

GRAPHIC NOVELS

Understanding how Fifth Graders Read Literary Text through Eye Movement Analysis

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Abstract

The use of multimodal texts as a teaching resource is believed to be one of the fundamental requirements in keeping abreast with the rapid evolvement of literacy. This practice is reflected in the teaching of literature at primary schools in Malaysia when graphic novels, an example of a multimodal text, are introduced as one of the contemporary literary texts. The unique combination of language and images to make meaning in new ways is considered to be one of the main attributes why graphic novels are relevant in promoting multimodality in literature learning. Although its benefits are extensively explored, little research has been conducted to investigate how graphic novels are read. Do the readers actually effectively use the textual (language) and visual (images) elements when reading graphic novels? To this end, a study to investigate the patterns of visual behaviour of good and poor readers was conducted to observe the moment-by-moment processes during reading. Forty-nine Year 5 primary schoolers participated in a reading experiment using the Tobii TX300 eye tracking machine. Twelve pages of graphic novels from the Hardy Boys and the Nancy Drew series were used as stimuli. Utilizing gaze plot and heat map analysis as the eye movement measure, this paper reports

the eye movement behaviours of these young readers when reading graphic novels in three categories, namely, the sequence of panels, the reading path and the textual or visual focus. Results indicate that the participants, irrespective of their reading ability, had difficulty to follow the correct sequence of panels when the layout of the stimuli involves 'staggering' and 'blockage' manipulations. Although the majority of the participants followed the "left-to-right and down order" or the "Z-path", when reading graphic novels, greater amount of attention was given to the textual elements compared to the visual features which were overlooked when navigating the stimuli. Results from this study highlight the educational implications that the importance of visual processing and its integration with textual elements should be taught to young readers to assist comprehension.

Keywords

graphic novels; literature; multimodality; primary pupils; textual elements; visual elements

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INTRODUCTION

Incorporating literature in English into the English language program is “to help students improve their language skills (especially reading) and also to experience both education and pleasure when reading literary texts” (Vethamani 57). In achieving this, the implementation puts immense emphasis in fostering the students’ love for reading literary works which are normally dominated by printed fictional texts such as novels, short stories, and poetry. However, in this 21st century, students are now exposed to a variety of available information, both textual (words) and visual (graphics), to construct meaning (Serafini; Unsworth). The modes of making meaning have multiplied and almost a lot of these means are regarded as texts. As mentioned by Carter, “text” has now been defined as “anything in the surrounding world of the literate person” (12). Likewise, the contemporary definition of “literature” and what constitutes a literary “text” has also widened to include not only language but also other means of communications including images, sounds, films, electronic texts, and multimedia. Gupta advocates that contemporary literature is read with a sense of being closer to us than literature from the past. This is because the literature that is written in our time is directly relevant to our lives and our world.

The use of contemporary literary texts is also reflected in what students study as literature in schools today. In October 2010, the Malaysian Ministry of Education issued a circular on the implementation of the new Standard Curriculum for Primary Schools to replace the Integrated Primary School Curriculum (Rahman and Haslynda). The curriculum reform or its widely used Malay equivalent, ‘Kurikulum Standard Sekolah Rendah’ (henceforth, KSSR), involves all subjects including English. In the KSSR curriculum, literature in English is given a bigger role by introducing Language Arts and graphic novels, one of the examples of a multimodal text, as one of the prescribed texts for the pupils. The use of graphic novels in the English literature classroom is seen as a change from traditional texts that are generally mono-modal in nature, to texts that are multimodal. The Language Arts module has been added to the English language curriculum from Year 1 to allow pupils to engage and enjoy stories, poems, songs, rhymes, and plays written in English. Through fun-filled and meaningful activities, this component allows pupils to use fictional and non-fictional sources so that they will gain a rich and invaluable experience using the English language (Kurikulum). As a fresh approach to teaching literature in Malaysian primary schools, classics like *The Jungle Book* (for Year 4), *Gulliver’s Travels* (for Year 5), and *The Wizard of Oz* (for Year 6) in the form of graphic novels are introduced to upper primary level as required literary texts.

Studies on the use of graphic novels as a literary text in Malaysian classrooms are still very much in its infancy since it has only been incorporated in the primary school English language syllabus in 2011. Sabbah, Masood, and Iranmanesh recommended graphic novels to be used in primary schools based on the effective results in improving students' reading comprehension mainly for visual learners. In addition, Sabbah, Masood, and Iranmanesh's study, which used Felder and Soloman's learning style index to determine the students' learning styles, found that the use of graphic novels may also be beneficial for reluctant and struggling readers. Interestingly, besides English, other subjects have also benefited from the use of graphic novels. For instance, a study by Ching and Fong has revealed the positive value of multimedia-based graphic novels on students' critical thinking skills toward History learning. A more recent study focuses on the effectiveness of using comics as a learning tool in the process of teaching and learning of Science in primary schools. It shows a significant increase in the pupils' achievements on the topic of Energy, thus, improving their higher order thinking skills and their ability to remember Science facts and concepts (Krishnan and Othman).

In order to construct coherent mental representations of the subject matter, knowledge acquisition from these complementary sources requires integrating textual and visual information (Schnotz; Mayer, *The Cambridge Handbook of Multimedia Learning*). The *multimedia principle* has shown that students comprehend better when learning from text (textual) and pictures (visual), rather than from text alone (Mayer "Multimedia Learning [2nd]"). Empirical research has also documented that texts accompanied by visuals are more effective than non-illustrated texts (Butcher; Mason, Tornatora, and Pluchino). However, research has also shown that many students mistakenly assume that pictures are sufficient to grasp fundamental information. The pictorial information is processed superficially without examining the full instructional potential of pictures (McDonald and Thornley).

The existence of more than one mode in multimodal texts makes reading and navigating more challenging (Kress; Kress and Van Leeuwen). Jewitt agrees with this notion when they posit that readers of multimodal texts have the added burden of navigating through multi-layered and multi-coded animations, symbols, photos, and linguistic texts simultaneously. Understanding the ideas carried by these information separately may not be enough. Instead, making the connections and understanding how these ideas are affected by their representation through different modes will be more valuable.

A study to investigate whether graphic novels significantly improve students' reading comprehension compared with textual novels was done by Sabbah, Masood, and Iranmanesh. The findings of this study showed that the students'

reading comprehension scores for textual novels were significantly higher than for graphic novels. One reason for this difference could be that reading multimodal texts (e.g., graphic novels) is a challenging task for students, as students have difficulty finding the relationship between pictures and texts and understanding their meaning. Another reason pertains to the fact that multimodal texts require “parallel processing” in which visual elements are combined with words (Luke). It requires students to process graphic and written messages simultaneously to make one meaning (McDonald et al.).

A study on the newly introduced graphic novels to teach English via literary text in the Malaysian primary schools was recently conducted (Yusof, Lazim and Salehuddin). It involved a survey conducted on teacher trainees to explore the challenges they faced in teaching graphic novels to primary schoolers. Results show that although the graphics succeeded to entice the pupils into reading the literary text, the trainee-teachers felt that the graphics did not help their pupils in understanding the storyline. The pupils’ eagerness to go through the graphics has caused them to ignore the words in the speech balloons. Consequently, this resulted in incomprehensible input and, worse, misinterpretation of the content. This is consistent with findings from a study by Magliano et al. which suggested that graphic narratives are the most complex and demanding resource because they require text reading and pictorial comprehension.

With the aim to improve students’ textual and visual learning by teaching them how to integrate textual and visual information for successful comprehension, one needs sufficient understanding of how students deal with literary texts that combines these two elements. Furthermore, one also needs to know how students from different levels of proficiency interact with multimodal texts such as graphic novels in the school context. In the past almost all studies on processing and learning from texts have adopted the thinking-aloud method through which rich data can be collected. An alternative method that allows the processing of textual and visual elements to be tracked is the eye tracking experiment. The current study is aimed at contributing to these issues by conducting an in-depth qualitative analysis via the gaze plots and the heat maps on the eye movement patterns when the participants read graphic novels. Data was collected through a reading experiment using an eye tracking device called Tobii TX300 to find out the features of the eye movement patterns of good and poor readers when reading a graphic novel. For these purposes, the following research questions were formulated:

1. Do good and poor readers read according to the correct sequence of panels when reading a graphic novel?
2. How are the reading paths of good and poor readers when they read a graphic novel?

3. Do good and poor readers focus on textual or visual elements when reading a graphic novel?

LITERATURE REVIEW

Features of Graphic Novels

Apart from the combination of textual (words) and visual (pictures) elements and the organization of the texts into sequential units, the uniqueness of graphic novels lies in the components that form the medium. Terms like conventions, formats, or codes of graphic novels (Connors; Little) should be explicitly taught to students so that they can maximize their knowledge related to learning from graphic novels (Lawn). This section adapts Saraceni's *The Language of Comics* on the explanation of the special characteristics used in graphic novels. Figure 1 below is a sample of a two-page graphic novel taken from Rudyard Kipling's *The Jungle Book* retold by



Fig. 1. An excerpt from Rudyard Kipling's *The Jungle Book* retold by Carl Bowen (2013)

Carl Bowen, which is also the text for Year 4 in Contemporary English Literature for Primary School. This excerpt is used to assist the explanation on the conventions of the graphic novel.

