Profiling CEFR-Basic Readers at Primary Schools through Their Eye Movement Behaviours

Warid Mihat [a]
waridmihat@uitm.edu.my
Universiti Teknologi MARA Cawangan Kelantan, Malaysia

Hazita Azman
drhazitaazman@gmail.com
Retired Professor of Literacy,
Universiti Kebangsaan Malaysia

Nurjanah Mohd Jaafar [b]
nurjanah@ukm.edu.my
Universiti Kebangsaan Malaysia

ABSTRACT

This study profiles CEFR-basic readers in Malaysia by examining their eye movements and fixations during reading comprehension tasks in response to the studies conducted by Cambridge Assessment in Malaysia in 2013 and 2018. To this end, forty 12-year-old school pupils at A1/A2 reading proficiency level were observed using Tobii Pro Glasses 100hz. The participants were asked to read three texts and answer ten multiple-choice questions. Data were transformed into statistics and gaze plots. The results of the experiment indicate that basic readers in this study have an average first pass duration (FPD) of 0.50-0.59 seconds and an average second pass duration (SPD) of 0.76-0.81 seconds. This study also found four pejorative behaviours that can impede the process of reading: 1) rereading at micro level, 2) limited processing capacity for sentences of more than 14 words, 3) negative skipping and, 4) desegmentation. Through these behaviours, this study highlights the importance of improving the readers' reading skills to improve the quality of their SPD as it is related to the ability to process and integrate the various subprocesses involved in reading. While this study suggests the need for further replication in diverse reading environments, it also provides valuable insights into the current reading proficiency of Year 6 pupils in their second language.

Keywords: A1/A2; CEFR-Basic Readers; Eye Movements; Reading Proficiency; Reader Profiles

INTRODUCTION

According to the 2013 baseline research conducted by Cambridge Assessment (CA) (Cambridge English Language Assessment, 2013), 80 per cent of Malaysian primary school students were unable to meet the curriculum mandated A2 level in reading by the end of their primary school. This condition presents a dilemma for the system because learners' proficiency starting point at the secondary school level falls below the starting point outlined in the curriculum. Despite the minor improvement, this difficult circumstance was deemed to be recurrent and continuous until 2019 (Cambridge English Language Assessment, 2018) and the COVID-19 pandemic has further worsened students' literacy skills (Shukri et al., 2020). Due to this circumstance, comprehensive

[a] *Main author*
[b] *Corresponding author*

eISSN: 2550-2131
ISSN: 1675-8021

research must be undertaken to determine why many primary school students in Malaysia are unable to acquire the basic level (A2) in their second language reading skill. The present study investigates this issue by analysing the students' reading behaviours as this information can be very useful in the process of improving the 'can-do' descriptors of the curriculum, which are used in the classroom. To fulfil this objective, the present study compares the attention data of readers when reading different texts to uncover patterns that explain their reading behaviours and then classifies these behaviours according to their strengths or weaknesses. To this end, we hope to answer these two questions: 1) What are the attention durations of basic readers? and 2) What reading behaviours can be highlighted based on eye movements?

LITERATURE REVIEW

READING PROFILES

Reading profiles can be both a process and a product (Spear-Swerling, 2013). As a process, these profiles are standardised tools or instruments used by qualified educators or reading experts to evaluate reading abilities and understand readers (Spear-Swerling, 2015). Reading profiles are used to assess reading issues, track progress, and inform instruction by examining skills such as phonemic awareness, phonics, fluency, vocabulary, and comprehension (Spear-Swerling, 2013). As a product, the results of a reading profile can provide educators and reading experts with crucial information about a reader's strengths and limitations, enabling them to plan appropriate interventions and instruction (Joshi, 2019; Spear-Swerling, 2013, 2015). By using the information provided by reading profiles, educators and reading experts can help develop and improve a reader's skills. Technological advancements however have brought changes to how profiling readers can be done. This would involve the use of a device to detect a reader's eye movements while they are reading, which can provide vital information about reading patterns and behaviours.

Understanding how eye-trackers can be used to observe and build reading profiles would require a certain level of comprehension on how reading progresses from a simple unit to a complex one (Mohd Yusof et al., 2020). To this end, this paper discusses three theoretical formalisms which could help map the observations in building the profiles, namely the cognitive process of reading comprehension model, simple view of reading (SVR), and the E-Z Reader model.

THEORETICAL MODELS IN BUILDING READING PROFILES USING EYE-TRACKING

SIMPLE VIEW OF READING

Traditionally, developing a reading profile is often influenced by the componential view of reading and this view is shaped by the simple view of reading (SVR) theory (Joshi, 2019). The theory put forward and discussed by Gough and Tunmer (1986), and Hoover and Gough (1990) assert that the complexity of reading is often represented by two interdependent processes; reading comprehension (RC) happens when both decoding (D) and language comprehension (LC) are processed at the same time. If LC is zero, then the RC will be zero and vice versa.

According to Joshi (2019), although SVR only stresses two components (decoding and language comprehension), each component contains subcomponents that provide a comprehensive understanding of the SVR. In decoding, phonemic awareness plays an important role in helping readers to read. This is because it contains the knowledge of phonemes, syllables, and rhyme.

Another subcomponent in decoding is lexical access, i.e., information about a word's form and its meaning (Joshi, 2019). Decoding, therefore, is a prerequisite to becoming a good reader. Language comprehension, on the other hand, refers to the knowledge of vocabulary and how it functions in the syntactic and semantic frameworks (Joshi, 2019). A typical reader should show a normal rate of language comprehension skill, which can be assessed through reading and listening comprehension. Problems related to vocabulary are not about how to pronounce the words, but rather to understand their meaning when used in context.

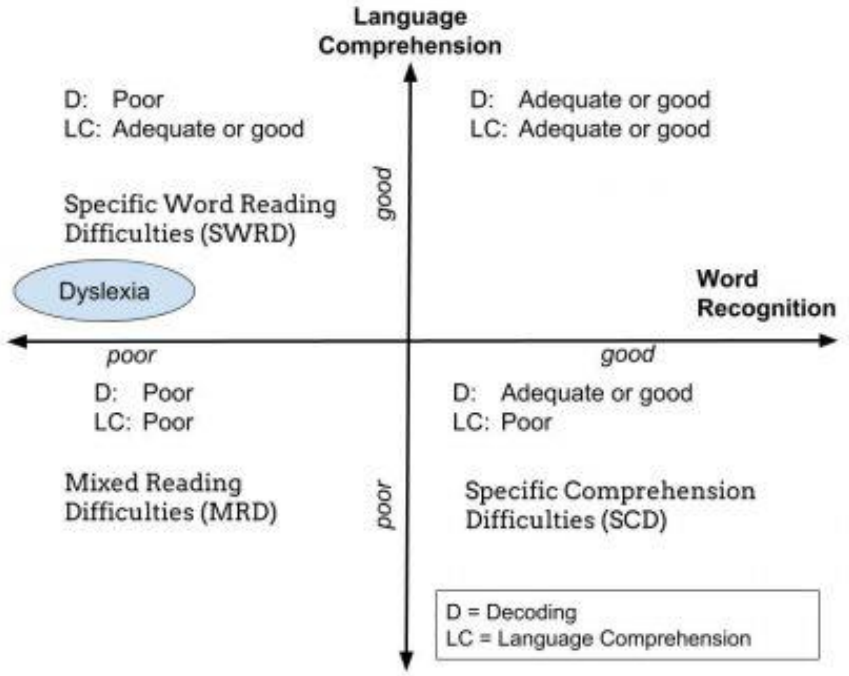

FIGURE 1. Reading Difficulties Mapping (Wooldrige, 2017)

As stated earlier, reading profiles is a research area that is often viewed componentially. For example, Figure 1 shows the alignment of reading difficulties by Spear-Swerling (2015) with SVR. The upper left quadrant of the diagram describes the ability that is often associated with dyslexia; these readers have problems with decoding but not with language comprehension. The lower left quadrant, on the other hand, explains the typical situations for beginning readers; these readers have problems in decoding and language comprehension. The lower right quadrant of the diagram, in contrast to dyslexia, reflects readers who can decode the word well or adequately but have problems putting the words into context. Finally, the upper right quadrant explains good readers who have good decoding and good language comprehension components.

