

SlideIt+ New Ebook Reader for Personal Computer (PC) for Improved Reading Comprehension

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ABSTRACT

Reading expository text is essential in educational settings but can present challenges. eBooks bring several advantages: they are portable, searchable and efficiently stored. However, eBooks have disadvantages compared to natural books. eBooks are more rigid and fragile than natural books. Although reading on a mobile phone is more flexible than on PC (desktop or laptop), it still lacks the flexibility of a natural book. Further, mobile phones can only handle relatively small texts and are not suitable for texts with high-resolution graphics or multimedia. This study developed SlideIt+, an eBook reader for PC to target reading comprehension while drawing on eBook advantages. Thirty-four participants were grouped into three conditions: an experimental group that used the eBook reader; a control group who read natural books, and an experimental group who read natural books with a structured reading strategy that was also incorporated into the eBook reader. The eBook reader outperformed natural book reading, and performance was equivalent for the eBook reader and natural books when the reading strategy was used. SlideIt+ effectively helps comprehension of expository text on PC. The SlideIt+ eBook reader mechanism could be adapted for other eBook readers, supporting research into the integration of reading strategies into eBooks.

Keywords: eBook Reader, SQ3R, Sliding Interaction

INTRODUCTION

Reading is a conventional literacy skill that has been researched through centuries. With the advent of Information and Communication Technology (ICT), reading is no longer confined to conventional books and can be enjoyed online using an ICT version of a book usually called an eBook. However, reading with ICT has both advantages and disadvantages. The advantages are clear: the physical space required is reduced, and searching is faster. A disadvantage of eBooks is that they tend to be less flexible. Although several enhancements to hardware like mobile phones and fold phones have been made, they still cannot match natural books in terms of their flexibility. Furthermore, besides the reduced flexibility which increases reading fatigue, phones are less powerful than notebooks and desktop PCs. Reading using ICT, especially on a desktop PC or notebook, can result in increased fatigue although these devices have more power and can open multimedia documents with ease. However, as the hardware does not easily bend, readers typically remain stationary on their chairs, which can make reading monotonous, leading to loss of concentration.

This study set out to address difficulties associated with reading on PC by developing an eBook reader. Phone mechanisms for enhanced flexibility, such as sliding interaction, were incorporated into PC-based reading, an approach that has not yet been specifically adopted for reading with PCs. The study goal was to examine the result of using the eBook reader called SlideIt+, compared with baseline reading. Baseline reading in this study was a natural book, considered harder to outperform than if comparisons were made with a plain eBook reader system. SlideIt+ uses sliding interaction as movement between the desktop and an internally embedded SQ3R (Survey-Question-Read-Recite-Review) reading strategy. The study examined the effectiveness of SlideIt+ in improving reading comprehension compared with traditional book reading.

Although much research has focused on SQ3R as a reading technique when using natural books (e.g. Asiri & Momani, 2017; Biringkanae, 2018) there is little research on implementation of the SQ3R reading technique with eBook readers. Zhang, Cheng, Huang, He and Koyama (2003), and Zhang, Cheng, He, Aiguo, Koyama and Huang (2004) were the first to implement an SQ3R reading framework in an eBook reader. However their research did not evaluate the benefit of the system for participants. Pham, Chen and Dang (2011) conducted an SQ3R evaluation, but the SQ3R framework was conducted externally and not embedded in the system. Li, Chen and Yang (2013), Li et al. (2014) and Yang, Lee, Chen, Li and Yang (2011) used the SQ3R framework in an eBook reader with visual cues and variants of Kindle’s visual cues, but with no sliding interaction. Super and Chen (2011) implemented sliding interaction in their reading study but did not include SQ3R. Sliding interaction has been shown to have potential to improve reading comprehension but it has not been implemented in any commercial eBook reader, e.g. PDF reader or Kindle, to date. This research was undertaken from a book perspective rather than being conceptualized as part of an electronic ‘bag.’ The ‘bag’ perspective covers many items, including the book, in detail from macro to micro. A book perspective has the book as the main focus together with other supportive items (micro to adjacent view).

THE STUDY

Materials and Rationale

SlideIt+ (with the full name of SlideIt+SQ3R) introduces a sliding interaction environment of a multiple eBook reader desktop, with an SQ3R framework. The design is presented in Figure 1.

