group on the other hand was given a short orientation session to ensure that they were familiar with the digital platform and its hypermedia capabilities before the treatment commenced. The learners read passages over the screen in the multimedia gloss, pronunciation, visual, and searching program, which provided the learners with an opportunity to understand the reading

passages. Despite a difference in the modality of content delivery, both groups took the same paper-based comprehension tests so as to have measurement consistency.

During the last stage, which was the post-instructional stages, students in the experimental group were asked to answer the 25-item attitude questionnaire that was created to evaluate their perception of digital reading regarding usefulness, easy to use, motivated, learning results as well as their preferences to use it again.

Data Analysis

The SPSS version 18 was used to analyze the data. The test of normality was done using the Kolmogorov-Smirnoff test and the group variance was done using the Levene test. To compare the scores on comprehension, independent -samples t -tests ($\alpha = .05$) were used, and the effect size was estimated with the help of Cohen d. Frequencies and percentages were used to analyze the attitude data in a manner that expounded affective and evaluative orientation towards screen-based reading conditions by the learners.

Results

Preliminary Analyses

Kolmogorov-Smirnoff tests showed that there was normal distribution in both the scores on placement ($Z = 1.251, p = .088$) and reading ($Z = .705, p = .704$). The test used by Levene showed the homogeneity of variance ($F = .105, p = .747$). A t-test on independent samples showed no statistically significant difference in the baseline proficiency ($t = 1.292, p = .199$), which, in turn, has confirmed the equivalence of the groups.

Table 2*Tests of Normality*

Variable	N	Kolmogorov-Smirnov Z	Asymp. Sig. (2-tailed)
TOEFL Placement Test	111	1.251	.088
Reading Passage Scores	111	.705	.704

Performance in Reading Comprehension

Descriptive statistical tests showed that there were equal levels of performance under experimental conditions. The mean score in the control (print-based) was 58.90 (SD = 16.63, range= 20.70-88.00), and in the experimental (screen-based) the mean was 52.85 (SD=15.65, range=21.50-77.90).

Also, two sample t-test did not indicate that there is a statistically significant group difference ($t(109) = 1.974$, $p = 0.051$). The homogeneity of variances test by Levene did not show any violation ($F = 0.055$, $p = 0.815$). The Cohen d (0.37) obtained from the calculation shows that the effect size can be considered small to medium, and the print modality is directionally advantageous.

Even though the p-value of .051 is slightly larger than the conventional 0.05 of traditional 0.05, it is still within the gray zone of a statistical decision-making procedure as described by Lakens (2021). This trend in combination with the small-to-medium effect size (d $R^{-1} = 0.37$) and 6 points mean difference in favor of the print condition suggests a potentially substantive trend, which should be interpreted with care.

Moreover, the fact that $\alpha = .05$ is strictly followed justifies the retention of the null hypothesis that the modality of reading has no significant effect on the comprehension performance. Also, the identified mean difference of 6.05 points, which is equivalent to approximately 10% of the score continuum, might have practical educational implications, in particular, due to the accrual characteristic of the comprehension gains in language-acquisition context.

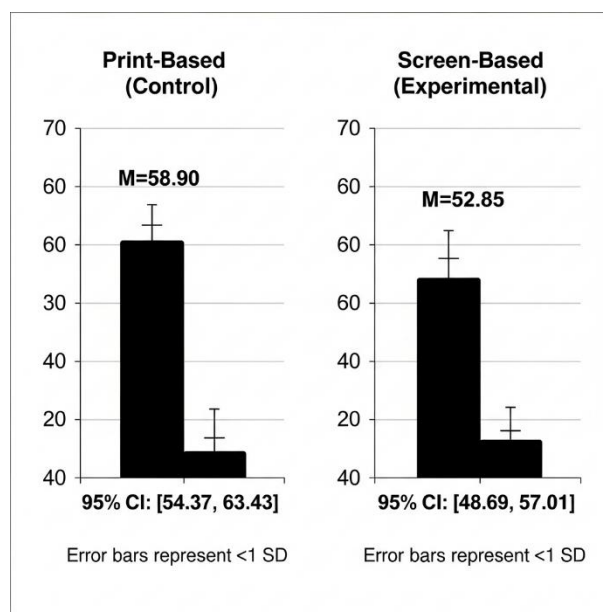
Furthermore, an estimated 65% power to detect an effect of this magnitude at 650 participants at 805, with 111 participants, demonstrated that the study achieved a power of this magnitude at the 0.05 level; A larger sample could have statistically significant results.