SVR is significant in this study because decoding and language comprehension in the SVR can be associated with early and late measures in eye-tracking. In eye-tracking research, the ability of the readers to decode can be represented by the early measure data, normally represented by first fixation and first-pass data. Past studies have shown that inflation in the early processing rate may indicate problems in decoding the word (Godfroid, 2019). Language comprehension, on the other hand, can be represented by the late or second-pass data (Dolgunsöz, 2015; Godfroid et al., 2020). The second pass duration (SPD) is a revisit fixation (Godfroid, 2019). SPD refers to the

fixations of the second entrance in the region of interest (ROI). According to Dolgunsöz (2015), significant inflation in SPD may suggest difficulties in understanding the word in sentence. The use of SVR through the lens of early and late measures would help the researchers to understand better the strengths and weaknesses of the readers as proposed in this study.

COGNITIVE PROCESS OF READING COMPREHENSION

The SVR offers a componential view of reading comprehension but requires further explanation of the sub-processes involved in decoding and language comprehension. Weir and Khalifa's (2008) cognitive model of reading comprehension addresses this limitation by providing a three-component model consisting of the goal setter, central processing core, and monitor (see Figure 2).

The goal setter plays a critical role in determining the relative importance of various processes in reading. Urquhart and Weir (1998) distinguish between careful and expeditious reading and reading at local and global levels and note that different reading goals lead to different reading behaviours. Although the present study does not delve into these distinctions, it is suggested that varying reading tasks would yield different results and provide a more comprehensive understanding of reading (Grabe, 2009; Weir & Khalifa, 2008).

The central processing core model describes the reading behaviours of proficient L1 readers, which L2 readers are expected to emulate as their proficiency in L2 increases. To become proficient readers, one of the essential skills is efficient word recognition. However, less experienced L2 readers may struggle with this process due to their limited vocabulary and inefficient recognition. By improving word recognition, readers can liberate attentional resources, which, in turn, increases their working memory capacity for more complex operations. Lexical access is a vital component in word recognition, as it involves retrieving a lexical entry that contains information about a word's form and meaning from the lexicon. To comprehend a text, the reader must group words into phrases and larger units at the clause and sentence levels after determining their meanings. Once the reader has identified the meaning of each word and their syntactic relationships, the next step is syntactic parsing. This process is crucial for comprehension, as it enables the reader to construct the syntactic structure of a sentence, which is necessary for understanding the text's meaning. Propositional interpretation is another essential component in the comprehension process. It involves creating a message that is relevant to the context in which the event occurred by adding external knowledge. Finally, inference is a creative process that involves adding information that is not explicitly stated in a text to establish coherence. The development of an accurate and comprehensive text comprehension model would necessitate an understanding of discourse structure, recognising macro-level relationships between ideas, and identifying which propositions are central to the text's objectives.

Weir and Khalifa (2008) proposed that readers engage in metacognitive activity to assess their comprehension after activating each level of the processing core. Self-monitoring, which is a complex process that occurs at various stages of the reading process and relates to different levels of analysis, is facilitated by 'the monitor', a mechanism that provides feedback to the reader regarding the success of a specific reading process. Monitoring in decoding text involves examining word recognition, lexical access, and syntactic parsing, and may entail determining the extent to which the reader can decipher the author's intentions or the argument structure of the text. Unskilled L1 readers frequently fail to monitor comprehension or make less use of monitoring strategies at the comprehension level (Oakhill & Garnham, 1988; Perfetti, 2007). Skilled readers, on the other hand, will take action, such as rereading, to deal with comprehension problems.

eISSN: 2550-2131
ISSN: 1675-8021

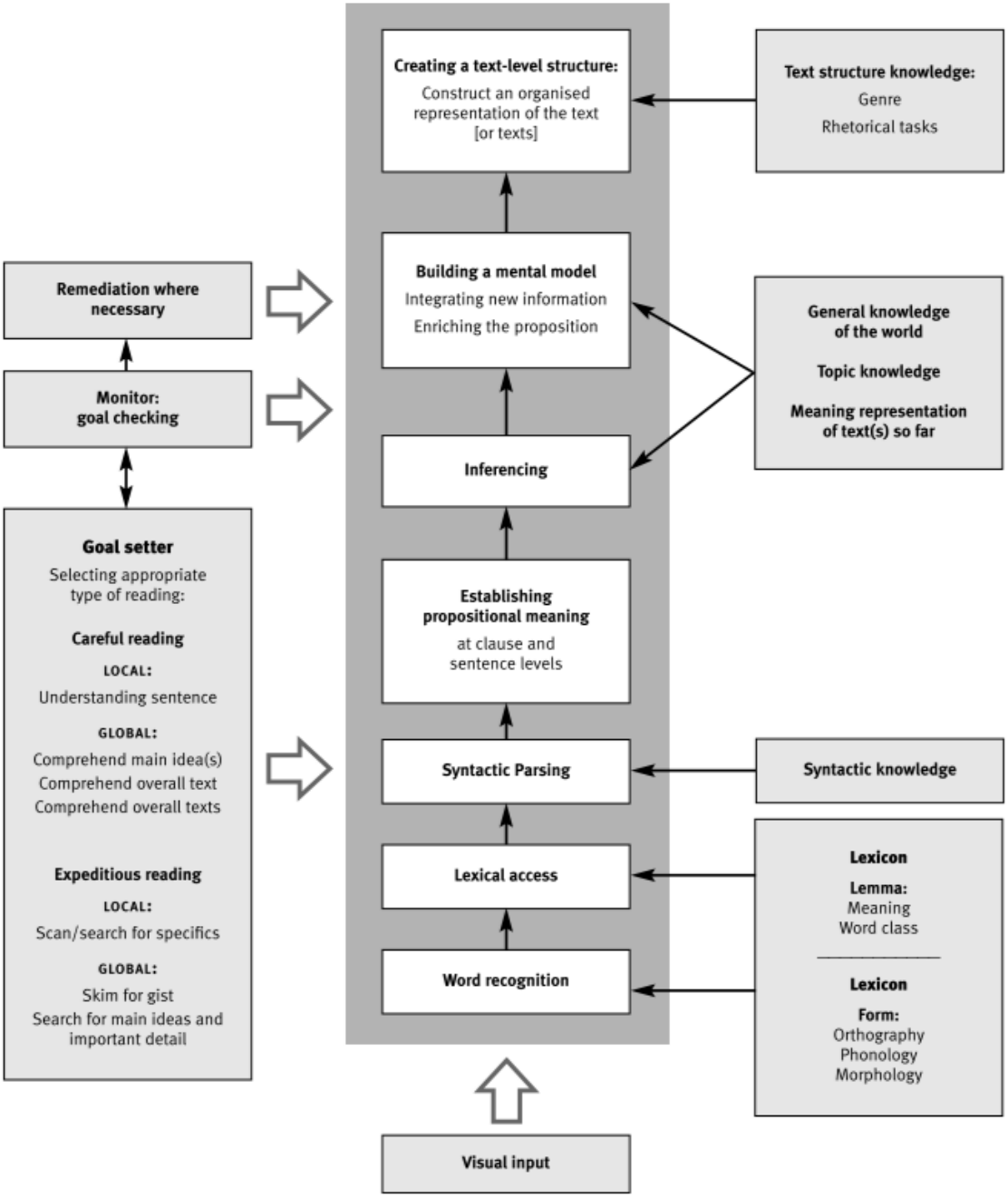

FIGURE 2. Cognitive Process of Reading Comprehension (Weir & Khalifa 2008)

E-Z READER MODEL

The next part of this theoretical discussion discusses how eye movement behaviours can be used as a premise to explain the reading process by looking at one of the most comprehensive models in the eye-tracking field, the E-Z Reader model, developed by Reichle and Sheridan (2015).