The panels

Panels are rectangular frames that display single instants of actions or “stills”. These panels are part of a portion of a narrative, where actions and dialogues take place and take time. In Figure 1, the first page of the graphic novel comprises of two smaller rectangular panels on top of the page and a bigger horizontal panel at the bottom. On the next page, another horizontal panel occupies the top half of the page and the three smaller panels occupy the bottom half. These panels vary in size and most of the time the sizes depend on the content of the narration. The graphics may not be restricted within the panel as shown in the second panel of the first page in figure 1. The visual of Mowgli being pulled by monkeys overlapping onto the other two panels provides a three-dimensional effect.

The gutter

Gutters are one of the most essential elements of graphic novel design. They are the blank spaces that separate each panel from each other. The gutter is important because it is the space that contains what happens between the panels. Through the readers’ imagination, they are able to fill in the missing information between panels for the narrative to move forward. Gutters, according to McCloud and Monnin, are where the action and movement of the story occur in the mind. Saraceni highlights that the actual width of the gutter is not very important as long as the division between the panels exists. In Figure 1, although the width of the gutters on both pages may not be even, the presence of the gutters grants some moments for readers to make sense of the flow of the story.

The Speech Balloon

The speech balloon is the most common feature that is associated with comics and graphic novels. Balloons contain the speech or thoughts of the characters in the comics. The tail, a small pointed projection from the main balloon, indicates the character who is uttering the dialogue. As for the thought balloon, the tail is formed by a series of small bubbles. In Figure 1, in the second panel of the first page of the graphic novel, the word “Hey!” illustrates an example of an oval shape speech balloon shouted by Mowgli when he was pulled by the monkeys.

The Caption/Narrative box

Another component of the graphic novel that contains its linguistic element is the caption. The caption is commonly found at the top or at the bottom of the panel. Captions contain the voice of the narrator, providing more information and context for the graphics or dialogue for the benefit of the reader. This information helps readers reconstruct the flow between panels and fill the gap between the panels as represented by the gutter.

Apart from that, a caption can show other pertinent information like time. For example, “The next day.” An example of a caption can be seen on the first two panels of the first page in Figure 1. The caption at the top of panel 1 provides extra information on the existence of the monkeys that Baloo are not aware of. The next caption on top of panel 2 continues to tell readers about how upset the monkeys felt when Baloo talked about them. This caption helps readers to understand the content of the second panel where Mowgli is caught by the angry monkeys.

The language

The language of comics and the language that we use every day have a lot in common. Saraceni emphasizes the presence of functional words and content words when examining the language component. Functional words operate to link other words together such as conjunctions (and, but, or), articles (the, an), prepositions (off, in, for), and so on. On the other hand, content words carry meaning. Some examples of functional and content words can be shown in Figure 1. On both pages of the graphic novel, more content words can be found such as “Bagheera!”, “Baloo!”, “Help!”, and “Let me go!” The only functional word, “but,” is in panel 4 on the second page.

Another interesting point to note is that apart from words, there are other functional elements present in the form of icons. For instance, the sweat drops represent anxiety and nervousness while the musical notes represent the sound of characters humming a tune. In Figure 1, one functional element can be found in panel 3 of the second page. The words “Huff...huff...” represent the act of Baloo panting after running and trying to keep up with Bagheera’s fast pace.

Sound effects

Another component that is uniquely found in comics is sound effects or onomatopoeia, words that mimic sounds. These are usually drawn on panels

in big, bold letters and aid in the action happening within the panels. They add another dimension to the reading experience by way of visualizing sound. Some examples of this would be the words “FWOOSH!” and “RREEORR” in Figure 1 to depict the sound of Mowgli moving from tree to tree and sound of Bagheera’s roar, respectively.

Graphic Novels Page Layout

Navigating graphic novels is influenced by the layout of the panels. The physical layout of the sequence of panels is known as External Compositional Structure (ECS) (Cohn “Navigating Comics: An Empirical and Theoretical Approach to Strategies of Reading Comic Page Layouts”). In some comics or graphic novels, the panels are laid out into meaningful shapes that relate to the meaning of the sequence. Some comics may have broader layouts that use decorative functions to enhance mood (Cohn). This paper, however, elaborates on five variations in ECS that help explain the layout of the stimuli used in this study (Figure 2). The discussion also includes findings from Cohn’s study that discovers that some of these layouts had

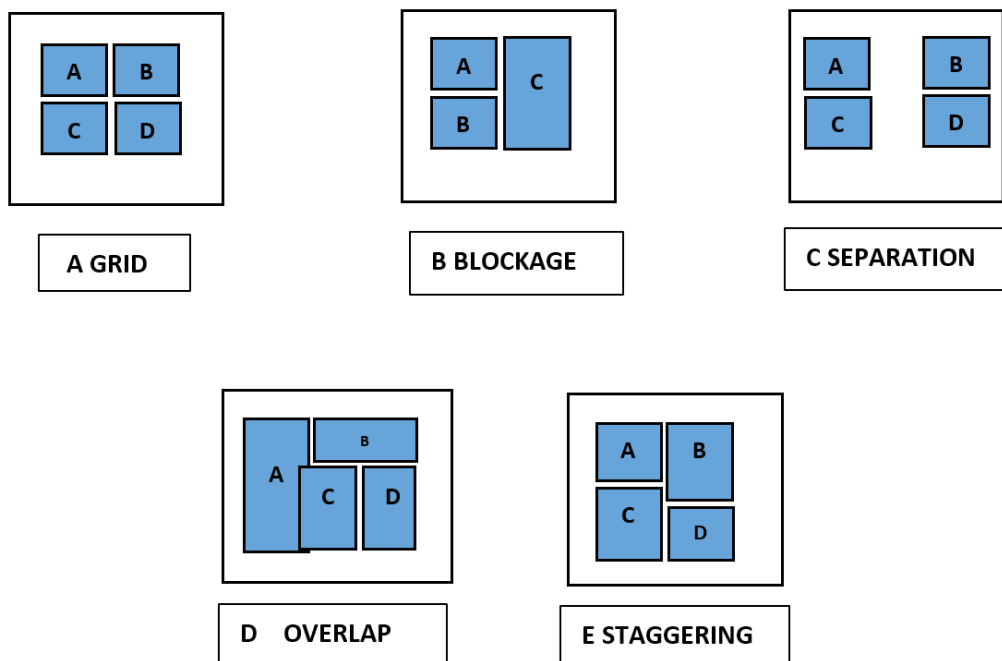


Fig. 2. Manipulations of comics page layouts adapted from Cohn (2013)

caused readers to violate the common way of navigating comics, with the left-to-right and downward reading orders used in written language, otherwise known as the “Z-path”.

Grid

The first layout is a straightforward grid, a single four-panel comic strip arranged horizontally, vertically, or in a 2 x 2 grid. In Figure 2A, readers begin to read from panel A to panel B and continue downward to panels C and then D. Due to its clear cut arrangement, Cohn discovered that a majority of the participants read in the Z-path almost all the time.

Blockage

Another example of panel layout is blockage. It occurs when a long vertical panel “blocks” the horizontal gutter entirely. As illustrated in Figure 2B, “blockage” occurs when panel C “blocks” the Z-path, forcing readers to move vertically from panels A to B and then horizontally to C. According to Abel and Madden, blockage has often been cited as “problematic” by comic creators and inexperienced comic readers. This notion was supported by Omori, Ishii, and Kurata when the eye movements of the readers showed that they tend to skip reading panel B when presented with “blockage” layouts. On the other hand, there was a noticeable decrease in the skipping of panels when the layout was modified to a horizontal path. However, Cohn’s findings were the opposite of earlier studies. When faced with a “blockage” layout, readers preferred using the blockage path of navigating through comic panels over the Z-path. Cohn concluded that the readers’ reading expertise has a strong influence on the contradictory results. In other words, novice comic readers who may have less experience encountering blockage layouts may revert to the common Z-path that they are more familiar with.

Separation

Separation is a layout that violates the Gestalt principles of grouping within proximity, in which we group items that are nearest to each other (Cohn). In Figure 2C, the space between the columns of panels is extended, hence, requiring readers to jump over a large gap between panels in order to maintain the Z-path (A-B). Adhering to Gestalt principles, following the most closely grouped panels (A-C) will disrupt the order of the Z-path. However, the findings from Cohn’s study

advocates that the participants chose to follow the “Z-path” almost three times more than the separation order.

Overlap

Overlap is a layout that is the opposite of separation. This happens when a panel (or panels) overlaps with another panel or two as illustrated in Figure 2D. Cohn found that only 50% of the time the Z-path was followed by the readers. This result indicates that overlap on its own does not influence readers to change their preference for the Z-path.

Staggering

Staggering is another type of Gestalt constraint that is concerned more with the continuation of a common flow (Cohn). The size of each panel varies so that their borders do not line up cleanly to create a smooth row or column. In Figure 2E, none of the panels are the same size and this makes the flow of panels unclear. In Cohn’s study on the strategies used in navigating comic layouts, the results showed that participants opted for the “Z-path” when faced with staggering manipulation. Unlike blockage manipulation, staggering had the least impact on participants to depart from the Z-path.