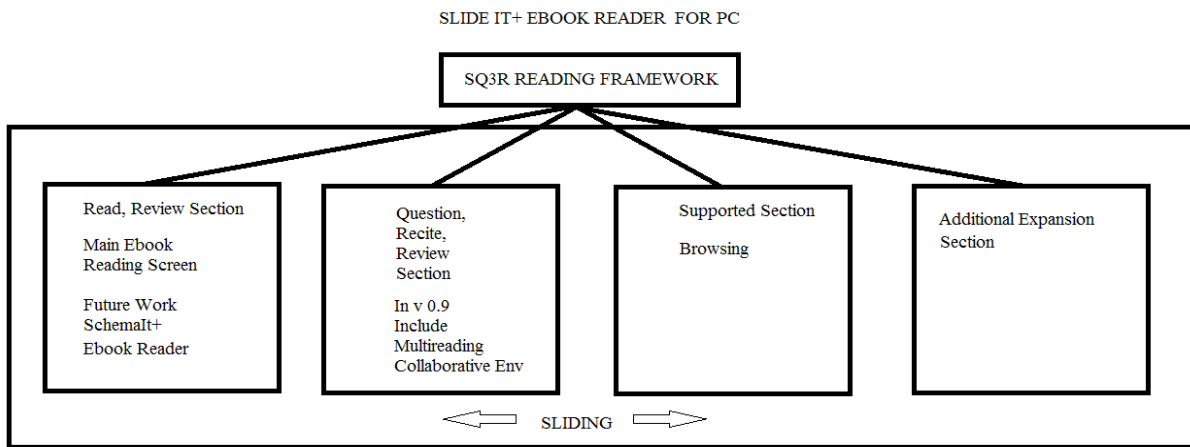


Figure 1: SlideIt+ Design

‘Survey, Question, Read, Recite, and Review’ (SQ3R) is a reading strategy introduced many years ago (Johns & McNamara, 1980; Pauk & Robinson, 1963). ‘Survey’ refers to skimming or quickly grasping the macro meaning of a text and becoming familiar with its content. ‘Questioning’ requires readers to generate questions based on the text. The questions may include ‘5W and H’ (Who, what, when, where, why and how?) questions or take the form of more critical questions. ‘Read’ refers to detailed reading activity that occurs after generating the questions. ‘Recite’ is repetition of the questions previously posed while no longer viewing the text to make it more challenging. ‘Review’ is where the text is read again for final comprehension.

The sliding menu of the Apple iPhone is needed due to the limited screen size of a mobile phone. In PC, the screen is already sufficiently large so there is no need to have an additional desktop to display the menu. Linux Ubuntu tried to adopt a sliding menu, e.g. Ubuntu 10 Lucid Lynx has four desktops on the bottom right, but this gained little attention and the interaction was not sliding but by clicking. A sliding menu has not yet been adopted for PC – especially for reading and windows. However, given the potential to expand the desktop view, it was adopted here to expand the eBook reader desktop. The rationale for the sliding interaction was to give the perception that the entire desktop is connected – like the menu in IOS Apple or Android phones. It creates the impression that sliding to the right is an extension of the screen as the screen size of the mobile phone is limited. A similar approach was used with Ubuntu 10 Lucid Lynx. The flexible interaction of the mobile phone is very pleasing, however the computing power of mobile phones is more limited than that of desktop or laptop PC. Thus, reading complex documents with many high-resolution graphics and complex calculations or embedded media is beyond the limit of mobile phones, although PCs continue to gain momentum in terms of power.

Method

The present eBook experimental method was embedded in Woolf’s (2009) framework. According to Woolf, there

are several methods for evaluating effectiveness of a new reading system. These approaches can be categorized from ‘hardest’ to ‘easiest’ comparison. The experimental group assigned the SlideIt+ eBook reader. The control group chose a natural book, but were not deprived of access to an eBook reader.

- a. *Natural control group vs. treatment system*: As the natural system is usually impossible to improve on, this is the ‘hardest’ comparison, e.g. eye vs. computer vision, human tutor vs. computer tutor, natural book vs. experimental eBook system. A natural book has many advantages over an eBook, which means that the comparison is a challenging, rigorous one.
- b. *Other eBook system vs. treatment system*: This kind of method makes a fair comparison between two similar technologies or extends previous technology, e.g. Adobe acrobat vs. treatment system.
- c. *Part of treatment system vs. entire treatment system*
- d. *Part of old treatment system vs. part of new treatment system*
- e. *No read vs. treatment/eBook system*: This type of comparison is the least rigorous or ‘easiest’ one in which change could be demonstrated.