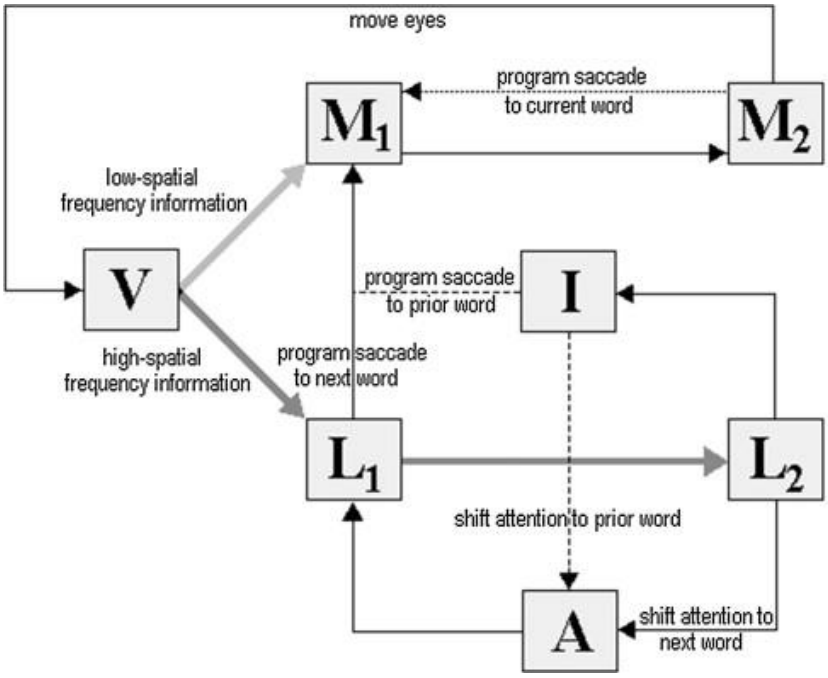

FIGURE 3. E-Z Reader Model (Reichle & Sheridan, 2015)

The E-Z Reader model (see Figure 3) is a computational model of eye movements built to understand and predict reading behaviours when reading takes place. The model provides a formal description of the interaction between perceptual span and cognitive processes during reading, stressing that visual processing requires attention to give meaning to the word read (Reichle & Sheridan, 2015). It is considered the most comprehensive model in connecting eye movement behaviours with reading processes, not just at the word level but also at the sentence and text levels, owing to its flexibility in expanding the applications that the model can cover (Reichle & Sheridan, 2015).

The discussion of this model is composed of two basic components, fixations and saccades. Fixation is the stationary attention during reading while saccade is the movement between two fixations, which is also known as the line between fixations (Rayner et al., 2012). The model (Figure 3) highlights two core assumptions. First, lexical processing is completed in a strictly serial manner. Within this framework, the type of attention that is required for lexical processing or binding together the features that make up a word is done one word at a time. The second core assumption promoted by this model is that familiarity check (L1) is a preliminary stage that initiates the programming of the saccade to move the eyes to the next word before achieving lexical access (L2). Alternatively, L1 and L2 can be conceptualised as orthographic and semantic processing (Reingold et al., 2010). For this process to happen, the word must be in the foveal view of the eyes (see Figure 4), also known as the high spatial frequency information (L1). However, this might be the case for low-frequency words (Rayner et al., 2012). According to Rayner et al. (2012), good readers tend to skip high-frequency words such as function words because they are highly predictable, where the semantic or syntactic constraints on the words are sufficient for them to be identified using only minimal visual information about the word. Due to this phenomenon, some words do not have a duration value, i.e., 0 milliseconds (ms).

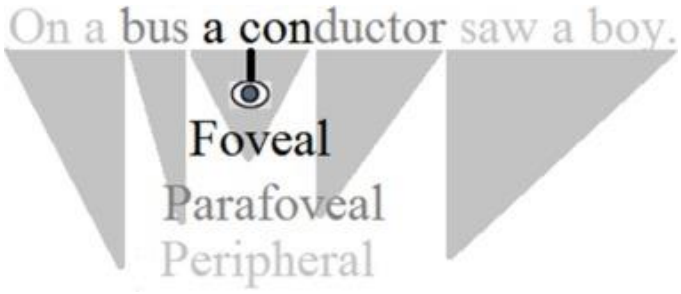

FIGURE 4. Foveal, parafoveal and peripheral views (Stoops & Christianson, 2019)

After a word undergoes the familiarity check, its meaning is activated in a stage called lexical access (L2). Unlike the familiarity check, which can sometimes be skipped, lexical access is a process that takes some time. This duration reflects the completion of the word's meaning activation, whether it is coming from the sentence context, visual input, or both. The outcome of lexical access results in two simultaneous events: 1) a shift in attention from the current word to the next, allowing for lexical processing of the next word to start, and 2) the integration of the current word's meaning.

The integration is the minimal time required by the readers to know that the meaning of the identified word fits into the semantic and syntactic frameworks. The failure of this second process will create the integration failure effect, which causes the eyes and attention to move back to the location of the integration failure. When integration failure happens, it will lead the eyes to perform familiarity check for the second time, hence, creating the late measure (second pass) in the eye-tracking metrics. This process is also known as regression, an eye movement that typically occurs under the pressure of syntactically ambiguous or semantically implausible sentences. In eye-tracking studies, the familiarity check and lexical access can be represented by the early and late measures (Godfroid, 2019). As discussed previously, the early and late measures reflect the two main processes in portraying reading comprehension of a reader, decoding and language comprehension. Past studies found that inflation in the first pass (>0.47seconds) suggests difficulties in decoding, and inflation in the second pass (>0.40seconds) suggests difficulties in processing the word sententially (Dolgunsöz, 2015). The term 'difficulties', however, must not quickly be associated with failure to comprehend the words because a good number of past studies also have proven that inflation in fixation duration can also lead to successful outcomes (Godfroid, 2019; Godfroid et al., 2020).

It is important to note that lexical access can be understood from two standpoints; successful word integration, and integration failure. A word that has been successfully integrated into the semantic and syntactic frameworks will only contain early measures (Reichle & Sheridan, 2015), i.e. the first fixation duration and first pass duration/gaze duration (depending on the size of the ROI). Concurrently, skipping can also occur with high-frequency words but still be comprehended because it is automatically processed (Rayner et al., 2012; Reichle & Sheridan, 2015). Words with integration failure, on the other hand, will be revisited, creating regression data or second fixation (second pass duration) in the ROI.

PROFILING THROUGH EYE-TRACKING

The three models mentioned in the theoretical discussion are the core foundations for the conceptual framework developed for this study. Figure 5 represents the theories or models that are used to achieve the goal of this study, which is to develop reading profiles of basic readers to address the gap between readers' behaviours and CEFR-aligned reading standards practiced at Malaysian primary schools.