How Graphic Novels Are Read

The way readers read comics and other media (i.e., newspaper, magazines, and websites) also follows the culture of the readers’ written language (McCloud; Bongco). Hence, for English speakers, the way they read comics follows the English writing system, which begins from the left-to-right and then downward otherwise known as the Z-path (Cohn). Figure 3 below explains the Z-path when reading a comic page. The solid arrows (Situations A and B) illustrate the Z-path when a reader reads within the speech balloons and captions in a panel. This begins from the left of the speech balloon, moving to the end of the line on the right and then downwards to the lower left as shown in situation A and B in Figure 3. The dotted arrows (Situation C and D) show the Z-path pattern when a reader reads the speech balloons and captions between the panels. A reader starts from the left of a speech balloon or caption placed at the top panel and moves to the right. The reader then moves downward to a speech balloon or a caption at the bottom panel

and continues to read from the left of the speech balloon or caption and moves on to the right as presented in Situations C and D in Figure 3.

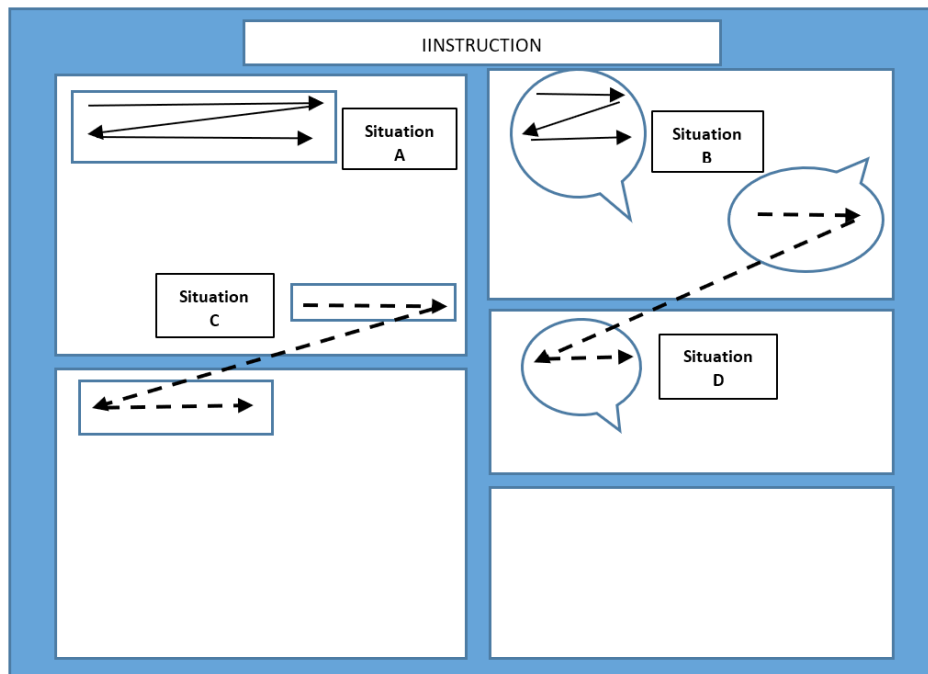


Fig. 3. The reading path which involves between (inter) panels and within (intra) panels

METHODOLOGY

Eye Movement Studies in Textual (Verbal) and Pictorial (Visual) Learning

A vast amount of research has been conducted on the workings of eye movement during the process of reading (Holmqvist et al.; Rayner) or looking at pictures (Boucheix and Lowe; de Koning et al.). Despite the overwhelming information presented in these dual modes, text (textual) and picture (visual), it is somewhat surprising that little research deals with eye movement when text and pictures are integrated in the comprehension process. Thus, this paper discusses four researches that highlight the combination of text-picture comprehension via eye movement recordings.

Hannus and Hyönä examined the role of illustrations when learning the contents of biology textbook materials among intellectually high-ability and low-ability children. A total of 108 4th grade students (55 girls and 53 boys) from two urban elementary schools in Finland took part in this real classroom learning situation study. Utilizing authentic biology textbooks for 4th grade in Finland, they found that learning was heavily driven by text and that illustrations were minimally reviewed by the children. In addition, illustrations benefited high-ability students more compared to low-ability students in terms of learning outcome. This was because the high-ability students spent relatively more time on pertinent segments of text and illustrations that improved comprehension scores.

Another study that analysed the integration of textual-pictorial information in print advertisement was conducted by Rayner et al. Twenty-four students of the University of Massachusetts were asked to view 24 advertisements at their own pace while their eye movements were recorded. The findings reported that when looking at advertisements comprising both textual and pictorial information, students spent more time fixating at text than at the picture part of the advertisement. The eye movement pattern showed that the viewers did not fixate back and forth between text and the picture. Instead, the large print in the advertisement caught their attention first, followed by the small print and finally to the picture.

A more recent study on the processing of text-picture combinations led by Schmidt-Weigand, Kohnert, and Glowalla also obtained similar results as the earlier researchers. The participants consisted of 90 students for Experiment 1 and 31 students for Experiment 2 from the Justus Liebig University of Giessen. They were asked to view a 16-step multimedia presentation on the formation of lightning. Results from both experiments concluded that students spent more time reading text than inspecting dynamic visualisations. However, it is important to note that learners also tended to switch between text and visualisations several times per scene. These transitions, according to Schmidt-Weigand, Kohnert and Glowalla, indicated the effort taken by the readers to connect the textual and pictorial elements in order to gather the information.

Masood and Mahmoud Al-jawarneh did another study that was largely text-directed in the comprehension process. The study involved seven student volunteers who were pursuing a Master's program in the field of Instructional Technology at Universiti Sains Malaysia (USM). Four general knowledge passages with modified preexisting pictures inserted within the respective texts were used as the stimuli in the experiment. The results from the cumulative heat map of the participants' visual fixations revealed that the area that the participants focused the most was on the text and not the picture. The students were found to only glimpse at the illustrated pictures and paid more attention reading the text to gain information

for the comprehension test. Although the pictures were clear and able to support the textual materials, it was concluded that the presence of illustrations did not contribute to the students' comprehension.

This pattern of results may probably derive from the layout of the stimuli used in the experiments, namely: textbooks, advertisements, multimedia presentations, and general knowledge passages, which contained more textual elements than visualizations. Focusing on textual information might reflect how the participants were used to text-based content based on years of interaction from the early age of schooling with language-based stimuli. In addition, the participants who were largely from the tertiary level failed to recognize the explicit cues to how text and illustrations are related in content (Hannus and Hyönä). In relation to this present study, the difference in the nature of the stimuli which emphasizes on graphic narrative is hoped to add to the existing literature on the role of text-picture that supports comprehension.

PARTICIPANTS

The participants in this study were 56 Year 5 pupils from a primary school in Kuala Lumpur. We obtained consent from the parents of each participant before they participated in the experiment. However, after considering the loss of data due to technical problems (5 participants) and poor eyesight (2 participants), only 49 samples (mean age: 11 years) were included in the experiment. Table 1 illustrates the number of pupils involved in the study. The participants went through two levels of screening tools in order to group them into good and poor reading ability. The first level of screening involved the use of the final examination marks. This was the preliminary selection tool, which was used in order to ensure that there would be a range of good and poor readers (based on their school's assessment) among the participants. The second level of screening took place when the participants had completed the eye tracking experiment. The eye tracking reading comprehension scores were utilized to categorize the participants into their respective categories. The total score for the eye tracking reading comprehension was 12 and the manner the students was categorized is as follows.

Table 1. Details of Grade bands, reader's category and number of pupils involved in this study

Grade	Bands	Range of marks	Readers' Category	No. of pupils
	A	100-80	GOOD	6
	B	79-65	GOOD	6
	Upper C	64-58	GOOD	7
	Lower C	57-50	POOR	4
	D	49-40	POOR	7
	E	39 below	POOR	19
	TOTAL			49

Initially, all data from 49 participants were analysed in order to investigate their eye movement patterns when reading a graphic novel. The results had shown a lot of similar patterns among the participants in both groups. Thus, for the purpose of an in-depth analysis, nine participants out of 49 scored the highest in the eye tracking reading comprehension and were chosen as representatives of the good readers. Their marks from the eye tracking comprehension questions ranged from 8 to 12. As for the poor readers' group, data from nine participants who scored the lowest were chosen to be representatives with marks ranging from 0 to 3. These participants were given individual codes for reference purposes. The good readers were labelled as G1 to G9 and the poor readers were labelled as P1 to P9. The distribution of participants' code and the eye tracking comprehension marks are shown in Table 2.

Table 2. Distribution of participants' code and the eye tracking comprehension marks

Good Readers		Poor Readers	
Participants' Code	Eye Tracking Comprehension Marks	Participants' Code	Eye Tracking Comprehension Marks
G1	12	P1	0
G2	10	P2	0
G3	10	P3	0
G4	10	P4	2
G5	8	P5	1
G6	8	P6	2
G7	8	P7	1
G8	8	P8	2
G9	8	P9	3

APPARATUS

The Tobii TX300 Eye Tracker (Tobii Technology AB, Sweden) was used to record the participants' eye movements. It has a 300 Hz sampling rate and allows free head movement of 37 x 17 cm at 65cm. This combination of a higher sampling rate and wide range of head movement allows participants to move freely and naturally in front of the stimuli, hence, making it most suitable for behavioral or eye movement research involving children. The Tobii TX300 comprises an eye tracker unit attached to a removable 23-inch, 1920x1080-pixel widescreen monitor. The user camera and speaker is fully integrated into the eye tracker unit so as not to distract the participant while the eye tracking recording is in process.

