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Does Infographics Reduce Mind Wandering and Increase Attention?

Mohd Khairul Mustakim Bin Mustapa Kamal, Mona Binti Masood, Mus'ab Khalili Bin Rosli, Ahmad Khalid Bin Kamarul Saman & Muhammad Farhan Fauzan Bin Masaat.
Faculty of Creative Multimedia & Computing,
Universiti Islam Selangor
Centre for Instructional Technology and Multimedia,
Universiti Sains Malaysia
Khairulmustakim@uis.edu.my, msmona@usm.my, m.khalili@uis.edu.my, ahmadkhalid@uis.edu.my & farhanfauzan@uis.edu.my

Abstract

This study investigates the effectiveness of infographics in reducing mind wandering among learners by examining their visual attention using eye-tracking technology. Mind wandering, often associated with cognitive overload or disengagement, poses a challenge to effective learning, especially when information is presented textually. To address this, an infographic integrating headings, colour, layout, pattern, shape, and form was designed to explore its potential in sustaining attention. A qualitative case study approach was employed, involving ten graduate students aged 24 to 28 from a public university in northern Malaysia. Data were collected through methodological triangulation: semi-structured interviews as the primary data, supported by eye-tracking metrics such as scan paths and focus points for validation. The findings showed that infographics, compared to textual information with images, were more effective in maintaining attention and reducing mind wandering. Participants reported that visual cues such as arrows and structured information chunks facilitated comprehension and reduced cognitive burden. Eye-tracking data further reinforced these perspectives by demonstrating more focused and less repetitive gaze patterns when interacting with infographics. Although the sample size is limited and context-specific, the combination of qualitative insights and visual behaviour analysis provides meaningful implications for instructional design. It is suggested that educators and designers integrate visual cues, chunked information, and supportive texts in infographic designs to improve learner engagement and decrease mind wandering, especially for content-heavy topics..

Keywords: Eye tracking glasses, Mind Wandering, Information Processing Theory, Fixation and Gaze & Heat Maps

Introduction

Information graphics or infographics are graphic visual representations of information or data intended to convey the message quickly and clearly. According to Andayani, M., Murtadho, F., & Lustyantie, N. (2024) infographics can improve cognition by using the graphs to enhance the ability of the human visual system to see trends and patterns. In addition, Park and Kim (2024), colour choices in visual materials can significantly influence learners' attention and understanding, making the content more engaging and memorable. Since infographics are known to be attractive and colourful, they tend to attract our attention. Further, the issue of mind wandering can be controlled when the design of the infographic incorporates specific elements such as colours, headings, and layout. Thus, to ascertain that infographics can capture the audiences' attention and convey information successfully, the use of eye tracking glasses (ETG) was administered as a form of data collection.

Background of the Study

Infographics have the capability to provide the reader with an overview of the topic and are an effective way to describe information and data as they capture the attention of readers. With the use of infographics, the public can understand and find a piece of information more quickly without having to spend too long to read all of the text provided. Accordingly, the use of images and short texts can provide a comprehensive focus on delivering information.

When information is presented solely in text form, readers are more susceptible to cognitive overload and mind wandering. Smallwood and Schooler (2024) proposed that mind wandering occurs when executive control fails to suppress task-unrelated thoughts from entering conscious awareness. They also identified a correlation between working memory capacity and the frequency of mind wandering episodes.

Similarly, Kalyuga and Singh (2024) emphasized that when learners' working memory is overloaded, cognitive processing efficiency decreases, leading to reduced comprehension and attention. Thus, to maintain understanding, readers must regulate their reading pace according to their cognitive capacity, minimizing off-task thoughts that interfere with comprehension.

In contrast, Smallwood and Schooler (2024) argued that mind wandering is a resource-demanding process that competes for working memory resources. Recent evidence supports this notion, indicating that individuals with higher working memory capacity tend to experience more frequent mind wandering during reading, as their greater cognitive resources enable simultaneous off-task processing (Zhang, Li, & Wang, 2023; Smallwood & Schooler, 2024).

Furthermore, mind wandering can be identified in reading tasks through deviations from normal eye movement patterns—typically left-to-right and top-to-bottom—detected using visual analytics of eye-tracking data (Smallwood & Schooler, 2024). It becomes more pronounced when readers fail to visualize textual content, weakening both attentional focus and comprehension (Kucuk & Sisman, 2024).