The present study used Woolf’s (2009) first level of comparison where reading of natural books was compared with the experimental system. Two natural book groups were used: the first one as baseline comparison or control group and the other as the gold standard experimental comparison. The study adopted an extended control system (a+b) to make a very rigorous comparison that would be challenging to improve upon, i.e. natural book reading + SQ3R method vs. the new eBook system.

The study grouped the participants into three groups as follows:

Group A – Control group: Read a natural book with a freestyle approach for 30 minutes.

Group B – Experimental group: Used SlideIt+ reading environment. This group was also given 30 minutes to read but in practice took up to 1.5 hours due to the novelty of the SQ3R method and participants’ questions about the software. Participants finished at different times, but due to the simultaneous posttest those who had completed the task needed to wait for their friend to finish. SlideIt+ operates on a ‘supervised’ mode with a teacher ensuring each participant conducts all of the SQ3R steps.

Group C – Gold standard experimental group: Used a natural book together with the SQ3R reading strategy.

FINDINGS

The goal was to determine whether the SlideIt+ treatment group performs better in reading comprehension than a control group, and the gold standard experimental group. Hypotheses were formulated as follows.

H_a: Treatment Group (TG) > Control Group (CG)

Thus, rendering the following formal hypothesis

H₀: TG ≤ CG

H_a: TG > CG

As this study only needed to determine whether TG > CG in one direction, one tailed significance was sufficient.

Table 1: Comparison of the mean reading comprehension scores for the three groups

Mean score on reading comprehension task and the standard deviation		
Group A – Control group Free style, natural book reading (n=23)	Group B – Experimental group SlideIt+ eBook reading (n=11)	Group C – Gold Standard experimental group SQ3R natural book reading (n=11)
2.91+/-1.5	5.18+/-1.89	6.27+/-1.85

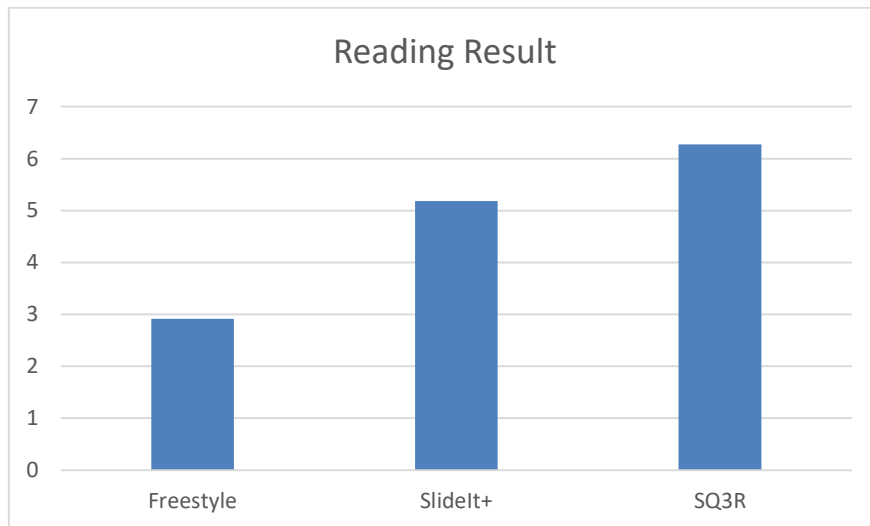


Figure 2: Mean score on reading comprehension task and the standard deviation

There are two comparisons in this result: The first between Groups A and B (freestyle natural book group vs. SlideIt+ group), and the second between Groups B and C (SlideIt+ group vs. SQ3R natural book group). In the first comparison, the experimental group significantly outperformed the control group on mean score for reading comprehension (5.18 vs. 2.91). Participants in the freestyle natural book group had not been taught how to use the SQ3R technique, unlike those in the experimental groups in which SQ3R was embedded. Group A used natural books, considered difficult to outperform due to their flexibility that makes it easier for readers to sustain attention and a comfortable viewing angle. The result shows both one ($p=0.0015$) and two-tailed significance ($p=0.003$) with both values less than $\alpha=5\%$, thus rejecting H_0 ($t=3.49$). SlideIt+ was shown to effectively improve reading comprehension when compared to the control group.