EXPERIMENTAL STIMULI

The experimental material for this study was part of a series of unpublished tests developed to assess how the participants read and answer questions in a graphic novel. This paper, however, only discusses the findings of the eye movement patterns when the participants read a graphic novel.

The reading stimuli for this experiment were chosen from the *Nancy Drew* and the *Hardy Boys* novel series. The series have been in publication since the 1930s and are enduringly popular with tweens and young teens in the West as well as Malaysia, where they have been translated into Bahasa Malaysia as *Siri Salmah* and *Siri Hadi*. In general, they are considered part of the children's canon in the adventure/mystery genre, and are part of a growing group of novels which have been published in graphic novel format. Three excerpts were extracted from each series and they were chosen based on three themes: family setting, onomatopoeia, and mystery. The excerpts were labelled as Text 1 to Text 6, respectively. Before the experiment, a compatibility test was conducted to look at the slide projection onto the Tobii TX300's screen as well as to adjust the assigned viewing distance. An example of the reading stimuli layout from Text 1 is shown in Figure 4 below. Each excerpt consists of two pages of the selected graphic novels and a short instruction was placed at the top of the slide.

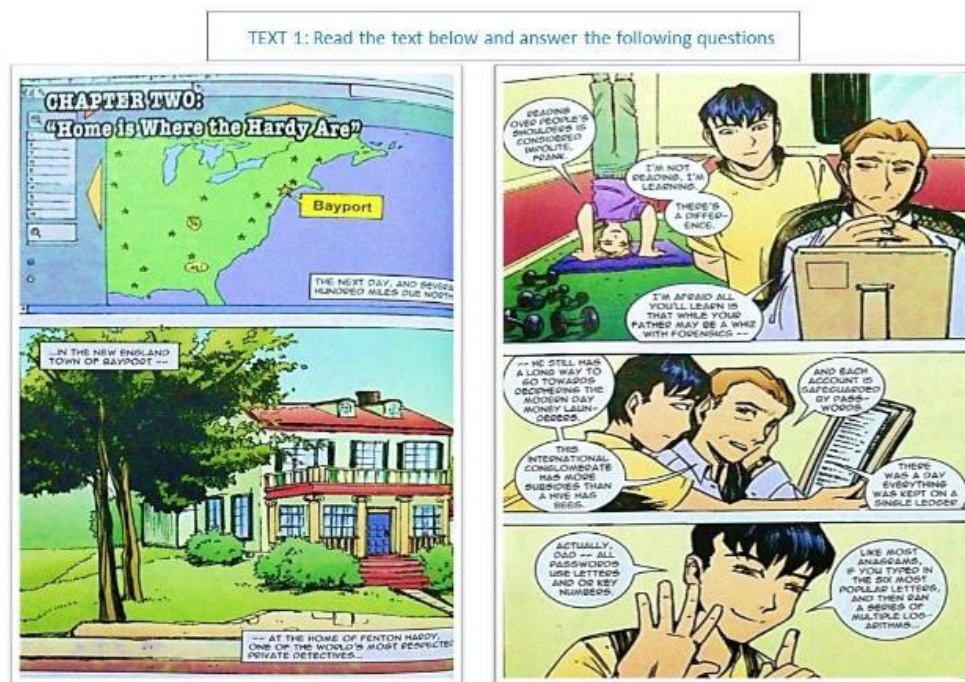


Fig. 4. An example of a reading slide (Text 1)

The page layout of each text in this study differs from one another as illustrated in Figure 5 below. Based on Cohn's research on navigating comics, three variations in ECS are elaborated to help explain the layout of the stimuli used in this study. Text 1's panels (Figure 5A) are arranged in a grid. Page 1 consists of panels 1 and 2 while Page 2 consists of panels 3, 4, and 5. Text 2 (Figure 5B) shows panels 1 and 2 on the first page while second page has panels 4 to 6 staggered. The layout for Text 3 (Figure 5C) is the "blockage" type which involves panels 2, 3, and 4 on the first page of the comic and panels 5, 6, and 7 on the second page. Text 4 (Figure 5D) consists of a three-page comic where the whole first page is the first panel. Panels 2, 3, and 4 are arranged in a grid on the second page and the rest of the panels (5, 6, 7, and 8) are on the third page. The layout for Text 5 (Figure 5E) shows panels 1 to 5 all placed in the first page of the comic. There is also a 'blockage' manipulation which involves panels 1, 2, and 3 on the same page. Panel 6 covers the whole second page for this text. Finally, Text 6 (Figure 5F) shows a clear grid organization for the first and second page of the comic. Panels 1, 2, and 3 are placed horizontally on the first page and panels 3, 4, and 6 on the second page of the comic.

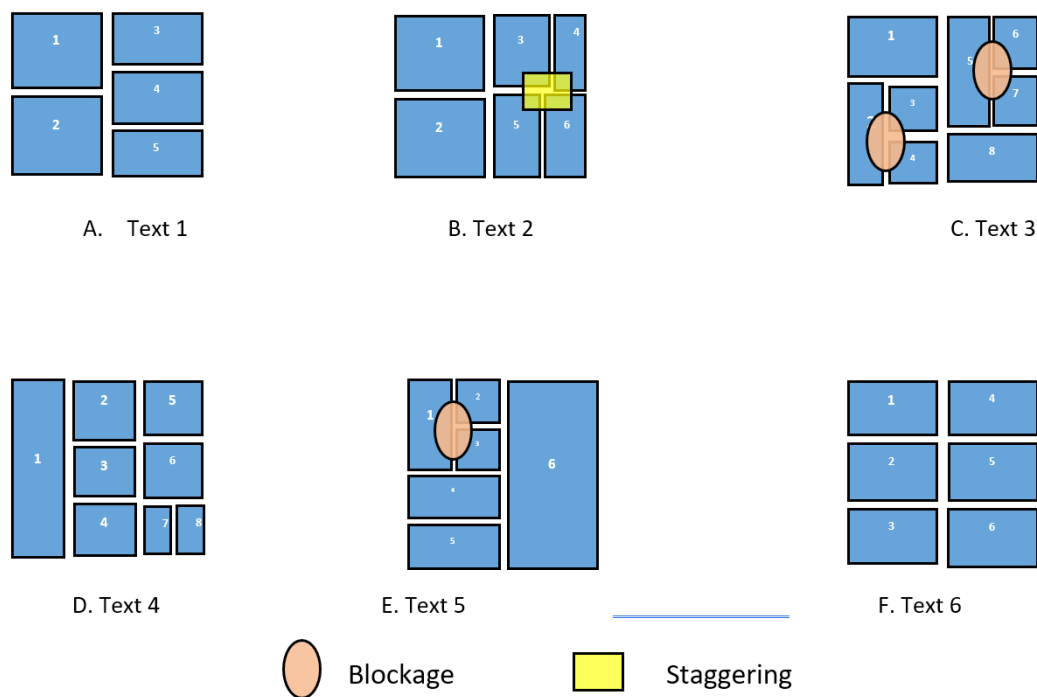


Fig. 5. Layout of all comic pages with notations of grid, blockage, and staggering layouts.

PROCEDURE

Before the actual experiment, a pilot test was conducted to test the eye tracker, the software, the stimuli (the comics), and the experimental procedure. The duration that the participants spent on reading was also recorded for reference during the actual experiment.

Before beginning each experiment, the researcher explained what the participants would be reading by using an excerpt from a graphic novel entitled *The Jungle Book* as a dummy stimulus. This text was purposely chosen because the pupils had used it as a text in the Language Arts module in Year 4. A laminated 46cm x 61cm poster sized *The Jungle Book* excerpt was also prepared to assist the briefing on the comics conventions such as the gutter, caption, speech balloons, panels, and sound effects or onomatopoeia.

The seat was then adjusted for height and distance from the screen so that the eyes were roughly 60 cm from the eye tracker's screen. The next step was to conduct the calibration process to ensure eye movement data accuracy. During the experiment, the participant was asked to read the graphic novel text silently

and answer two comprehension questions orally. Altogether, there were six texts for the participants to read and twelve comprehension questions to answer. The students performed the test at their own pace; they clicked the mouse whenever they wanted to move to the next slide. Turning pages backward was not possible.

DATA ANALYSIS

This study utilized the visualization analysis of the eye tracking data to provide greater clarity in understanding how young readers read comics and graphic novels. Using gaze plots and heat maps, visual qualitative inspection of the eye movement patterns when the participants read graphic novels were collected. Gaze plots are useful to understand which areas of the comic draw the reader's attention and the sequence in which the contents are viewed. As shown in Figure 6, each visual fixation is illustrated by a dot and a number. For instance, "1" shows the first place that the participant looked at, "2" represents the second place and so on (Bergstrom 15). Gaze plot therefore is an effective presentation to show the path that the participant takes as their eyes move across the page. In addition, heat maps are static or dynamic aggregations of gaze points and visual fixations revealing the distribution of visual attention (iMotions). Using color as a coded scheme, red and yellow (represented by the darker shades in Figure 7) signify "hot zones," or a large number of visual fixations; green and blue (represented by the lighter shades in Figure 7) denote "cool zones," or fewer visual fixations; unshaded areas indicate no visual fixations (Conklin and Pellicer-Sánchez 5).