Also, the print superiority effect inclination is in line with the larger print superiority effect that is reported to be documented in meta-analytic studies (Clinton, 2019; Delgado et al., 2018; Kong et al., 2020), indicating that the effect under consideration is an authentic albeit small modality difference which can be mitigated by situational variables discussed further on.

Despite the fact that the null hypothesis is still officially held, the consistent trend of the print superiority which is presented in both the mean scores and the effect size should be given serious consideration in the pedagogical decision-making process, especially given the solid theoretical basis of the print superiority in comprehension-based tasks.

Table 3*Independent-Samples t-test Results*

Group	N	Mean	SD	Range	Levene's F	Sig.	t	df	p	Cohen's d
Control (Print)	54	58.90	16.63	20.70-88.00	0.055	.815	1.974	109	.051	0.37
Experiment al (Screen)	57	52.85	15.65	21.50-77.90						

Figure 1*Distribution Comparison**Attitudes to Digital Reading*

The respondents in the experimental group expressed incontrovertible positive responses regarding onscreen-based teaching. Key findings include:

-88.33% agreed computers were used to make the course interesting.

-74.99 percent were sure about the use of computers in reading.

- 69.99 per cent looked upon the program to augment vocabulary acquisition.

-71.66% of them considered computer-based tasks easier to accomplish.

-68.33 percent considered comprehension questions as a manageable item.

Table 4*Selected Attitude Questionnaire Items (N=60, Percentages)*

Item	Statement	SA	A	NI	D	SD
10	Use of computers made course more interesting	43.3	45.0	8.3	3.3	0
18	I felt confident using computers	28.3	46.7	21.7	3.3	0
6	Program helped me learn vocabulary better	33.3	36.7	18.3	11.7	0
17	It was easy to work on computer	33.3	41.7	21.7	3.3	0
22	I could finish reading faster on computer	38.3	33.3	16.7	10.0	1.7

Note: SA=Strongly Agree, A=Agree, NI=No Idea/Neutral, D=Disagree, SD=Strongly Disagree

Attitude-Performance Discrepancy

The level of comprehension did not surpass that of the control cohort in the experimental group in spite of the positive attitudes. This difference suggests that motivational and affective advantages of digital tools do not necessarily result in the gain in

comprehension, which agrees with the previous studies (Ansarin et al., 2017; Adeli-Jam et al., 2017).

To sum it up, none of the modality effects were statistically significant ($p = .051$), but the effect size ($d = .37$) was small-to-medium in support of print reading. High standard

deviations (16.63, 15.65) are evidences of high levels of variability at an individual level in groups. The beneficial study directions of the experimental group toward digital reading are not reflected in better understandings, which uncover an attitude-performance paradox that has important pedagogical consequences.

Discussion

The research did not establish any statistically significant difference, in reading comprehension between the screen-based and the print-based instruction of Iranian EFL students ($p=.051$). The small-to-medium effect size (Cohen, $d = 0.37$) and the mean difference of 6.05 in favor of print makes it a case to be cautiously interpreted, although still the null hypothesis is technically retained.

Also, the p -value of .051 is what Lakens (2021) defines as a gray zone, which can only be interpreted subtly over binary significance testing. The identified trend is consistent with the meta-analytic reports of small print benefits on academic reading (Clinton, 2019; Delgado et al., 2018; Kong et al., 2020), indicating a true yet insignificant effect which can reach statistical significance in larger sample sizes. A post-hoc analysis of power reveals that the study could have been underpowered with the current sample having about 65 percent power to identify this effect size.