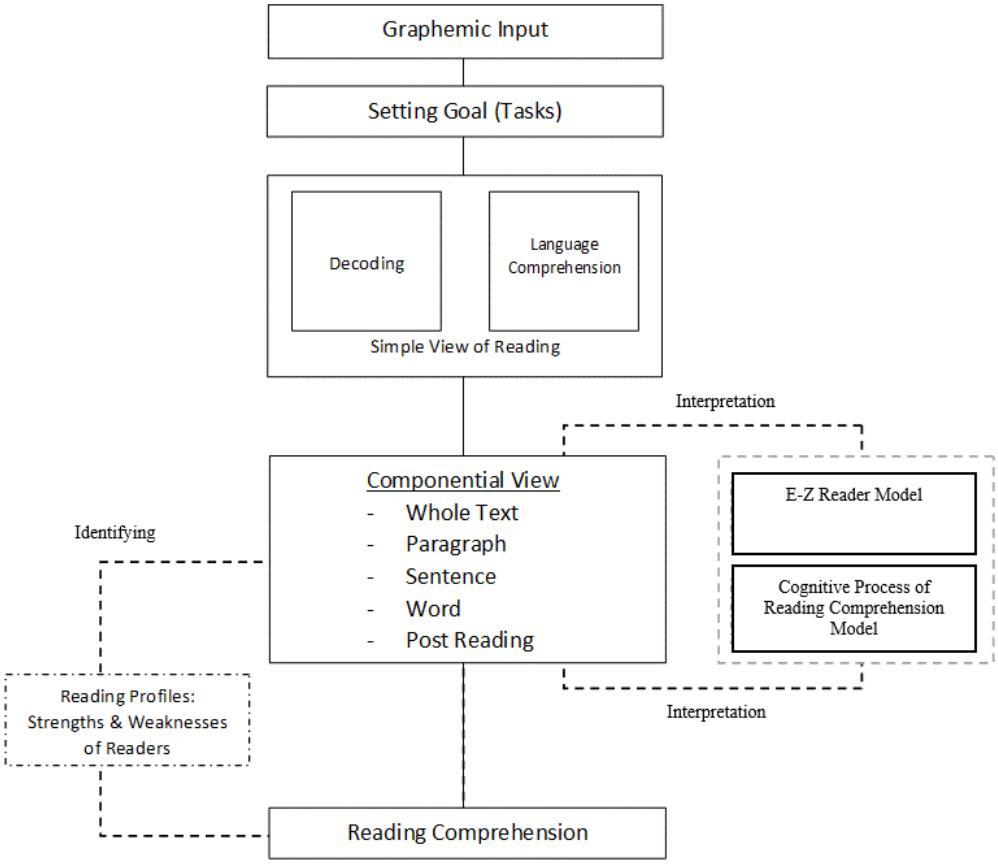

FIGURE 5. Conceptual Framework

The process of observing the eye movements began with a graphemic input presentation to the readers. In this study, the readers were asked to read three different types of texts. This was followed by goal setting, which is to ensure that the reading is guided by the tasks – reading comprehension. Reading behaviours were then observed at two levels, decoding and language comprehension (Joshi, 2019) and each level was further defined through Weir and Khalifa's (2008) work. Acting as the lens, participants' eye movement behaviour was then observed at different text levels including whole text, sentence, paragraph, and word. The reading comprehension scores were used to group the data into either successful or less successful reading which later helped the researchers to identify their profiles and limitations. To give a consistent meaning to the eye movements, the E-Z Reader Model of Eye Movement by Reichle and Sheridan (2015) were used. Based on this setting, we hope to answer these two questions: 1. What are the average attention durations of basic readers? and 2. What reading behaviours can be highlighted based on their eye movements?

METHODS

RESEARCH DESIGN

This study is an experiment through sequential explanatory mixed methods design (Creswell & Creswell, 2016) where gaze plot recordings and attention heatmaps were used to find behavioural patterns to give meaning to the quantitative data. Tobii Pro Glasses 100Hz with single calibration was used to collect the fixation data and to produce the gaze plot recordings and attention heatmaps for qualitative discussion. The timeline of this study was cross-sectional, where the data collection was done once, i.e., during the first school term for three months. The research was conducted with permission given by the authority involved. Data collection was done in the school lab prepared for the research after school hours.

PARTICIPANTS

Basic readers (A1-A2) in this study were based on the CEFR scale. To identify suitable participants, 230 12-year-old students from one school sat for the Cambridge English Key English Test (KET) for Reading and Writing Tests (Cambridge English Language Assessment, 2014). To represent the term basic readers, this study used the CEFR categorisation, where participants who scored between 28 and 44 on the test were selected to be the participants of the study. From the 230 candidates, 40 participants (17%) (i.e., 20 Malay boys and 20 Malay girls), were identified as suitable candidates. As reported by their parents, all students had normal or corrected-to-normal vision.

MATERIALS

STIMULI

Three texts of different genres (Narrative, Expository and Infographic) and topics were randomly chosen from a CEFR international textbook (Capel & Sharp, 2013). All texts had never been used in the classrooms. The international texts were used as it is aligned with the current practice in Malaysian classrooms (Ya Shak et al., 2021). The narrative text consists of 12 sentences comprising 176 words, including a text title. The expository text, on the other hand, consists of 13 sentences (172 words) with a text title. The infographic text comprises 9 sentences (97 words), a text title, and 4 graphics. The readability of the texts was determined using the Flesch-Kincaid test. The grades for the three texts are between 5.28 and 5.94, indicating that the texts can be used for students in Grades 5 (ages 10-11) and 6 (ages 11-12). Text inspector (a web-based text analysis tool by Cambridge Assessment) results also indicated that all words in the texts are mostly at A2 and A1 with some B1 or B2 words. The ROIs were set at the sentence level and later manipulated to describe the observations. Each text, except the infographic text, contains three paragraphs. Before being presented on screen, the texts were transformed into a by-paragraph mode (Mihat et al., 2018), where each paragraph is assigned to one slide, to ensure enough gap between the sentences and to reduce the probability of fixations collapsing in both ROIs. Figure 6 explains how the slides were presented and used for data collection before being analysed. The infographic text was presented as one text in Slide A, considering the text feature was different from the other two texts. Data collection guidelines were produced based on the findings found in the pilot study (see Azman et al., 2021).

eISSN: 2550-2131
ISSN: 1675-8021

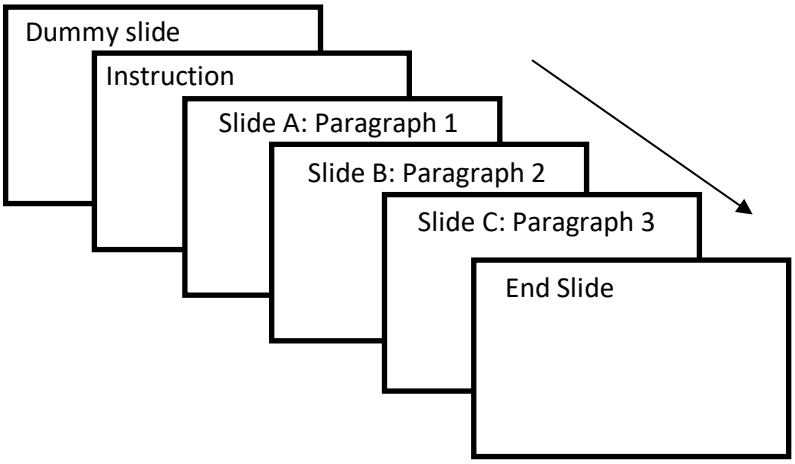

FIGURE 6. Stimuli presentation on PowerPoint

POST-READING TASK

This study used comprehension scores to understand the participants' eye movement behaviours during the reading activity. Each text has 10 questions, and the participants must tick whether the statements given are *right*, *wrong,* or *doesn't say*. This format is similar to Part 4 of the KET Reading and Writing tests (Cambridge English Learning Assessment, 2014). These are four Right statements, four Wrong statements, and two Doesn't Say statements. Two lecturers working at the English Language Teaching Centre of Malaysia (ELTC), an organisation under the Ministry of Education, checked the questions for external expert review. The reading comprehension task was done on paper and the participants had to rely on their understanding to answer the task.