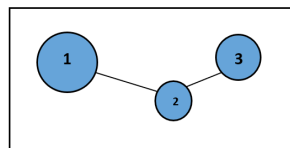


Fig. 6. Gaze plots

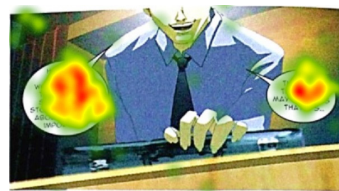


Fig. 7. Heat map

FINDINGS

Research Question 1: The Sequence of Panels

Good Readers

Looking at the way the participants navigated the panels in all six texts, it was revealed that the first visual fixation for all participants (G1 to G9) was focused in the middle of the two pages. This “entry-point” (Cohn “Navigating Comics: An Empirical and Theoretical Approach to Strategies of Reading Comic Page Layouts” 1) was either on the gutter (space between the panels) or on the visuals which are situated in the middle of the two pages.

After the first visual fixation in the centre of the computer screen, the majority of the participants continued to focus on the reading instructions at the top of the page. However, the researchers found that in all six texts, there were participants who did not focus on the instructions in the beginning. For instance, in Text 1, G3, G4, G5, and G6 only read the instructions after they have finished reading all the panels in the two-page comic. The scenario of ignoring to read the instruction at the beginning of the reading process continued in Text 2 (G3, G4, G5, G6, and G8), Text 3 (G2, G3, G4, G6, and G8), Text 4 (G5, G6, and G7), and Text 5 (G4 and G8). However, in Text 6, except for G1, all of the other participants ignored the instructions totally.

The gaze plot analysis showed that most of the Good Readers were able to read the comics according to the correct sequence in all six texts. However, the researchers realized that there were two occurrences that showed some of them read the comics in an irregular sequence.

First, there were Good Readers who skipped reading some panels. This was evident in Text 1 where G2 and G5 skipped visually fixating on panel 2 where there were only visuals and captions included. As for Text 3, G1 skipped visually fixating on panel 1 as there were only visuals without any speech balloons. Another evidence of skipping panels occurred in Text 3 where G7 was found to visually fixate on the first page in the sequence of 1-2-4 and skipped reading panel 3. Similarly, G3 and G6 skipped visually fixating on panel 6 and continued reading the panels on the second page in the sequence of 5-7-8. Another surprising result was found in Text 5 where all participants (G1 to G9) were found to read the sequence of the first page incorrectly. The sequence they read was 1-2-4-5 as they missed reading panel 3 on the first page of the comic.

Second, the researchers found that the majority of the participants in the Good Readers' category have the tendency to look first at the last panel (panel 6) of Text 5, which is the only panel on the second page, dwarfing all the other panels on the first page. The participants look at the second page first before moving back to the first page and start reading from the first panel.

Poor Readers

Among the Poor Readers group, the researchers found that the majority of them visually fixate at the centre of the screen (the page) first. The common entry point was the gutter in the middle of the two pages.

On the whole, the majority of this group also did not immediately look on the reading instructions at the top of the page. For instance, in Text 1, only P5, P6, P7 looked at the instructions after their entry point at the center of the two-page comic. The rest of the group (P1, P2, P3, P4, P8, and P9) only read the instructions after they have read the first few panels. Some of them only looked at the instructions after reading all the panels in the comic. All subsequent texts saw participants ignoring the instructions at the top after looking at the center of each comic as in Text 2 (P2, P3 and P4), Text 3 (P2, P3, P4, P6, and P8), Text 4 (P4, P5, P6, and P7), Text 5 (P3, P4, and P6), and Text 6 (P1, P3, P4, P5, P6, and P7).

In this particular group, there were two ways in which the participants read the comics in incorrect order. First, there were four participants who were not capable of reading the stimuli correctly. These participants' fixations, namely P5 (in all Texts), P1 (in Text 3), P7 (in Text 3, 4, and 6), and P6 (in Text 4 and 6), who were observed jumping from one panel to another without following the correct order.

Second, some of the participants skipped some of the panels. This was observed in Text 1 where P6 and P9 skipped panels 1 and 2. P3 ignored panel 1 in Text 3 and in Text 4, P1 and P3 did not visually fixate on panels 1 and 4. Skipping panels also occurred in Text 2 where P1 and P8 read the second page in the sequence of 3-4-6 but skipped panel 5. It was also interesting to note that, similar to the Good Readers' group, all the participants in the Poor Readers category (P1 to P9) were also observed to incorrectly read of the first page of Text 5. All of these participants were observed to read in the sequence of 1-3-4-5 and skipped reading panel 2. On top of that, some of the participants were observed not reading the last panel. In Text 1, P5, P6, and P7 ignored the last two panels. Similarly, in Text 2 and Text 5, P2, P3, P6, and P8 skipped reading the last panel that contained a lot of dialogue.

Research Question 2: The Reading Path

Good Readers

In this section of the analysis, the researchers observed the paths that the participants' eyes take in reading between panels (inter) and within speech balloons and captions (intra) (refer to Figure 3). The whole group (G1 to G9) were observed to read in the Z-path pattern, the standard reading path of the English writing system.

In reading the speech balloons across panels, the participants started from the top left panel and moved across to the right panel. Then the eye moved downwards and across to the left panel of the next row before moving to the next panel on the right. As for reading speech balloons and captions in a panel, a majority of the participants also successfully followed the Z-path. Occasionally, there were instances where some of the participants skipped visually fixating on some panels. When this happened, the visual fixation pattern seemed to jump from one panel to another. However, the confusion only involved a few panels and most of the participants were able to continue to read in the standard Z-path for the rest of the text.

Poor Readers

The analysis on the reading path for the Poor Readers' group shows that there were two types of reading paths. The first group, which consisted of P1, P2, P3, P4, P8, and P9, demonstrated the normal Z-path when reading the speech balloons between panels as well as within speech balloons and captions in a panel (refer Figure 3).

The second group, which was comprised of P5, P6, and P7 showed a more complex eye movement pattern. For instance, in Text 3, the participants showed irregular patterns of visual fixations when their eye movements jumped from one panel to another. Their reading pattern based on their eye movement did not follow the correct sequence of panels when they skipped reading a few panels in the second page of the comic. Thus, there was no evidence of the Z-path reading pattern in this group.

In Text 4, all participants in this group (P5, P6, and P7) showed more disorganized eye movements. They seemed to glance through the panels without fixating on any speech balloons. Their eye movement did not follow the correct sequence of panels and instead, they jumped from one panel to another. Thus, there was no regular

use of the Z-path detected when they read the speech balloons between panels as well as within speech balloons and captions.

Research Question 3: Verbal/Visual Focus

Good Readers

The gaze plot analysis also shows whether the participants focused more on the textual elements (speech balloon and caption) or the visual elements (graphics and illustrations) when reading the comics. Among the Good Readers, the focus was aggregated to the texts. An interesting point to note was that all participants (G1 to G9) unanimously focused more on the textual elements of Text 1, Text 2, and Text 6. These texts were rich with speech balloons in all the panels. In Text 1, for instance, the researchers noted that all the participants visually fixated more on the textual elements (captions and speech balloons) of the comics. They did not alternately fixate between the textual and the visual elements. In other words, they “read in depth” all the speech balloons that appeared from panel three to panel five and ignored the visuals in these panels. The act of ignoring the visuals was obvious in panel 2. Although the whole panel occupies most of the page with an illustration of the setting (a house surrounded with trees), the readers largely focused on the captions. This tendency to focus on text shows a reliance on textual information, which is the reason why some participants tended to skip panels with no speech balloons.

The Good Readers group were observed to pay some amount of attention to both the textual and the visual in Text 3, Text 4, and Text 5. These participants tend to visually fixate on sound effects which were the motif of Text 3 and Text 4. For example, in Text 3, the participants showed interest in focusing on both the textual and visual elements of panels 1 and 5 where the sound effects appeared by alternately focusing on the word “SCREEECH!” and the illustration of cars in panel 1, and the word “SMASH” as well as the picture of the door in panel 5.

Text 5 was illustrated with fewer speech balloons so the participants’ attention was focused equally on both the textual and the visual elements. Although it seemed that the participants were focusing on both the textual and the visual elements in these texts, the gaze plot analysis was able to detect the length of time spent on these elements. In Text 3, Text 4, and Text 5, the researchers observed that the participants only glanced through the visual elements quickly. They took more time to focus on the textual elements in the texts compared to the visual elements.

In summary, the textual elements were still the main focus of these participants when reading these texts.

Poor Readers

The results of the experiment revealed three types of reading patterns. The first pattern demonstrated by P1, P2, P3, P4, P8, and P9 showed that they tend to focus on the textual elements in Text 1, Text 2, and Text 6. Although there were many speech balloons included in these three texts, the participants visually fixated on all the speech balloons and some even disregarded the existence of the visuals until the last panel.

The second pattern was observed in P5, P6, and P7 in Text 1, who alternately focused between visual and textual elements within a panel and jumped between panels as if they were skimming the page. P7 was observed to stop focusing on the penultimate panel before ignoring the last panel altogether. In Text 2, P5, P6, and P7's focus was neither on the textual nor the visual elements. Their eye movements made quick leaps from one panel to another, as if they were skimming the page instead of reading it.