Effective communication relies on how information is logically organized and visually structured to guide learners' attention and enhance comprehension (Wang & Lim, 2023; Moraes & Nunes, 2023). This principle is essential in determining the layout pattern for infographic design. Kim and Lee (2024) emphasized that a clear typographic hierarchy—featuring large, bold, and well-contrasted headlines—plays a critical role in directing visual attention and improving information retention. Additionally, supporting textual elements such as *chatters* (short explanatory paragraphs) and *callouts* (or labels) help clarify specific visual components within the infographic. Furthermore, the use of colour enhances attention and emotional engagement compared to grayscale visuals, while appropriate shapes and forms effectively guide the viewer's focus toward key data points.

A study by Andayani, Murtadho, and Lustyantie (2024) found that infographics significantly engage students in science learning. The research revealed that students not only used infographics to present classroom project results but also developed a deeper connection with the content compared to traditional text-based or PowerPoint presentations. According to their findings, designing infographics encourages students to identify essential information and justify their perspectives with supporting evidence. Consequently, many students became more interested in combining artistic creativity with scientific content in their projects.

In this study, the topic of *butterflies* was chosen for data collection as it represents an informative, factual subject suitable for both text and infographic presentation. Mind wandering can occur in any form of reading material; therefore, this topic allows the comparison of comprehension and attention between infographic-based and text-based information delivery. The study further aims to determine

which infographic design patterns are most effective for conveying scientific information clearly and engagingly.

Research Objective

The objectives of this study were:

i. To explore how the use of infographics influences learners' attention and helps reduce mind wandering during information processing.
ii. To identify the pattern of info graphic that help gain attention

Theoretical Framework

The theoretical framework for this study uses both the Information Visualization and the Information Processing theories.

Information visualization Theory

Contemporary frameworks define information visualization as the process of designing interactive visual representations that enhance cognitive processing and learning efficiency (Munzner, 2023; Chen & Golan, 2023). Abstract data encompass both numerical and non-numerical forms of information, such as textual, categorical, and geographic data.

The theoretical foundation for this study was adapted from recent developments in information visualization theory, which emphasize how visual representations support cognitive processing of abstract and complex information (Munzner, 2023; Chen & Golan, 2023). These frameworks identify three primary dimensions of visualization:

i) **Task type** — including overview, zoom, filter, details-on-demand, relate, history, and extract;
ii) **Interactivity type** — encompassing textual and graphical interaction; and
iii) **Visualization variables** — involving image and differential attributes.

The theory posits that task type directly influences visualization but indirectly affects interactivity type, whereas interactivity has a direct impact on visualization outcomes.

For the purpose of this research, only the **visualization component** was adapted, as it aligns most closely with the study's objectives. The visualization component integrates both textual and graphical elements. In this study, the **image variables** considered include *size* and *value*, while the **differential variables** comprise *texture*, *colour*, *orientation*, and *shape* (Figure 1).

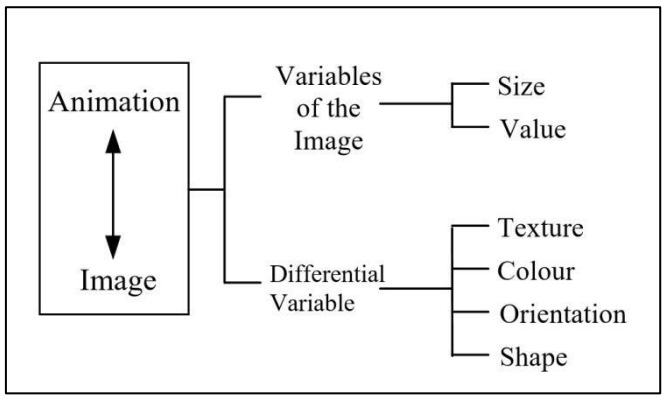


Figure 1: Output dimensions of the information visualization framework adapted from Munzner (2023)

Information Processing and Cognitive Load Theory

The mechanisms through which learning occurs can be explained by *Information Processing Theory*, which conceptualizes the human mind as an information processor that receives, analyzes, stores, and retrieves information from the environment. Within this framework, *Cognitive Load Theory* further explains how the limitations of working memory influence learning effectiveness. According to Sweller, van Merriënboer, and Paas (2023), cognitive load refers to the total amount of mental effort imposed on working memory during learning and problem-solving. Sweller also argued that effective instructional design can help minimize unnecessary cognitive load in learners.

Recent studies have reaffirmed that perceived mental effort remains a valid indicator of cognitive load, now measurable through both subjective rating scales and physiological data (Paas & van Merriënboer, 2023; Kalyuga & Singh, 2024). Among physiological measures, task-evoked pupillary response (TEPR) has been identified as a sensitive and reliable indicator of cognitive load, directly reflecting working memory activity (Ayres & Paas, 2024).