PROCEDURE

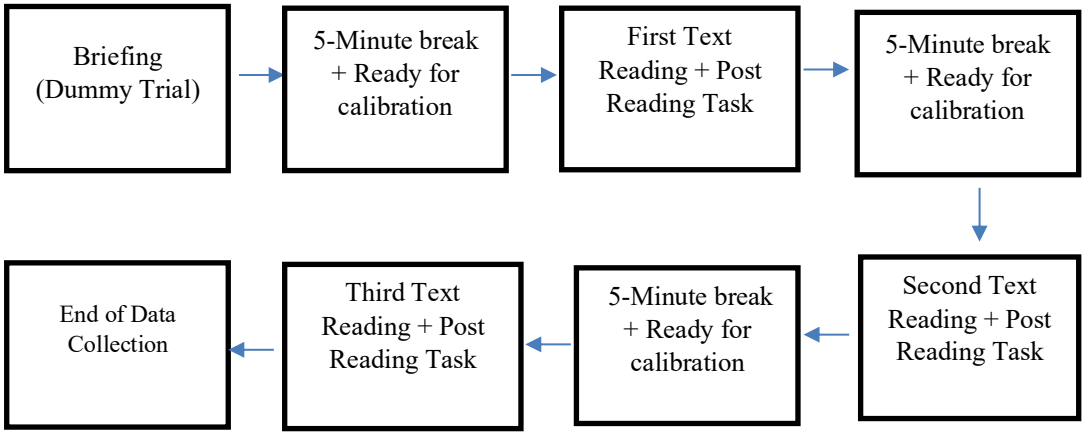

FIGURE 7. Data collection flow

The data collection (see Figure 7) began with a briefing on what the participants needed to do. The briefing was accompanied by a dummy trial where participants were presented with a paragraph and required to answer three questions based on the paragraph. The dummy trial followed the exact procedure in the real data collection as stated in the data collection guidelines. This procedure ensured participants knew what was expected from them during the data collection. Then the participants were required to read the three texts. The texts were presented to each participant in one of the three sequences shown in Table 1, with a five-minute break after the first and second texts.

TABLE 1. Sequence of the text presentation

P	First text	Second text	Third text
P1	Narrative	Exploratory	Infographic
P2	Infographic	Narrative	Exploratory
P3	Exploratory	Infographic	Narrative

Note: P = Participant

DATA ANALYSIS

The interpretation of data (both the attention data, attention heatmaps and gaze plot recordings) was conducted using the E-Z Reading Model (Reichle & Sheridan, 2015). Through this model, we learn that the eyes move in a serial movement (see Figure 8: 1-6), from one fixation to another. While this movement happens, skipping short and automatically processed words will occur (see Figure 8: The article 'a' was skipped). However, when information integration fails, regression (looking back) at the word will occur, increasing the fixation time on that word (see Figure 8: 3 and 5; The word 'herself' was fixated twice). Figure 8 further illustrates how the eye metrics were calculated by the system and further observed through the gaze plot recordings.

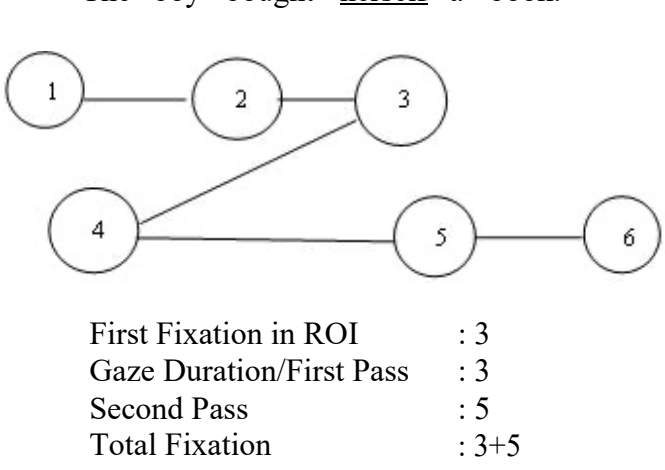

FIGURE 8. Fixation (Cunnings, 2018)

Among the popular views on these metrics are that high FPD tends to highlight problems in word identification, and longer SPD heralds difficulties in processing words in sentential context [see Godfroid (2019) for further explanation]. Since the number of participants in this study is more than 30 (n = 40), the analysis in this study abides by the law of the Central Limit Theorem for inferential statistical analysis later. Data were also winsorised, and log10 transformation was conducted to ensure the data were normally distributed and fit for inferential analyses.

FINDINGS AND DISCUSSION

WHAT ARE THE ATTENTION DURATIONS OF BASIC READERS?

To answer the first question of this study, the researchers used data at whole text level. The analysis investigates participants' eye movement differences between early and late measures during reading. The analysis also examines the differences between early and late measures during reading. The analysis can therefore determine whether the basic readers still have issues in decoding or whether the large proportion of reading difficulties is due to language comprehension. The analysis here is also significant as it works to establish the eye-movement profile of basic readers by looking at how they read three different types of texts based on the Malaysian context and how they perform in the post-reading task.

TABLE 2. Summary of fixation rates (Whole text)

Metric	Type of Text		
	Narrative M(SD)	**Expository** M(SD)	**Infographic** M(SD)
Total Reading Time (TRT)	73.38s	59.77s	47.75s
Total Fixation Duration (TFD)	28.08s (5.9)	25.9s (6.4)	21.85s (5.6)
First Fixation Duration (FFD)	0.48s (.04)	0.48s (.05)	0.54s (.05)
First Pass Duration (FPD)	0.50s (.03)	0.51s (.05)	0.59s (.07)
Second Pass Duration (SPD)	0.81s (.05)	0.80s (.07)	0.76s (.06)
Reading Comprehension Score (Range)	3 to 5	4 to 6	4 to 6

Note: Data, winsorised and transformed, represent the average duration in seconds (s) of each text. Full score for reading comprehension task is 10.

Table 2 summarises the attention durations for the three texts. The total reading time (TRT) analysis reveals that participants took the longest time to process information in the narrative text (73.38 seconds), followed by the expository text (59.77 seconds) and the infographic text (47.75 seconds). Additionally, it is noteworthy that as the total fixation duration (TFD) decreases, the first fixation duration (FFD) and the first pass duration (FPD) of the participants increase. Despite this trend, the second pass duration (SPD) of the participants indicates that they spent approximately the same amount of time revisiting the previous words in each text. The range for comprehension scores for the narrative text is 3 and 5; for the expository text, it is between 4 and 6, and for the infographic text, it is also between 4 and 6.

Having established the fixation durations based on the parameters for this study, the next discussion attempts to establish whether there is a significant difference between FPD and SPD. To reiterate, inflated values of early processing rate (as reflected in FPD) represent initial problems in recognizing the words, while inflated values of late processing rates (as reflected in SPD) herald

difficulties in identifying words in sentential context (Dolgunsöz, 2015). To investigate this matter, a paired t-test was conducted.

TABLE 3. Difference between early and late processing according to text types

Type of text	Type of processing		Paired t-test results
	Early processing M(SD)	Late processing M(SD)	
Narrative	0.50s (.04)	0.81s (.05)	$t(39) = -40.1, p \leq 0.01$**
Expository	0.51s (.05)	0.80s (.07)	$t(39) = -28.4, p \leq 0.01$**
Infographic	0.59s (.06)	0.76s (.05)	$t(39) = -20.0, p \leq 0.01$**

Note: p is significant at 0.05

Table 3 shows the paired t-test results. Significant differences emerged for all three texts, with late processing being significantly longer than early processing (all ps ≤ 0.01). These findings suggest that when basic readers' reading proficiency is between A1 (mid) and A2 (mid), problems related to reading could be due to issues related to the language comprehension component.

Several key observations can be drawn from these findings. Firstly, the fixation durations observed in all three text types were higher than in previous studies that investigate reading in silent, oral and scene perception but still within the acceptable range as per Godfroid's (2019), and Rayner and Clifton's (2009) suggestions. Such a situation could occur because the fixation is influenced by the exact nature of the task that participants do. Secondly, the paired t-test revealed that basic readers had significantly higher sentence fixation durations (as reflected in SPD) than word fixation durations (as reflected in FPD), indicating difficulties in comprehending words in a sentential context; suggesting the need for an intervention on how to ensure SPD is not dominant (significantly higher) in reading comprehension. Finally, while this study confirms the difference between SPD and FPD, it is important to note that the FPD in all three texts was higher than in previous studies. Having discussed and established the eye movement behaviour during reading comprehension in general, the next part of our discussion will focus on behaviours that merit our attention.