Table 2: Comparison of Group A (Control – Free book Reading) vs. Group B (Experimental – SlideIt+ eBook Reading) with the experimental group significantly outperforming the control group

t-Test: Two-Sample Assuming Unequal Variances		
	<i>Variable 1</i>	<i>Variable 2</i>
Mean	5.181818182	2.913043
Variance	3.563636364	2.264822
Observations	11	23
Hypothesized Mean Difference	0	
df	16	
t Stat	3.490680942	
P(T<=t) one-tail	0.001511227	
t Critical one-tail	1.745883676	
P(T<=t) two-tail	0.003022454	
t Critical two-tail	2.119905299	

Following Woolf’s (2009) control group theory, the experimental group was compared further to a more rigorous ‘gold standard’ experimental group: Group C, which used natural books but had been taught how to read using the SQ3R technique. Group C slightly outperformed Group B, although no significant difference was shown between the mean reading comprehension scores of the two groups (Group B: 5.18 vs. Group C: 6.27; $t=-1.369$). This means that students using SlideIt+ on a desktop PC or laptop can obtain learning results comparable to using SQ3R with a natural book whilst exploiting the power of a computer such as portability and ease of searching.

Table 3: Comparison of Group B (Experimental – SlideIt+ eBook Reading) with Group C (Gold Standard Experimental – Natural SQ3R book reading): No significant difference (alpha=5%)

t-Test: Two-Sample Assuming Unequal Variances		
	<i>Variable 1</i>	<i>Variable 2</i>
Mean	5.181818	6.272727
Variance	3.563636	3.418182
Observations	11	11
Hypothesized Mean Difference	0	
df	20	
t Stat	-1.36931	
P(T<=t) one-tail	0.093042	
t Critical one-tail	1.724718	
P(T<=t) two-tail	0.186085	
t Critical two-tail	2.085963	

Within-group results were already reported by Nugroho (2013) based on an initial study. Between-group results have not yet been reported and thus are presented here. Previous results only reported on two groups and not for all three groups. The treatment group (SlideIt+ eBook reader) outperformed the control group (freestyle natural book reading) and performed comparably with the gold standard SQ3R natural book reading group. It is hard to outperform natural book reading by electronic means, especially using a PC. Natural book reading is easy as users can bend a book into any shape they want; they can hold it however they like – vertically, horizontally or at any angle. They can move the book conveniently to suit any body movement or position thus avoiding boredom and fatigue. With a PC, one tends to stay in front of the computer, which is monotonous and tiring. The SlideIt+ eBook reader can be used to boost reading comprehension so that it outperforms freestyle natural book reading and is equivalent to natural book reading used with SQ3R.

The subjective result of the study was, however, quite average (approximately 3 on a scale of 5). This result may reflect that the experimental system is a prototype version that provides a fundamental framework function but still requires further refinement.

Table 4: Least Square Method for using and not using SlideIt+ with Reading Results

SUMMARY OUTPUT							
<i>Regression Statistics</i>							
Multiple R	0.556306028						
R Square	0.309476397						
Adjusted R Square	0.287897535						
Standard Error	0.400714517						
Observations	34						
ANOVA							
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>		
Regression	1	2.302868486	2.302868	14.34165	0.000635		
Residual	32	5.138307985	0.160572				
Total	33	7.441176471					
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>
Intercept	-0.173954373	0.148254694	-1.17335	0.249316	-0.47594	0.128031	-0.47594
Result	0.136406844	0.036019416	3.787037	0.000635	0.063038	0.209776	0.063038

Table 4 shows the regression using the least linear squares method, which generated a model as follows:
 $Y = -0.17 + 0.14x$

The model has an error value of 0.000635 (less than 1% error) and correlation strength of 0.56; it accounts for about 0.3 of the variance in the results.

DISCUSSION

The contributions of this research are as follows:

1. The study provided a new eBook reader environment that effectively improves reading comprehension even in contrast to a natural book environment (freestyle natural book reading). The new SlideIt+ eBook reader successfully matched performance on natural book reading. It uses multiple desktops and the SQ3R reading strategy blended with sliding interaction to provide an integrated reading environment. The study provides further evidence that implementing a reading strategy in an eBook improves reading comprehension. This was described here in a novel setting with new materials, methods, and participants.
2. The research proves that embedding a reading or learning strategy in an eBook learning environment can significantly improve reading or learning. This supports previous research which has shown that implementation of the SQ3R reading strategy in eBooks improves reading comprehension (Li et al., 2013; Yang et al., 2011).

CONCLUSIONS

The SlideIt+ eBook reader provides a new eBook reader environment for PC using multiple desktops and the SQ3R reading strategy blended with sliding interaction to provide an integrated reading environment. SlideIt+ significantly improved reading comprehension compared with freestyle book reading and performed equally effectively as natural book reading using the same SQ3R technique.

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