Excessive cognitive load can hinder task performance and comprehension, and its impact varies among individuals. Factors such as age and learning experience influence the degree of cognitive strain, with children, students, and elderly learners often experiencing higher levels of cognitive load.

Therefore, in this study, attention was given to how information is processed and the potential cognitive load generated when participants engage with text and infographic materials.

Methodology

This research adopts a qualitative case study approach to explore the effectiveness of infographics in reducing mind wandering among learners. Qualitative case study methodology provides the necessary tools for researchers to investigate complex phenomena within their specific contexts. According to Wallner (2023), when properly conducted, qualitative case study is a valuable method for developing theory, evaluating programs, and designing interventions in various fields including education and cognitive science. In this study, an infographic on the topic of butterflies was designed by incorporating visual elements such as headings, colours, layout, and arrows to observe their effect on visual attention.

Participants

The study involved ten graduate students aged between 24 and 28 years from a public university in northern Malaysia. The participants were selected using purposive sampling to ensure diversity in academic background and cognitive preferences.

Data Collection Procedures

This study utilized methodological triangulation by combining three methods of data collection:

- Semi-structured interviews were conducted to gather participants' perceptions and experiences related to attention, comprehension, and instances of mind wandering while viewing textual and infographic materials.
- Eye-tracking glasses (ETG): Eye-tracking technology was used to objectively measure participants' point of gaze, scan paths, and focus patterns when interacting with the materials. Eye tracking is widely applied in studies related to visual cognition, psychology, human–computer interaction, and product design (Holmqvist & Andersson, 2023).
- Comparative testing between infographic and text-based content, to further validate participants' responses and visual attention patterns.

Instrumentation and Data Analysis

The ETG device provided eye-tracking metrics such as fixation, gaze points, heat maps, and fixation sequences. For analysis within the Area of Interest (AOI), metrics such as time to first fixation (TTFF), total fixation duration, and fixation ratio were utilized to determine patterns of attention and cognitive engagement (Holmqvist & Andersson, 2023). Interview recordings were transcribed and thematically analysed, while eye-tracking data were processed using scan path and focus point visualizations. These findings were then triangulated to strengthen the credibility of this study and provide an in-depth understanding of how infographics support visual focus and reduce mind wandering..

Research Procedure

There were two sessions in this study. The first session by Group A (5 participants) begins by looking at the Infographic first followed by the text. The second session, Group B (5 participants) were given the text first then the infographic. At the beginning of the study, participants were briefed on the two sessions. Then the participant was given the ETG while going through the infographic/text poster. Each session took 10 minutes for reading the poster about butterflies. After the sessions were completed, the participants were interviewed. Figure 2 shows the research process used to collect data.