WHAT READING BEHAVIOURS CAN BE HIGHLIGHTED BASED ON EYE MOVEMENTS?

BASIC READERS DO MORE REREADING AT THE MICRO LEVEL THAN MACRO LEVEL

Through an analysis of slide transitions in Tobii Pro Studio, we have discerned that revisitation during reading can be delineated into three distinct contexts: revisit between sentences, revisit between paragraphs, and revisit of the entire text. Our observation revealed that participants who engaged in the revisitation of the entire text also demonstrated revisitation tendencies between paragraphs and sentences. Similarly, participants who revisited between paragraphs also displayed revisitation between sentences but did not exhibit revisitation of the entire text. Lastly, individuals who did not engage in revisitation of the entire text or between paragraphs were found to focus their revisitation efforts solely between sentences. It is worth noting an additional pattern of revisit between text and graphic exists; however, we have deliberately excluded this part in our discussion to ensure the discussion is in congruence with the other two texts.

TABLE 4. Frequency of second pass duration types

Second pass duration type	Type of text		
	Narrative	Expository	Infographic
Revisit within and between sentences	30	32	32
Revisit between paragraphs	7	6	6
Revisit of the whole text	3	2	2

Table 4 indicates that readers at A1/A2 tend to perform more revisit within and between sentences. This may suggest that connecting the ideas at whole text level or between the paragraphs are not a skill possess by A1/A2 readers, therefore solidifying the nature of their SPD and the habits of the readers themselves.

BASIC READERS SHOW A MULTIDIMENSIONAL RELATIONSHIP BETWEEN SENTENCES

TABLE 5. Post hoc test on types of sentences between FPD and SPD

Dependent Variables	(I)Sentence Types	(J)Sentence Types	Mean Difference	Standard Error	Sig
		Narrative			
FPD	Simple	Compound	.0089	.00977	.634
		Complex	.0181	.00977	.157
	Compound	Simple	-.0089	.00977	.634
		Complex	.0092	.00977	.615
	Complex	Simple	-.0181	.00977	.157
		Compound	-.0092	.00977	.615
SPD	Simple	Compound	-.0813	.01713	.000*
		Complex	-.1277	.01713	.000*
	Compound	Simple	.0813	.01713	.000*
		Complex	-.0463	.01713	.021*
	Complex	Simple	.1277	.01713	.000*
		Compound	.0463	.01713	.021*
		Expository			
FPD	Simple	Compound	-.0200	.01152	.197
		Complex	-.0143	.01152	.430
	Compound	Simple	.0200	.01152	.197
		Complex	.0056	.01152	.876
	Complex	Simple	.0143	.01152	.430
		Compound	-.0056	.01152	.876
SPD	Simple	Compound	-.0223	.02156	.557
		Complex	-.1269	.02156	.000*
	Compound	Simple	.0223	.02156	.557
		Complex	-.1046	.02156	.000*
	Complex	Simple	.1269	.02156	.557
		Compound	.1046	.02156	.000*
		Infographic			
FPD	Simple	Compound	.0559	.02827	.122
		Complex	.0515	.02827	.167
	Compound	Simple	-.0559	.02827	.122
		Complex	-.0044	.02827	.987
	Complex	Simple	-.0515	.02827	.167
		Compound	.0044	.02827	.987
SPD	Simple	Compound	-.0538	.03551	.057

	Complex	-.1221	.03551	.002*
Compound	Simple	.0538	.03551	.057
	Complex	-.0683	.03551	.055
Complex	Simple	.1221	.03551	.002*
	Compound	.0683	.03551	.055

Table 5 shows the Tukey post-hoc analyses of FPD and SPD for different sentence types, including simple, compound, and complex sentences. Unlike previous studies that focused on temporary ambiguous sentences, this study observed the effects of sentence types on readers' eye movements in the context of CEFR reading materials, which predominantly employ active sentences. These findings are part of a larger data analysis exploring the interconnection between sentence types. The results suggest that the association between sentence types is linear at the early processing stage, with similar fixation durations observed across sentence types. However, as readers enter the late processing stage, the association becomes non-linear, with some simple sentences having similar durations to complex sentences. Additionally, sentences longer than the average word count of 12 to 14 words received double the average SPD and FPD, probably due to the presence of relative clauses followed by dependent or independent clauses. However, simple sentences with two or more extended segments can receive similar processing times to compound or complex sentences. These findings suggest that basic readers can easily process linear information in sentences not exceeding 14 words but require additional support for sentences with extended word counts.

BASIC READERS SKIP LARGE PORTION OF SENTENCES, TEXT TITLES, PICTURES AND PARAGRAPHS

Another analysis was conducted to examine the basic readers' skipping behaviour. It was observed that the readers tend to skip information such as sentences, graphics, or the text title (18 participants for narrative; 12 for expository; 11 for infographic). The skipping at certain parts of information, especially the title and sentences heralds that some information has been neglected (see Table 6).

TABLE 6. Frequency of skipping

ROIs/TEXT	Type of text		
	Narrative	**Expository**	**Infographic**
Title	18	11	10
Sentence 1	-	4	4
Sentence 2	-	4	
Sentence 3	2	-	2
Sentence 4	4	-	2
Sentence 5	-	-	2
Sentence 6	5	-	7
Sentence 7	-	-	4
Sentence 8	-	-	5
Sentence 9	-	-	NA
Sentence 10	-	-	NA
Sentence 11	2	-	NA
Sentence 12	-	-	NA
Sentence 13	NA	-	NA

Graphic 1	NA	NA	-
Graphic 2	NA	NA	1
Graphic 3	NA	NA	8
Graphic 4	NA	NA	-

* NA = Not Available in the text.

As previously noted, the omission of words during reading may reflect the automaticity of word processing, which is considered a hallmark of proficient readers (Rayner et al., 2012). Additionally, a word may be skipped if it is recognised in the parafoveal vision, as posited by the Reichle and Sheridan model (2015). This theoretical perspective differs from the Eye-movements of reading: Optimal View Positioning (EOVP) model (Brysbaert & Vitu, 1998), which proposes that word skipping is based on more general cues and involves a probabilistic estimate primarily driven by parafoveal word length. Furthermore, according to the EOVP model, skipping a word is unlikely to impede overall text comprehension. In order to comprehend the pattern of skipping observed in basic readers in the current investigation, it is necessary to compare the characteristics of skipping and to determine what factors contribute to it being considered a desirable or undesirable reading behaviour.

Positive skipping (this study calls it positive skipping because the word is still being processed and does not impede text understanding) is often done at the word level and the skipped word is often within the saccade length or in between two fixations. This argument is based on the E-Z reader model, where the word is skipped because it is recognised in the parafoveal area, depicting automaticity in word recognition as promoted by Miles and Ehri (2019). The skipping demonstrated by the basic readers in this study, however, often involves large regions of interest (ROI), like whole sentences, phrases, or text bubbles (that contain one or two sentences). This pattern was observed in all three texts. This kind of skipping is negative because there was no attempt made to process the information in the region, hence, explaining why there were no fixations in the ROI. For example, Figure 9 is a gaze plot of a basic reader that illustrates a negative skipping in the infographic text.