The scenario changed slightly in Text 3, 4, and 5. All participants (P1 to P9) visually fixated on both the visual and the textual elements on panels with sound effects (panels 1 and 5). They alternately focused on both visual and textual elements and continued to focus on textual (speech balloon) elements in the rest of the panels. The scenario of giving focus to both textual and visual elements continued in Text 5, where there were not many speech balloons included in this particular text. Similar to the Good Readers, the Poor Readers were also found to visually fixate on visual elements quicker than the textual elements.

DISCUSSION

Any serious attempts to improve the quality and effectiveness of teaching and learning literature in schools should start from a clear understanding of how students read and make sense of what they read. This study aimed to advance our knowledge about the reading of comics and graphic novels as a literary text at the primary school level. The focus of this study was to examine the sequence of panels and the reading path that the participants took when reading graphic novels. In addition, the participants' attempt to concentrate on textual or visual elements

during the reading process was also looked into. Data was revealed through eye tracking which involved the qualitative analysis of the gaze plot and the heat map.

The first research question asked whether the good and poor readers read according to the correct sequence of panels when reading a graphic novel. The gaze plot analysis has proven that between good and poor readers, the entry point for all the reading texts was at the centre of the two-page comic. Although at the beginning of the experiment, the majority of participants in both groups started reading the instructions (such as in Text 1 and 2), as they progressed to the other texts, they seemed to visually fixate less on the instructions. This was probably because they had become familiar with the layout of the stimuli and were already able to anticipate the same instruction, which appeared at the top of the stimuli.

The majority of the participants from both groups were able to read and follow the correct sequence if the panels of the graphic novel were arranged vertically in a grid such as the layout for Text 1 and Text 6 (Figure 2). Their gaze plot patterns showed that most participants from both groups were able to read from the first panel to the last panel without any difficulties. However, an irregular pattern of reading was found in Texts 2, 3, 4, and 5 where the participants skipped some panels when reading. A panel was considered “skipped” if any of the later panels on the page were visually fixated on before the current panel was visually fixated on (Omori, Ishii, and Kurata 3). For example, if the sequence of panels that the participants fixated were 1-3-4-6, panels 2 and 5 were considered as “skipped.”

The findings of this research found that this scenario was due to two common features. First, there were participants who skipped reading panels that do not contain any speech balloons. Figure 8 below illustrated a sample of the gaze plot taken from Text 1 which revealed that there were fewer visual fixations detected on panel 2 which appeared to have no “human” interaction. An assumption that could be made was that the participants were more familiar with textual language such as in conventional novels in providing information compared to visuals. This result corresponds with the findings of many studies that showed learning to be heavily driven by text (Schmidt-Weigand, Kohnert and Glowalla; Hannus and Hyönä) and that students generally prefer to look at text rather than at pictures while learning (Rayner et al.). The panels that only contained visuals may be thought of as unimportant and thus were ignored during the reading process.

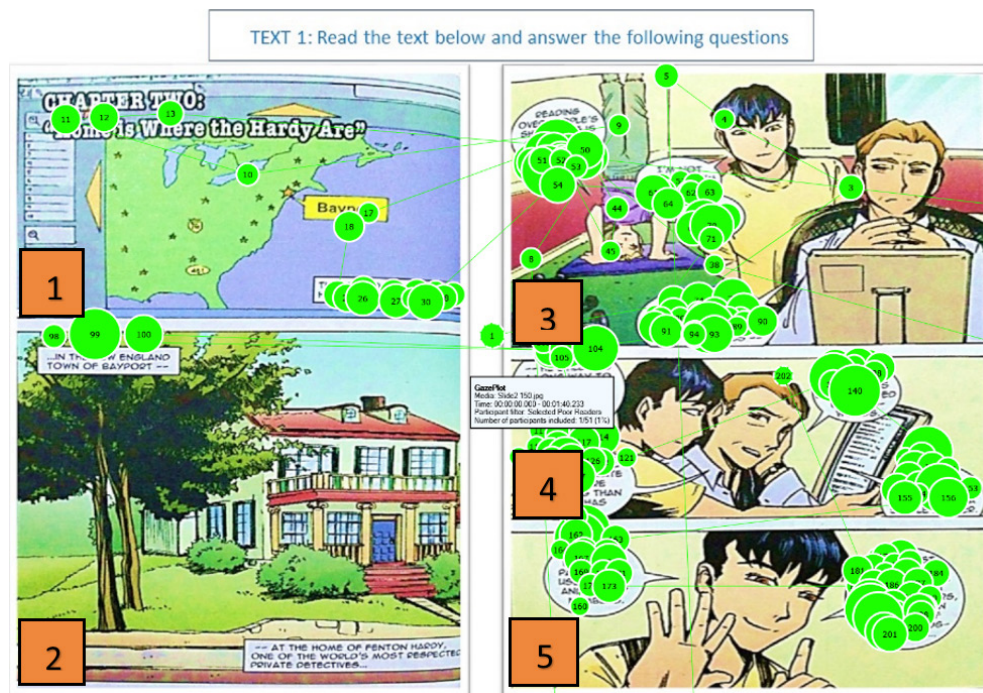


Fig. 8. A sample gaze plot of Text 1 showed fewer visual fixations on panel 2.

The layout of the panels was the second reason why some of the participants skipped panels, which led to reading the comics in incorrect sequence. The irregular reading patterns were seen in Text 2, 3, 4, and 5. This could be due to the “staggering” and “blockage” layouts as illustrated in Figure 2 (Text 2 to Text 5). Evidence taken from Text 2 in Figure 9 demonstrated that the participants ignored panel 5 on the second page of the comic, which is probably due to its staggered layout. In addition, Figure 10 displayed a sample of a gaze plot from Text 5 which showed that there was no visual fixation on panel 2 when it’s in a blockage layout. This finding supports the claim made by Abel and Madden who opined that “blockage” has often been commented as “problematic” by comic creators and inexperienced comic readers. Additionally, Omori, Ishii, and Kurata who looked at readers’ eye movements on comic pages also confirmed the discovery of skipping panels when readers are faced with a blockage layout. These findings from earlier studies help justify why the participants in this present study, who were newly introduced to comics and graphic novels, also found it perplexing when they read panels that involved blockage and staggering layouts.

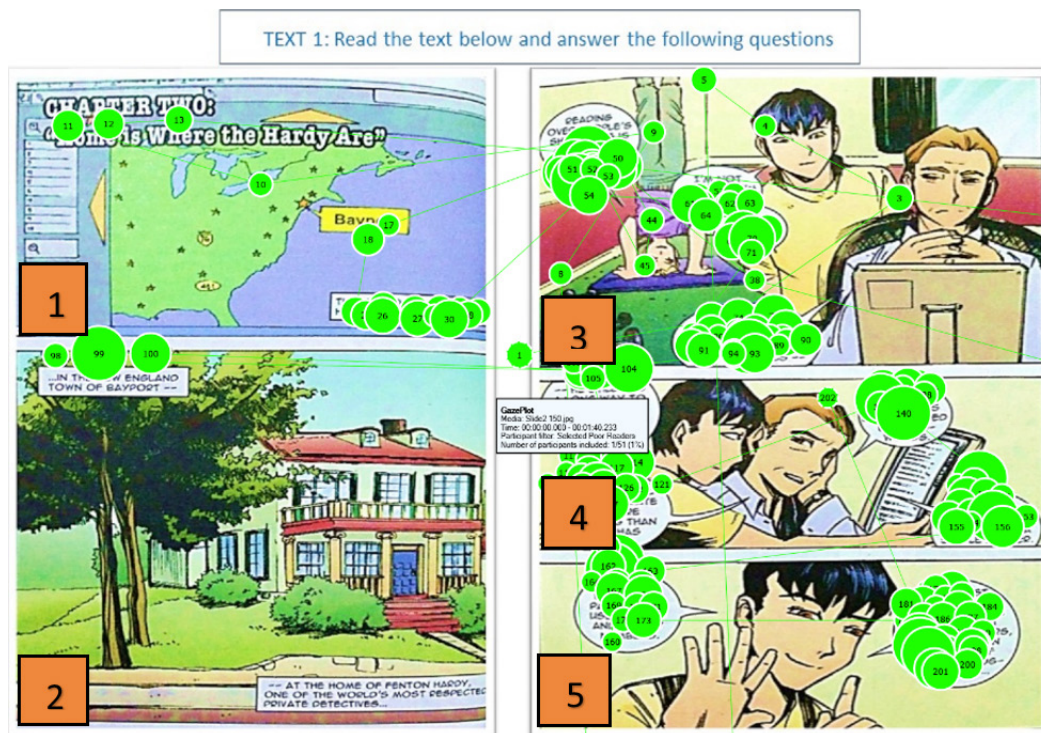


Fig. 9. A sample gaze plot from Text 2 showed skipping of panel 5 due to staggered layout.