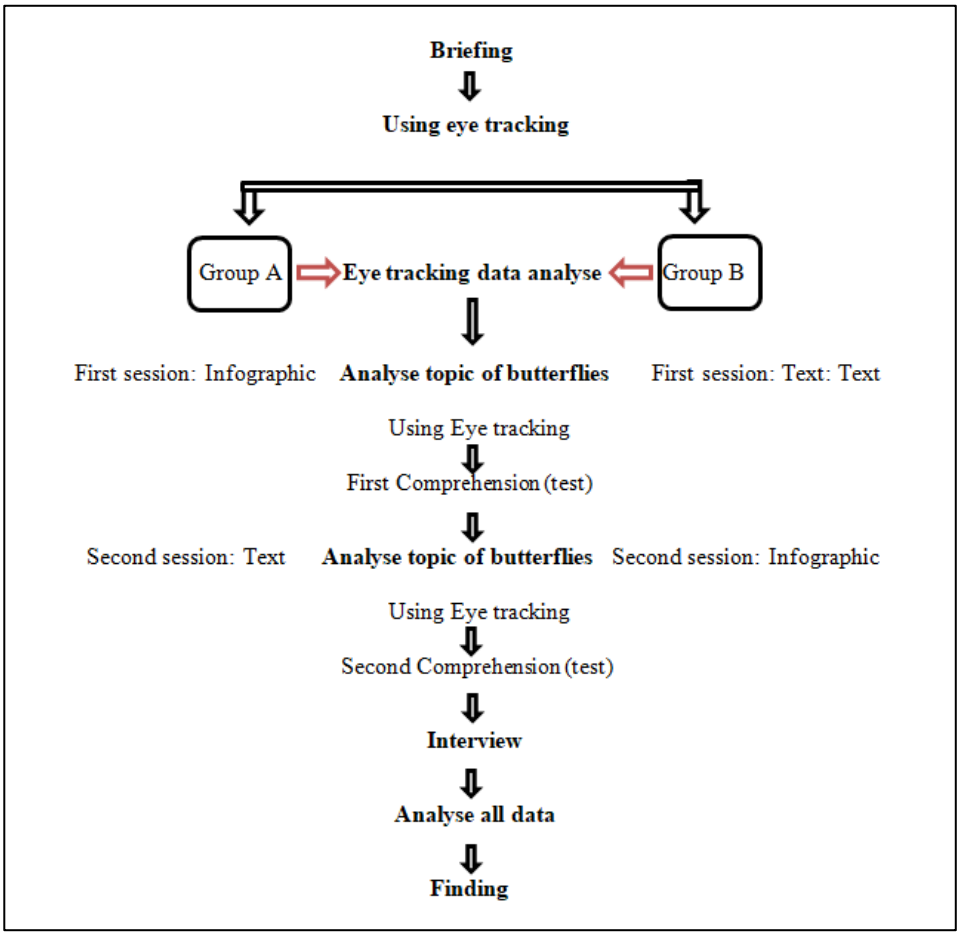


Figure 2: Research procedure.

Instruments

The instruments used in this study were the ETG and an interview session. The eye tracking data was obtained through eye tracking metrics. The interview was conducted to support the information obtained from ETG between infographic and text.

The infographic was constructed in two parts; diagrams and sequences. Consequently four subtopics were created: two were designed using sequences (SI & SII) and two were in the form of diagrams (DI & DII). An example for the first set, Set I(info), DI and SI is shown in Figure 3) while the second set, Set 2(info) consists of DII and SII. The participants were divided into Group A and Group B and were given Set I and Set II respectively.

DI *SI*

Figure 3: Example of Infographic for Set I

The text was constructed using the same topics and headings as in the infographic (TI, TII, TIII & TIV) (Refer Figure 4). TI and TII have the same topic as in the infographic of Set II while TIII and TIV has the same information as in Set I of the infographic (Table 1). Group A got Set I (TI and TII) for text and Set II (DI and SI) for infographic. Instead Group B was administered the Set II (TIII and TIV) for text and Set I (DII and SII).

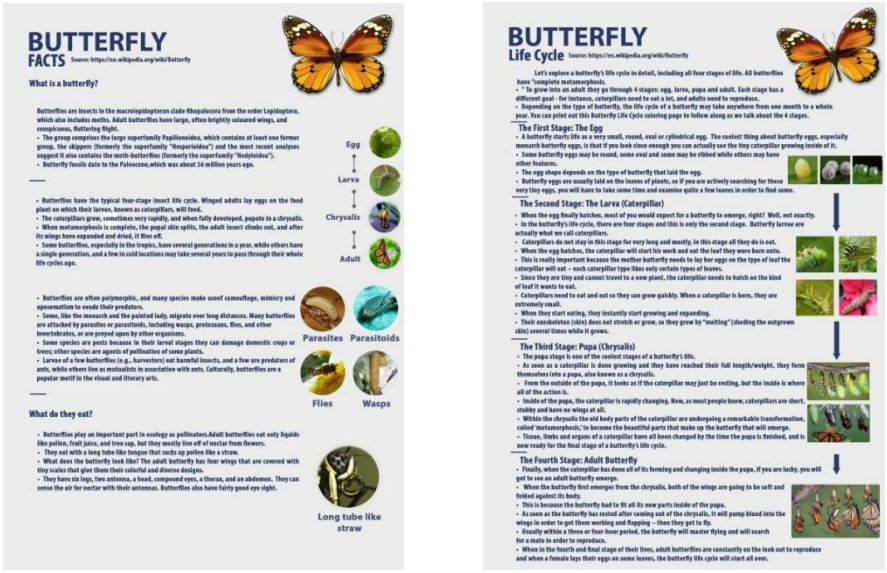


Figure 4 Example of text for Set I which is contains TIII and TIV

Poster	Infographic	Text
1	Facts, DI	Butterfly and Moth, TIII
2	Life Cycle, SI	Butterfly Family, TIV
3	Butterfly and Moth, DII	Facts, TI
4	Butterfly Family, SII	Life Cycle, TII

Table 1: *Infographic and Text Posters Topic*

The grouping of butterfly information through infographic and text is shown in Table 2.