Moreover, in practical terms, such a difference of 6 points (about 10% of the range of scales) may have significant educational benefit in the long term, especially since reading comprehension forms the basis of language acquisition.

Also, there are a number of contextual variables that must have moderated the anticipated screen inferiority effect:

-Text Characteristics: The intermediate-level expository texts (250 to 400 words) were fairly short and well-organized including controlled vocabulary. It has been found that modality effects are enhanced when longer and more complex texts need deeper processing that is done over time (Fujii et al., 2023; Mangen, 2023). The moderate text complexity that we used might have lowered the cognitive load of both modalities.

-Digital Scaffolding: The experimental group received access to multimedia glosses, audio pronunciation, hyperlinked materials and visual aids. Such scaffolds must have decreased cognitive load linked with navigating the digital content and vocabulary burden (Huang, 2022) and it may have neutralized the inherent disadvantageous nature of digital. This could be the reason why screen-based performance was relatively the same as compared to print-based performance.

-Learner Characteristics: The interviewees were motivated university students with intermediate level of proficiency and assumed moderate digital literacy. University students are better-acclimated to platforms (Zhang and Zhao, 2021), and because of their greater proficiency, this familiarity could have reduced platforms to minimal novelty effects that would otherwise compromise performance.

-Device and Interface: Visual strain and difficulty in navigation of smaller mobile devices was probably reduced by using laptop computers with larger screens and user-friendly interfaces (Fujii et al., 2023), which avoided the general drawbacks of digital reading.

One of the most interesting conclusions is the mismatch between the extremely positive attitude of learners have indicated that their interest and motivation have increased and

their similar performance in comprehension. The implications of this paradox are important:

-Motivational Benefits: Any positive attitude to digital reading can lead to a long-term engagement in literacy despite the absence of immediate understanding benefits. Improved motivation would indirectly contribute to the development of comprehension due to more voluntary reading with time.

-Metacognition Awareness: The attitude performance gap implies that there may be errors of calibration in metacognition. Learners are prone to false confidence because of the ease of digital navigation, the multimedia attraction, or the illusion effect due to novelty that have been reported in the literature of screen reading (Ackerman and Lauterman, 2012). This brings to focus the importance of an explicit training of metacognitive strategies in order to enable learners to make accurate self-assessment between modalities.

-Pedagogical Implications: As much as it is worth to exploit the motivational benefits of digital tools, a teacher should be aware that the positive attitude is not a sure-footed approach to understanding. Instructional design must leverage on the involvement advantages of technology and uphold evidence-based combating strategies of understanding.

Also, findings indicate that the same results as previous EFL studies in which null or small modality effects were found. Ansarin et al. (2017) and Adeli-Jam et al. (2017) also found no effect of comprehension in favor of digital tools even though learners felt positive about the tools. The implication of this pattern is that in EFL situations, where the demands of processing languages are high, the medium effects may be drowned in individual

differences in the level of proficiency, strategy application, and cognitive capacity.

Nevertheless, research on the benefits of print (Al-Seghayer, 2024; Freihat, 2024) usually included longer texts, more processing operations (inference, synthesis), or less digital support. This supports the fact that modality effects are based on the demands of tasks, features of a text, and technological affordances as opposed to medium. Additionally, this paper indicates more pedagogical studies:

-Balanced Multimodal Approach: Digital applications are to be used in addition to print media. Although digital-based resources have some benefits as to vocabulary support, multimedia interaction, and learner control, print-based materials still have some benefits when it comes to the tasks that need the ability to concentrate in one place, navigate in space and to have a lighter cognitive load.

-Task-Modality Matching: Congruence of instructional objectives and reading medium. Digital formats are appropriate in vocabulary development, skimming and motivation. Print formats are superior in terms of deep reading, critical analysis, lengthy texts, and tasks that need to be annotated and read over again.