The second research question aimed to find out the reading paths of the good and poor readers when reading a graphic novel. The gaze plot analysis showed that the reading paths that the participants in both categories made were closely related to the sequence of panels they followed. Two findings concerning how the participants read were discovered. First, the majority of the participants from both groups produced the standard Z-path of reading. The Z-path reading pattern is also the default order for navigating comic page layouts (Cohn “Navigating Comics: An Empirical and Theoretical Approach to Strategies of Reading Comic Page Layouts”; Cohn and Campbell). The common reading patterns were applied when reading between (inter) panels as well as within (intra) panels (refer figure 3).

An example of G1's gaze plot taken from panel 1, Text 6 is shown in Figure 11 below. This is an evidence to show the Z-path pattern that the participants did when reading within the (intra) panel. The visual fixations (numbered 20 to 33) followed the Z-path which began from the left and moved across to the right and down to another layer of sentence within the speech balloon.



Fig. 11. A gaze plot from panel 1 Text 6 showed sequence of fixations that follow Z-path pattern within (intra) panel

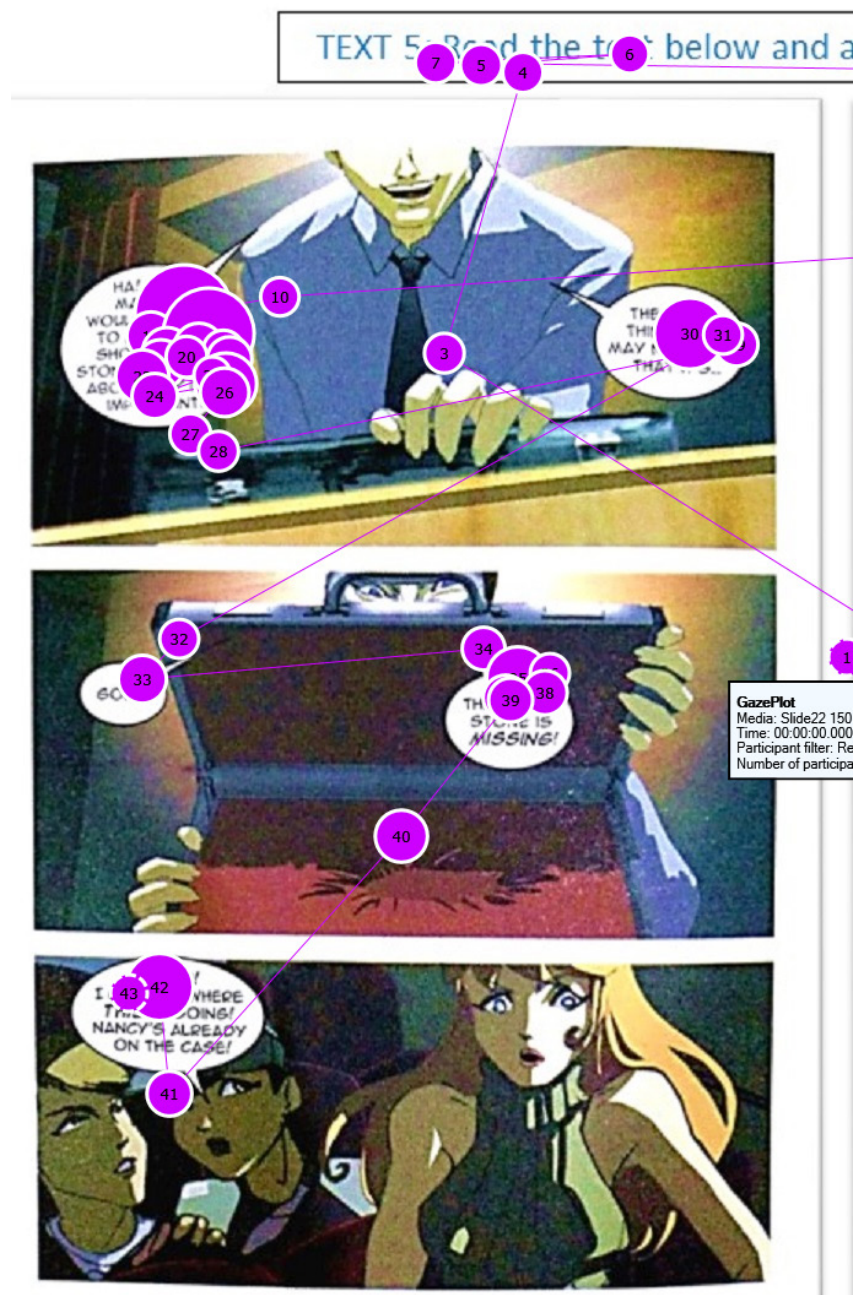


Fig. 12. A gaze plot from Text 6 showed sequence of fixations that follow Z-path pattern between (inter) panels

Figure 12 is another example of a gaze plot taken from Text 6 which illustrates how a participant followed the Z-path when reading between panels. The pattern was clearly observed when the participants visually fixated on the left speech balloon (28th fixation) and then moved to the speech balloon (29th to 30th fixations) on the right in panel 1. The visual fixations continued down to panel 2 which also began from the speech balloon on the left (32nd to 33rd fixations) and later to the speech balloons on the right (34th to 39th fixations). The reading moved to the speech balloons (41st to 43rd fixations) on panel 3.

However, participants who faced texts that contained complex layouts (such as staggering and blockage), as opined by Cohn, may need to be guided when reading. The participants were found to skip panels and tried to navigate panels in alternate routes when presented with various layouts such as staggering and blockage. Similar findings were reported by Cohn ("The Architecture of Visual Narrative Comprehension: The Interaction of Narrative Structure and Page Layout in Understanding Comics") in a study on how readers navigated comics when given various page layouts. He found that blockage greatly caused participants to deviate from the Z-path, whereas staggering created marginal deviation from the Z-path.

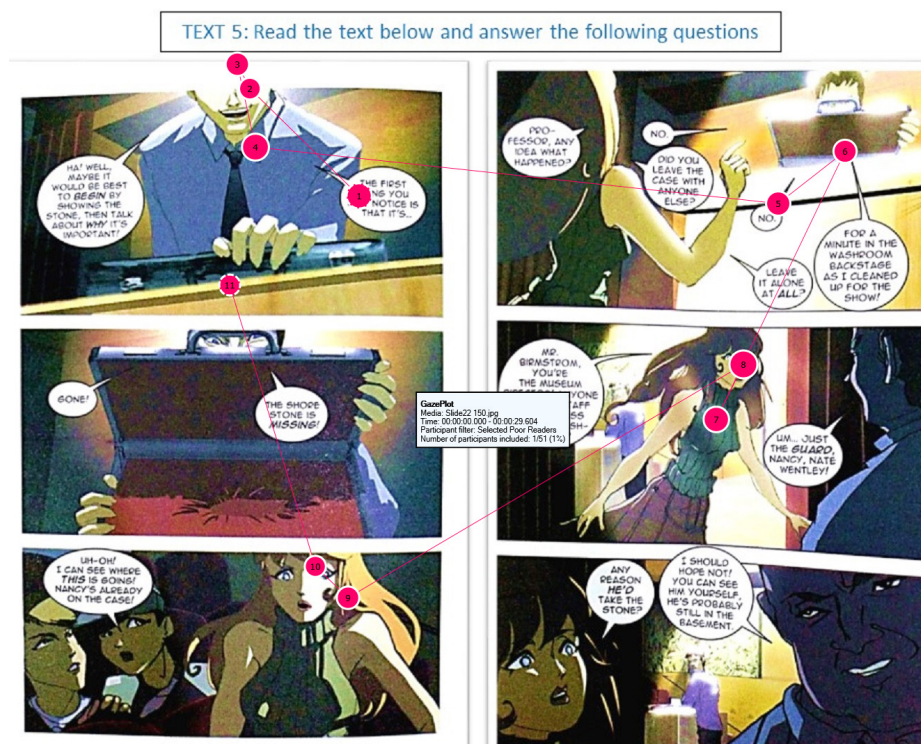


Fig. 13. A gaze plot from Text 6 showed fixations jumped from one panel to another.

In addition, it was revealed that a few participants from the poor reader group were found to lack knowledge on how to read comics and graphic novels. The quick movement of the gaze plot which also appeared to be jumping from one panel to another without following the correct sequence proved that these participants were not familiar with the layout and may not even know where to start.

Figure 13 illustrates an example of an irregular reading pattern that deviates from the Z-path pattern. Although the participant started fixating correctly on panel 1 (1st to 4th fixations), the following fixations were seen on panel 4 (5th and 6th fixations). The participant also continued to fixate on panel 4 (7th and 8th fixations) before regressing to panel 3 (9th and 10th fixations) and panel 1 (11th fixation). The eye movements, which jumped from one panel to another without following the correct sequence, indicated that the participant was not following the common Z-path pattern between (inter) panels and within (intra) panels.

The third research question seeks to find out whether the good and poor readers focus on textual or visual elements during the reading process of a comics page. The heat map analysis revealed an emerging pattern. The majority of participants from both groups visually fixated more on the textual (speech balloon and caption) elements compared to the visuals. This condition is highly evident in Text 1, 2, and 6 where the panels in the texts are loaded with speech balloons compared to the other three texts. For illustrative purposes, two exemplary heat maps taken from Text 1 showed the viewing patterns (in terms of the amount of visual fixations participants made in certain areas of the comics pages) of good (Figure 14) and poor readers (Figure 15). Red and yellow colours (represented by darker shades) indicate many visual fixations whereas green (represented by the lighter shades) signify fewer visual fixations. It can easily be observed that for both groups, the attention was focused more on the textual elements (speech balloons and captions) compared to the visual elements in all panels.