eISSN: 2550-2131
ISSN: 1675-8021

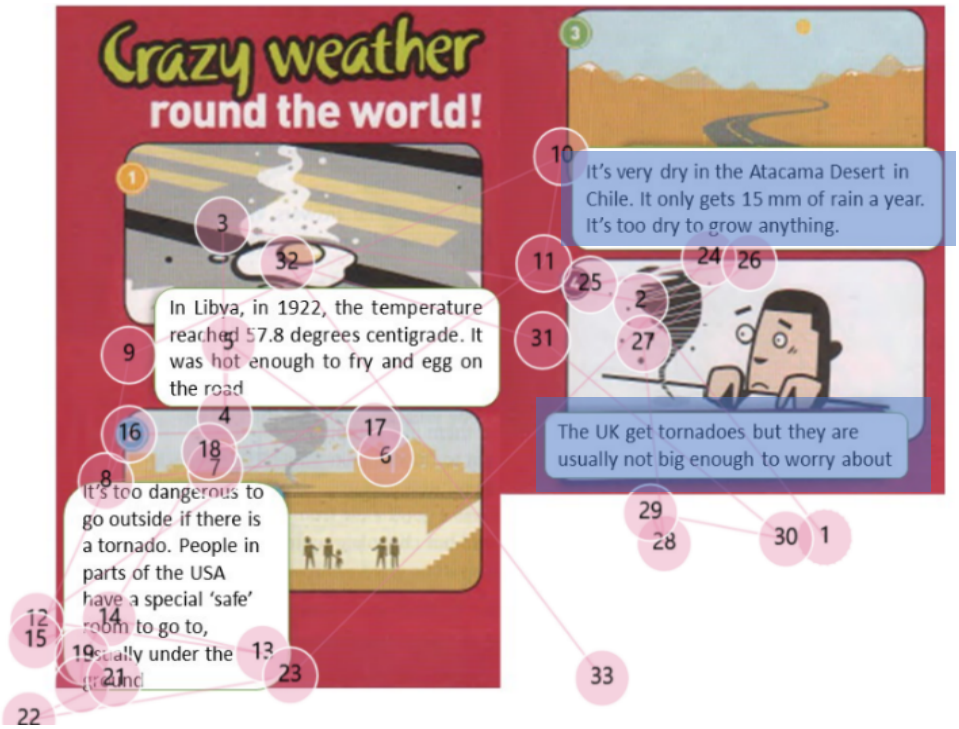

FIGURE 9. A gaze plot illustrating skipping in infographic text
Note: The pink circles are numbered gaze plots, plotting the sequence of fixations on the stimulus. The transparent blue boxes are skipped information.

The example above shows a challenge for readers to take in all the information presented, both graphics and words. It is evident that readers tend to overlook some information on the right side of the infographic text. This tendency to spend most of the reading time on the left side of the information when presented with two-column information may hamper the reader's comprehension of the infographic. The information skipped in the process could be critical, leading to a lack of understanding of the overall message (Jaafar & Thang, 2020). Further investigation and comparative analyses should be conducted in future research to understand why basic readers exhibit negative skipping and how it compares to other forms of reading behaviours. This issue requires a more extensive investigation, with extensive protocols and analysis which are beyond the scope of our research. Nevertheless, our findings provide valuable foundational insights into the reading behaviours of basic readers.

BASIC READERS MAKE DESEGMENTATION

Additionally, the basic readers appear to make venturous eye movements when they read the texts, creating what can be called desegmentations. A desegmentation takes place when a segment in one sentence is linked to a segment in another sentence before reading of the previous sentence is completed. Figure 10 is a gaze plot of a basic reader that illustrates a desegmentation.

FIGURE 10. A gaze plot illustrating desegmentations
Note: The yellow circles are numbered gaze plots, plotting the sequence of fixations on the stimulus

As shown in Figure 10, instead of reading the second sentence *The ride drops visitors from height of 139 metres!* in a linear fashion, the reader read the segment *The ride drops visitors* (plots 20-25), before shifting to a segment *1400 riders per* (plots 26-28) in the third sentence. The reader only shifted back to the second sentence at gaze plot numbered 31, i.e. *metres!* If one is to combine all the segments, the sentence produced will not make up a piece of coherent and understandable information. Desegmentations could be attributed to poor reading skills, commonly demonstrated by poor readers because of their poor visual processing (Conklin et al., 2020). This can be seen when they skip lines or segments of the sentences unmeaningfully. To enhance visual processing, reading-while-listening has been suggested as reading is guided by an audio or narration (Chang & Millet, 2015; Tragant & Vallbona, 2018).

A similar approach is found in the CEFR materials used in the Malaysian classrooms since they are also published by international publishers. All parts of reading activities in the textbooks have now included audio to accompany the reading materials. There is ample evidence that integrating written and aural representations is advantageous for L2 learners. For example, Webb and Chang's (2012) study of a large reading-while-listening program for young L2 learners found early gains in terms of comprehension, receptive vocabulary knowledge, and oral output measures. The study by Conklin et al. (2020) revealed that the use of audio support while reading improves eye-tracking skills (the ability to move one's eyes smoothly across the page and from one line of text to another) by separating individual words and sentences from a continuous stream of speech, thereby promoting the development of letter-sound correspondences and matching spoken and written forms. Additionally, it helps in the segmentation of text into larger meaningful units, such as collocations. Chang and Millett (2015) also found that adjusting the rate of the auditory presentation can enhance reading fluency. Given the advantages of reading-while-listening in enhancing reading skills at all levels of proficiency and the availability of audio materials in the Malaysian classrooms, L2 teachers should give serious considerations in incorporating it into reading lessons.

eISSN: 2550-2131
ISSN: 1675-8021

CONCLUSION AND WAY FORWARD

The main objective of this study is to profile CEFR-basic (A1/A2) readers by identifying their strengths and limitations. To achieve this objective, we observed the eye movement behaviours of our research participants using an eye-tracker. At this end, we found that their average First Pass Duration (FPD) and Second Pass Duration (SPD) are between 0.50s-0.59s and 0.76s-0.81s respectively. Having established that their SPD is significantly higher than the FPD, we further observed their eye movements and found several interesting patterns that merits our attention.

First, basic readers in this study portrayed revisit within and between sentences. Rarely the revisit consists actions of rereading the whole text for the second round. This pattern means their SPD are influenced by micro behaviours and we suggest activities that increase the frequency of revisit between paragraphs and of the whole text in order to improve the quality of the SPD. Second, we found that the interrelation between types of sentences became more apparent when they enter the second phase of reading – language comprehension. This situation suggests that introducing different types of sentences in the text for CEFR-basic readers, especially the complex structure, must be done under control (not more than 14 words per-sentence). Interestingly, our third observation found that CEFR-basic readers have the tendency of skipping information such as the title and sentences of the text during reading and this negative skipping in eye movements can pejoratively impact the understanding of the readers. Finally, we observe another pattern that we called as desegmentation of the sentences in the paragraph. These may be some of the reasons why participants scored between 3 and 6 on their post-reading task, indicating a need for a reading environment that enhances reading skills. Nevertheless, as discussed, the limitations mentioned earlier can be improved to become their strengths if their eye tracking skills during reading are enhanced and developed through audio-assisted reading technique.

Through this study, we also found that profiling readers through their eye movements, regardless of whether as a process or as a product, is possible if supported by a sound framework in interpreting the data. Future research may be interested in improving the framework and protocols in observing the behaviours using an eye-tracker. Similarly, we also wish to highlight that profiling readers in different reading settings must be done before we can properly establish their profiles. It is also essential to remember that eye-tracking is only one of several tools used to comprehend reading skills. Eye-tracking data must be combined with other research approaches, such as brain imaging, outcome measurements, and verbal reports, for a comprehensive understanding of the complex cognitive and perceptual processes involved in reading. We can conclude that the observations made in this study yielded interesting findings and highlighted the potential of eye-tracking as a tool for profiling readers.

REFERENCES

Azman, H., Mihat, W. & Soh, O. K. (2021). Analysing stimuli presentations and interview protocols to improve the data collection guidelines for reading research. *International Journal of Computer-Assisted Language Learning and Teaching (IJCALLT). 11*(2), 51-65.

Brysbaert, M. & Vitu, F. (1998). Word skipping: Implications for theories of eye movement control in reading. In G. Underwood (Ed.), *Eye Guidance in Reading and Scene Perception* (pp. 125–147). Amsterdam: Elsevier.