-Explicit Strategy Teaching: Close the attitude-performance gap by teaching metacognitive strategies modified to suit online learning. Learners should be taught to track the achieved understanding, locate essential details, solve conclusions and use digital texts, which are needed not only in print reading.

Furthermore, Digital Literacy Development Cultivate cross-modal reading competence as an essential literacy outcome. The adaptive strategy use between modalities is a critical skill; modern readers need to use the platforms with great flexibility.

Besides, generalizability is limited by a number of factors. First, the intermediate passages can have reduced the modality effects; future studies need to be conducted on longer and more complicated scholarly texts. Second, the use of laptops only restricts the applicability to mobile devices (smartphones, tablets) that have other affordances. Third, the 10-session intervention might not be sensitive to the long-term adaptation. Fourth, the individual differences (digital literacy, reading strategies, working memory, metacognitive awareness) also should be investigated as possible moderators. Fifth, the comprehension testing was based on chosen-response items; further research has to incorporate constructed-response indicators and process indicators (eye-tracking, think aloud) to test the level of comprehension. Lastly, experimental settings can be neither realistic nor approximate of real-life digital reading conditions involving multiple-tasks and distraction.

In spite of these shortcomings, the study adds evidence on the modality effects in EFL settings that has been well controlled, presenting both the performance results as well as the perceptions of the learners to guide pedagogical judgments regarding technology integration.

Conclusion

The quasi-experimental study assessed the effects of reading modality on the understanding of the Iranian EFL students. One hundred and eleven participants were chosen at random as either screen-based or print-based. Statistical analysis showed no significant difference in the scores of comprehension ($p = .051$) though the effect size ($d = 0.37$) was small-to-medium and supported slightly the print condition.

However, learners also indicated significantly positive digital reading attitudes with 88 per cent of those being more interested and 75 per cent of them indicating greater confidence; the positive affective gains were not correlated with high levels of comprehension performance.

Also, these findings suggest that it is the modality that does not determine the outcome of comprehension. Meta-analyses have consistently described worse performance of screens in large groups of people, but performance rates leveled across modalities of moderate-length text, intermediate-level readers, and where the digitally-scaffolded reading was carried out. Therefore, modality effects seem to be affected by the features of learners, complexity of text, task requirement, and technological affordances.

Moreover, pedagogically, digital tools must be used to add on to and not to replace print. They help stimulate motivation, accessibility and vocabulary building, and print is convenient in a thorough understanding and long-term attention. The reported attitude-performance gap highlights the fact that the engagement benefits do not necessarily result in the learning gains.

To sum up, the future research must examine longer or more complex texts, mobile based reading, individual difference-based moderators, and process-based measures to provide a better understanding of the how learners interact with digital materials. In conclusion, it is the strategies of the learner, instructional aid, and the meticulous nature of the design of the learning materials that make the difference in the effective reading comprehension not the medium itself.