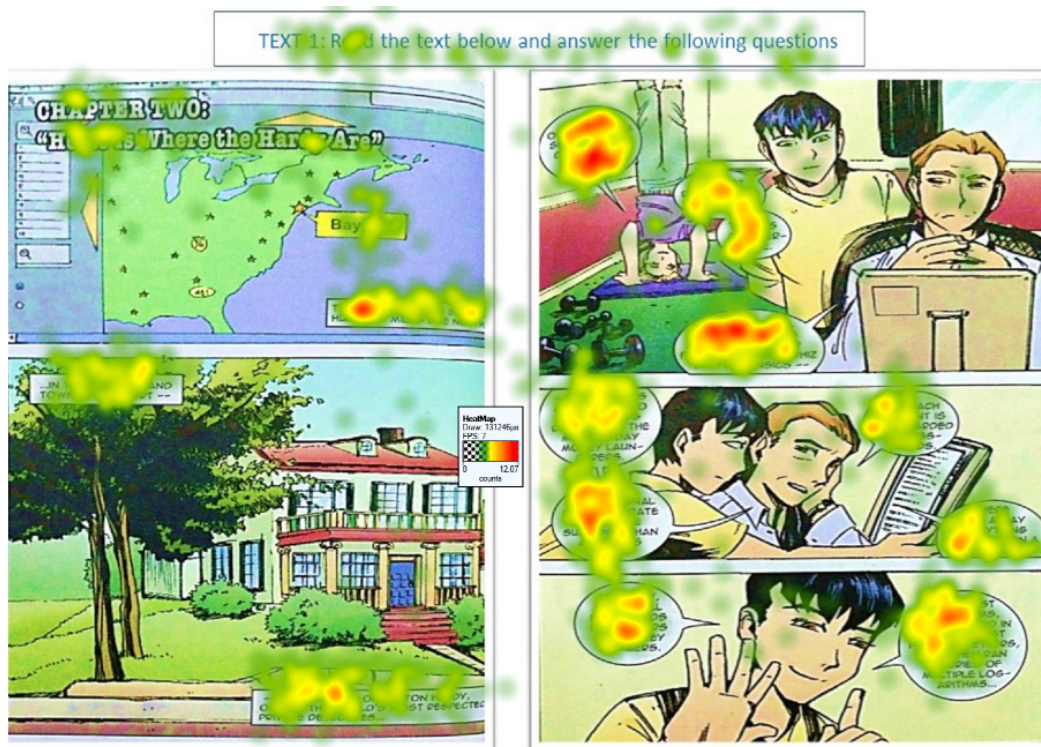


Fig. 14. Heat map of good readers for Text 1

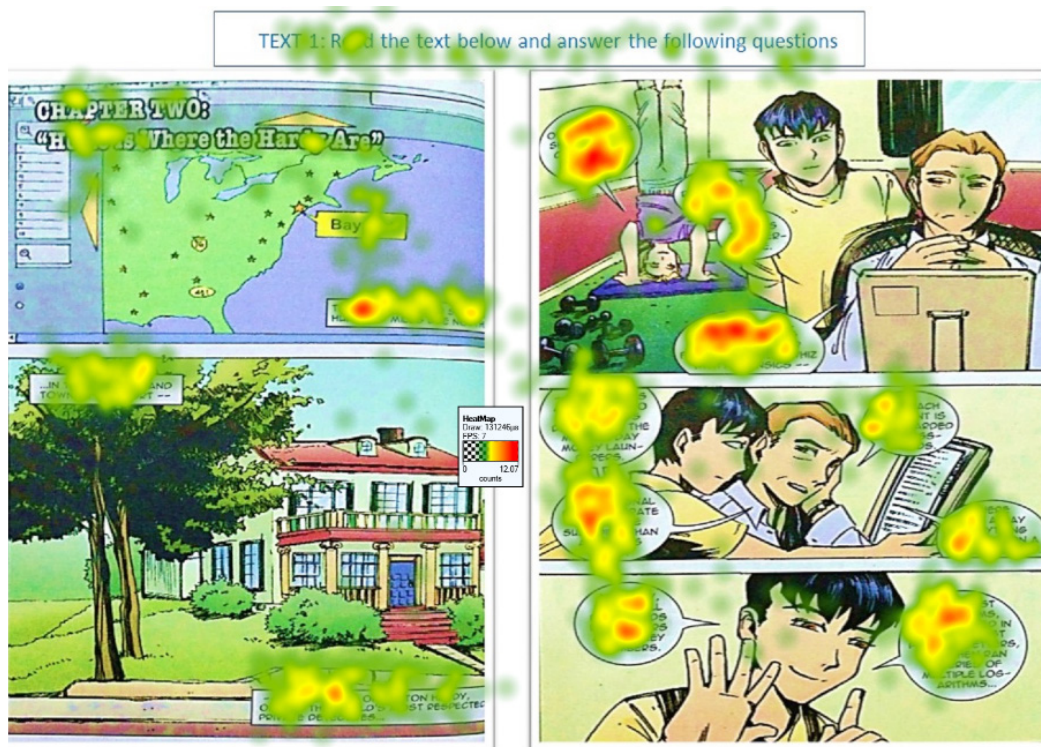


Fig. 15. Heat map of poor readers for Text 1

Giving focus to the textual elements more than the visual elements was also shared by researches in other media. Masood and Mahmoud Al-jawarneh, for instance, used eye tracking studies on online reading comprehension among tertiary learners. Utilizing heat maps to analyze the effect of the presence of illustrated pictures in four general knowledge texts, the researchers reported that the area of the picture was not visually fixated on by most participants. The participants were busy reading the text to prepare them for the comprehension test, giving only a “slight glance to the picture” (911). Similarly, Lewenstein et al. found that text is the preferred entry point among online news readers. The first visual fixations on the front page of a newspaper focus more on text (78%) rather than photos or graphics. In addition, Rayner et al., who used eye tracking to study the integration of text and pictorial information in print advertisements among university students, also discovered that 70% of the time was spent on text than the picture part of the advertisement. These findings back the assertion made by Zhao et al. that text processing differs fundamentally from picture processing. A high emphasis on text when processing material suggests that text is mainly used to build a mental model in general coherence-formation processing. On the other hand, a picture is more likely to act as guidance when readers need to solve a question with selective task-oriented processing. In relation to this present study, it can be concluded that although the participants primarily relied on the textual elements to make meaning, the significance of a balance between written words and visual imagery should not be ignored so that better comprehension can be attained.

EDUCATIONAL IMPLICATIONS AND CONCLUSION

This study has some important implications for educational practices, particularly in the teaching and learning of literature in the primary classrooms. One of the factors to successful literature lessons is the students’ competence to interact well with the prescribed texts. Only then would the students’ understanding of the aesthetic aspects of the language content be enhanced and simultaneously create an enjoyable learning environment. The findings of the current study, however, indicate that navigating through multimodal texts like comics and graphic novels is an ability that not all children possess. Although children may have read comics from an early age, basic knowledge such of comics such as its conventions, the variety of page layout styles as well as reading the panels in proper sequence still need to be explicitly taught so that the medium could be explored effectively.

The results from this study can be a significant indicator that learning the skills, expertise, and strategies needed to interpret the combination of images and words are necessary as the texts readers encounter are becoming more complex in the 21st century. The need to comprehend the factors that contribute to the understanding of multimodal texts is an important part of comprehension instruction (Serafini). Hence, the requisite to educate students from an early age on how to read visual images is also crucial (Steeves; Schwartz and Rubinstein Ávila; Burmark).

At this point, some suggestions could be made for teacher education programmes. The Institutes of Teacher Education Malaysia should be offering courses that are specifically designed to help teacher trainees learn about multimodal resources that could be utilized as literary texts. Apart from that, exploring multimodal teaching techniques in teaching literature is also important in pre-service training. At the same time, teacher education programs should also include professional development for in-service teachers on the pedagogical approaches addressing various strategies for comprehending visual images, in particular those included in contemporary comics and graphic novels. Thus, teacher trainees and in-service teachers will be better equipped with appropriate pedagogical practices to face challenges to teach literature using multimodal texts such as comics and graphic novels in schools.

The present study can thus be regarded as an initial attempt towards examining the actual reading behaviors of young readers using multimodal texts such as comics and graphic novels in literature lessons. Results indicate that the panel layouts of some comics which involves staggering and blockage affects the flow of how readers in both groups navigate the sequence of panels. Although the majority of them read in the Z-path, the focus on the textual elements compared to the visual elements is in accordance with prior research (Hannus and Hyönä; Masood and Mahmoud Al-jawarneh; Rayner et al.; Schmidt-Weigand, Kohnert and Glowalla) which examined text-picture relations in comprehension processes. Further studies might also be conducted to investigate the reading patterns of other multimodal texts that could be utilized in teaching literature such as picture books and magazines, as well as digital-based texts that contain hyperlinks, video images, sound effects, and 3D art. It would also be interesting to investigate the connection between the eye movement behaviors in reading multimodal texts with the readers' learning differences. The knowledge will provide valuable input to teaching, learning as well as designing multimodal texts which could be used in literature lessons.

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