Cambridge English Language Assessment. (2013). *Cambridge Baseline 2013: English Language in Malaysian Schools (Result Report)*. Putrajaya: Kementerian Pendidikan Malaysia.

Cambridge English Language Assessment. (2014). *KEY English Test: Sample Test.* Cambridge: Cambridge University Press.

Cambridge English Language Assessment. (2018). *Completion report: An evaluation of the nationwide implementation of the new CEFR-aligned curriculum at Pre-school, Primary Years & Secondary Forms*. Putrajaya: Kementerian Pendidikan Malaysia.

Capel, A. & Sharp, W. (2013). *Objective KEY: Student's book*. Cambridge University Press.

Chang, A. C. S., & Millet, S. (2015). Improving reading rates and comprehension through audio assisted extensive reading for beginner learners. *System. 52*, 91–102.

Conklin, K., Alotaibi, S., Pellicer-Sanchez, A., & Vilkait, E. L. (2020). What eye-tracking tells us about reading-only and reading-while-listening in a first and second language. *Second Language Research. 36*(3), 257–276.

Creswell, J. W. & Creswell, J. D. (2016). Research design: Qualitative, quantitative and mixed methods approaches. 5th Ed. London: Sage.

Cunnings, I. (2018). *Eye tracking workshop: Connect'M Conference* [Powerpoint Slides]. GoogleDrive.https://docs.google.com/presentation/d/1GQbyDpcydvk55ZsiZQ8TIEOH3FW_bl/edit?usp=sharing&ouid=105509701069818641994&rtpof=true&sd=true

Dolgunsöz, E. (2015). Measuring attention in second language reading using Eye-tracking: The case of the noticing hypothesis. *Journal of Eye Movement Research. 8*(5), 1–18.

Godfroid, A. (2019). *Eye tracking in second language acquisition and bilingualism: A Research synthesis and methodological guide*. New York: Routledge.

Godfroid, A., Winke, P. & Conklin, K. (2020). Exploring the depths of second language processing with eye tracking: An introduction. *Second Language Research. 36*(3), 243–255.

Gough, P.B. & Tunmer, W.E. (1986). Decoding, reading and reading disability. *Remedial and Special Education. 7*, 6–10.

Grabe, W. (2009). *Reading in a second language: Moving from theory to practice*. Cambridge: Cambridge University Press.

Hoover, W. A. & Gough, P. B. (1990). The simple view of reading. *Reading and Writing*. *2*(2), 127–160.

Jaafar, N. M., & Thang, S. M. (2020). Processing of a multi-representational science passage by ESL learners. *GEMA Online Journal of Language Studies*. *20*(4), 18–29.

Joshi, R. M. (2019). The componential model of reading (CMR): Implications for assessment and instruction of literacy problems. In D. A. Kilpatrick, R. M. Joshi & R. K. Wagner (Eds.). *Reading Development and Difficulties: Bridging the Gap Between Research and Practice* (pp. 3–18). Switzerland: Springer.

Miles, K. P. & Ehri, L. C. (2019). Reading development and difficulties: Bridging the gap between research and practice. In D. A. Kilpatrick, R. M. Joshi & R. K. Wagner (Eds.). *Reading Development and Difficulties: Bridging the Gap Between Research and Practice* (pp. 63–82). Switzerland: Springer.

Mihat, W., Azman, H. & Soh, O. K. (2018). Bringing reading research in multilingual Nusantara into a new direction through eye-tracking. *Journal of Nusantara Studies* (JONUS). *3*(2), 107–123.

Mohd Yusof, S., Mohd Lazim, Z., Salehuddin, K., & Mohamad Shahimin, M. (2020). Graphic novels: Understanding how fifth graders read literary text through eye movement analysis. *Kritika Kultura*. *33/34*, 388–427.

Oakhill, J., & Garnham, A. (1988). *Becoming a skilled reader*. Oxford: Basil Blackwell Ltd.

Perfetti, C. (2007). Reading ability: Lexical quality to comprehension. Scientific Studies of Reading 11(4), 357–383.

Rayner, K., & Clifton, C. (2009). Language processing in reading and speech perception is fast and incremental: Implications for event-related potential research. *Biological Psychology. 80*, 4–9.

Rayner, K., Pollatsek, A., Ashby, J. & Clifton, C. (2012). *Psychology of Reading*, 2nd Ed. New York: Psychology Press.

Reichle, E. D., & Sheridan, H. (2015). E-Z Reader: An overview of the model and two recent applications. In A. Pollatsek & R. Treiman (Eds.), *The Oxford handbook of reading* (pp. 277–290). Oxford University Press.

Reingold, E. M., Yang, J., & Rayner, K. (2010). The time course of word frequency and case alternation effects on fixation times in reading: Evidence for lexical control of eye movements. *Journal of Experimental Psychology: Human Perception and Performance, 36*(6), 1677–1683.

Shukri, N. H. A., Nasir, M. K. M., & Razak, K. A. (2020). Educational strategies on memorizing the Quran: A review of literature. *International Journal of Academic Research in Progressive Education & Development. 9*(2), 632–648.

Spear-Swerling, L. (2013). A road map for understanding reading disabilities and other reading problems, redux. In D. E. Alvermann, N. J. Unrau & R. B. Ruddel (Eds.). *Theoretical Models and Processes of Reading* (pp. 412–437). Barksdale: International Reading Association.

Spear-Swerling, L. (2015). *The power of RTI and reading profiles: A blueprint for solving reading problems.* London: Paul. H. Brookes.

Stoops, A. & Christianson, K. (2019). Parafoveal processing of inflectional morphology in Russian: A within-word boundary-change paradigm. *Vision Research. 158*, 1–10.

Tragant, E. & Vallbona, A. (2018). Reading while listening to learn: Young EFL learners' perceptions. *ELT Journal. 72*(4), 395–404.

Urquhart, A. & Weir, J. C. (1998). *Reading in a second language*: *Process and product*. London: Longman.

Webb, S., & Chang, C.S. (2012). Vocabulary learning through assisted and unassisted repeated reading. *Canadian Modern Language Review. 68*(3), 267–290.

Weir, C. & Khalifa, H. (2008). A cognitive processing approach towards defining reading comprehension. *Cambridge ESOL: Research Notes. 31*, 2–10.

Wooldrige, L. (2017). The simple view of reading: Part 1. Retrieved on August 10th, 2018 from: https://ortongillinghamonlinetutor.com/the-simple-view-of-reading-svr-part-1/

Ya Shak, M. S., Albakri, I. S. M. A., Tahir, M. H. M., & Adam, M. H. M. (2021). The use of imported CEFR-aligned English language textbooks in Malaysian schools: Issues and concerns. *International Journal of Academic Research in Business and Social Sciences*. *11*(9), 954–963.

ABOUT THE AUTHORS

Warid Mihat, PhD is an Assistant Professor at the Academy of Language Studies, Universiti Teknologi MARA Cawangan Kelantan. Prior to this position, he taught primary school for 12 years. His research focuses on literacy development, Computer-Assisted Language Learning (CALL), eye-tracking, language policy, and English as a Second Language (ESL).

Hazita Azman, PhD is a retired Professor of Literacy who had served at Universiti Kebangsaan Malaysia for nearly 30 years. During her career, she published numerous works on literacy and language studies. Before retiring, she was a member of the English Language Standards & Quality Council Malaysia and collaborated with other leading ELT professionals in Malaysia to develop the English Language Roadmap 2015-2025.

Nurjanah Mohd Jaafar, PhD is a lecturer at the Centre for Research in Language and Linguistics, Universiti Kebangsaan Malaysia. She is the coordinator of the centre's eye-tracking laboratory. Her research focuses on the use of representations (especially text and graphics) in learning by second language speakers.

eISSN: 2550-2131
ISSN: 1675-8021