References

- Ackerman, R., & Goldsmith, M. (2011). Metacognitive regulation of text learning: On screen versus on paper. *Journal of Experimental Psychology: Applied*, 17(1), 18–32. <https://doi.org/10.1037/a0022086>
- Ackerman, R., & Lauterman, T. (2012). Taking reading comprehension exams on screen or on paper? A metacognitive analysis of learning texts under time pressure. *Computers in Human Behavior*, 28(5), 1816–1828. <https://doi.org/10.1016/j.chb.2012.04.023>
- Adeli Jam, Z., Ansarin, A. A., Farrokhi, F., & Mahboudi, H. R. (2017). Attitudes towards smartphones and tablets: Implications for mobile-assisted language learning. *International Journal of Applied Linguistics and English Literature*, 6(4), 138–146. <https://doi.org/10.7575/aiac.ijalel.v.6n.4p.138>
- Al-Seghayer, K. (2024). Digital reading vs. print reading: A comprehensive review of comparative studies. *International Journal of Emerging Technologies in Learning (IJET)*, 19(1), 208–225. <https://doi.org/10.3991/ijet.v19i01.45871>
- Ansarin, A. A., Zohrabi, M., & Zeynali, S. (2012). Language learning strategies and vocabulary size of Iranian EFL learners. *Theory and Practice in Language Studies*, 2(9), 1841–1848. <https://doi.org/10.4304/tpls.2.9.1841-1848>
- Aryadoust, V., Mehran, P., & Alizadeh, M. (2016). Validating a computer-assisted language learning attitude instrument used in Iranian EFL context: An evidence-based approach. *Computer Assisted Language Learning*, 29(3), 561–595. <https://doi.org/10.1080/09588221.2014.968111>
- Clinton, V. (2019). Reading from paper compared to screens: A systematic review and meta-analysis. *Journal of Research in Reading*, 42(2), 288–325. <https://doi.org/10.1111/1467-9817.12269>
- Clinton, V., Taylor, T., Bajpayee, S., Davison, M. L., Carlson, S. E., & Seipel, B. (2020). Inferential comprehension differences between narrative and expository texts: A systematic review and meta-analysis. *Reading and Writing*, 33(9), 2223–2248. <https://doi.org/10.1007/s11145-020-10044-2>
- Clinton, V., & van den Broek, P. (2012). Interest, inferences, and learning from texts. *Learning and Individual Differences*, 22(6), 650–663. <https://doi.org/10.1016/j.lindif.2012.07.004>
- Delgado, P., Vargas, C., Ackerman, R., & Salmerón, L. (2018). Don't throw away your printed books: A meta-analysis on the effects of reading media on reading comprehension. *Educational Research Review*, 25, 23–38. <https://doi.org/10.1016/j.edurev.2018.09.003>
- Educational Testing Service. (2014). *TOEFL Junior standard test: Technical manual*. Educational Testing Service.
- Freihat, S. (2024). Reading comprehension in digital versus print formats: An empirical study among EFL learners. *Reading Psychology*, 45(2), 145–172. <https://doi.org/10.1080/02702711.2023.2287654>
- Fujii, Y., Murakami, M., Nakashima, A., & Nagai, M. (2023). Effects of scrolling on digital reading: A cognitive load perspective. *Journal of Educational Computing Research*, 61(2), 401–424. <https://doi.org/10.1177/07356331221109936>
- Furenes, M. I., Kucirkova, N., & Bus, A. G. (2021). A comparison of children's reading on paper versus screen: A meta-analysis. *Review of Educational Research*, 91(4), 483–517. <https://doi.org/10.3102/0034654321998074>
- Grabe, W., & Stoller, F. L. (2020). *Teaching and researching reading* (3rd ed.). Routledge. <https://doi.org/10.4324/9781315833743>
- Graesser, A. C., & McNamara, D. S. (2011). Computational analyses of multilevel discourse comprehension. *Topics in Cognitive Science*, 3(2), 371–398. <https://doi.org/10.1111/j.1756-8765.2010.01081.x>
- Huang, S. (2022). Effects of digital versus print reading on comprehension: An empirical synthesis. *Computers & Education*, 180, Article 104437. <https://doi.org/10.1016/j.compedu.2022.104437>
- Kasper, L. F. (2022). The impact of digital reading environments on L2 comprehension performance. *Computer Assisted Language Learning*, 35(3), 589–615. <https://doi.org/10.1080/09588221.2020.1774611>
- Kong, Y., Seo, Y. S., & Zhai, L. (2018). Comparison of reading performance on screen and on paper: A meta-analysis. *Computers & Education*, 123, 138–149. <https://doi.org/10.1016/j.compedu.2018.05.005>
- Kong, Y., Seo, Y. S., & Zhai, L. (2020). Effects of screen reading on comprehension: A meta-analytic review. *Educational Technology*

- Research and Development*, 68(4), 1775–1799. <https://doi.org/10.1007/s11423-020-09786-5>
- Lakens, D. (2021). The practical alternative to the p-value is the correctly used p-value. *Perspectives on Psychological Science*, 16(3), 639–648. <https://doi.org/10.1177/1745691620958012>
- Mahboudi, H. R., & Javdani, F. (2010). *An anthology of colloquial readings*. Zand Institute of Higher Education.
- Mahboudi, H. R., Farrokhi, F., & Ansarin, A. A. (2017). A review on application of computers in education inside and outside of Iran. *Advances in Language and Literary Studies*, 8(4), 193–205. <https://doi.org/10.7575/aiac.all.v.8n.4p.193>
- Mangen, A. (2008). Hypertext fiction reading: Haptics and immersion. *Journal of Research in Reading*, 31(4), 404–419. <https://doi.org/10.1111/j.1467-9817.2008.00380.x>
- Mangen, A. (2010). Point and click: Theoretical and phenomenological reflections on the digitization of early childhood education. *Contemporary Issues in Early Childhood*, 11(4), 415–431. <https://doi.org/10.2304/ciec.2010.11.4.415>
- Mangen, A., & Kuiken, D. (2014). Lost in an iPad: Narrative engagement on paper and tablet. *Scientific Study of Literature*, 4(2), 150–177. <https://doi.org/10.1075/ssol.4.2.02man>
- Mangen, A., Walgermo, B. R., & Brønnick, K. (2013). Reading linear texts on paper versus computer screen: Effects on reading comprehension. *International Journal of Educational Research*, 58, 61–68. <https://doi.org/10.1016/j.ijer.2012.12.002>
- Mayer, R. E. (2014). *The Cambridge handbook of multimedia learning* (2nd ed.). Cambridge University Press. <https://doi.org/10.1017/CBO9781139547369>
- Noyes, J. M., & Garland, K. J. (2021). Computer- vs. paper-based tasks: Are they equivalent? *Ergonomics*, 51(9), 1352–1375. <https://doi.org/10.1080/00140130802170387>
- Paivio, A. (1991). Dual coding theory: Retrospect and current status. *Canadian Journal of Psychology/Revue Canadienne de Psychologie*, 45(3), 255–287. <https://doi.org/10.1037/h0084295>
- Singer, L. M., & Alexander, P. A. (2017a). Reading across mediums: Effects of reading digital and print texts on comprehension and calibration. *The Journal of Experimental Education*, 85(1), 155–172. <https://doi.org/10.1080/00220973.2016.1143794>
- Singer, L. M., & Alexander, P. A. (2017b). Reading on paper and digitally: What the past decades of empirical research reveal. *Review of Educational Research*, 87(6), 1007–1041. <https://doi.org/10.3102/0034654317722961>
- Singer Trakhman, L. M., Alexander, P. A., & Berkowitz, L. E. (2019). Effects of processing time on comprehension and calibration in print and digital mediums. *The Journal of Experimental Education*, 87(1), 101–115. <https://doi.org/10.1080/00220973.2017.1411877>
- Støle, H., Mangen, A., & Schwippert, K. (2020). Assessing children's reading comprehension on paper and screen: A mode-effect study. *Computers & Education*, 151, Article 103861. <https://doi.org/10.1016/j.compedu.2020.103861>
- Sweller, J. (2011). Cognitive load theory. In J. P. Mestre & B. H. Ross (Eds.), *Psychology of learning and motivation* (Vol. 55, pp. 37–76). Academic Press. <https://doi.org/10.1016/B978-0-12-387691-1.00002-8>
- Wasserstein, R. L., & Lazar, N. A. (2016). The ASA statement on p-values: Context, process, and purpose. *The American Statistician*, 70(2), 129–133. <https://doi.org/10.1080/00031305.2016.1154108>
- Zhang, M., & Zhao, N. (2021). Digital reading and metacognitive strategies among EFL learners: A mixed-methods study. *Reading Research Quarterly*, 56(2), 371–394. <https://doi.org/10.1002/rrq.325>