Information Through	Group			
	A		B	
Infographic	DI	SI	DII	SII
Text	T I	T II	T III	T IV

Table 2: *The Grouping of Butterfly Information through Infographic and Text*

Findings

A total of ten graduate students participated in this study, comprising seven males (P1, P2, P3, P4, P5, P6, and P7) and three females (P8, P9, and P10). All participants had prior experience with infographics except for P2. In accordance with ethical research standards, participant identities were anonymized and referred to using the codes P1 through P10 to ensure confidentiality.

Findings Infographics and Reduction of Mind Wander

To determine whether the use of infographics can reduce the effect of mind wandering, this study applied a triangulation approach involving interview data as the primary source and eye-tracking results as supporting data. The eye-tracking data were analysed through scan path visualization and fixation point distribution, which strengthened the interpretations made from the interview responses through cross-validation. The following question served as the main interview prompt to explore this effect:

"In your opinion, between text and infographic, which captures greater attention? Explain how and why — including your reactions regarding attention and mind wandering.".

Nine out of ten participants indicated that using infographics, compared to text, reduces mind wandering. A key factor mentioned was the use of visual cues, such as arrows, which assist in directing the sequence of reading and enhancing focus. For instance, Participant 1 (P1) shared that:

> *"It helps you improve memory and makes it easier to remember information. Infographics also have arrows and directions that show where to start reading. All of this helps you remember the information. It helps a lot when reading with infographics."*
>
> *(P1)*

According to P1, directional elements such as arrows provide guidance on how to navigate the infographic, which not only aids comprehension but also improves memory retention by reducing cognitive overload. Similarly, Participant 2 (P2) mentioned:

> *"From my point of view, text is more structured and written in paragraphs that make it easy to read. In the early stages of reading, cues help to avoid unnecessary repetition when trying to*

remember information. Arrows help in identifying the correct sequence. It also helps in the process of understanding because the information is more structured."

(P2)

The responses from both P1 and P2 highlight that visual cues in infographics, such as arrows or directional markers, provide a clear reading path that reduces confusion and supports better focus. This is corroborated by eye-tracking data. Figures 5 and 6 show the scan paths for P1 and P2, respectively, illustrating more streamlined gaze patterns during infographic viewing.

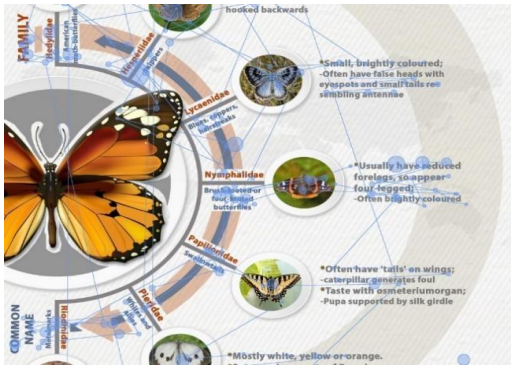


Figure 5: Scan path-Participant 1 (P1)

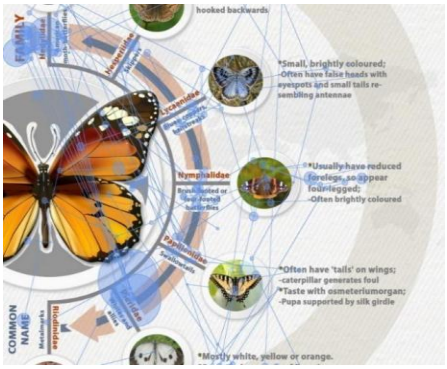


Figure 6: Scan path-Participant 2 (P2)

Another factor identified as contributing to the reduction of mind wandering when using infographics is the classification of information. Five out of ten participants shared that the way information is grouped and segmented within infographics plays a key role in maintaining attention and reducing cognitive overload. For example, Participant 3 (P3) explained:

"Infographic is more helpful because it has clear information about moths and butterflies. Information is divided into two groups to be easily understood… infographics also chunk the important contents of long texts to be elaborated."

(P3)

P3 further noted that when reading long texts, the need to imagine or interpret every sentence makes it harder to sustain attention. This often results in rereading lines or paragraphs — a pattern associated with mind wandering. However, infographics make this process easier by chunking the information into manageable parts, supported by visuals and structured layout.

The eye-tracking data supports this observation. As shown in Figure 10, P3's scan path reveals focused attention on the first chunk of information (related to the moth) before sequentially moving to the second part (related to the butterfly). This structured visual navigation suggests that the segmented layout of the infographic helps sustain reader engagement more effectively compared to text.

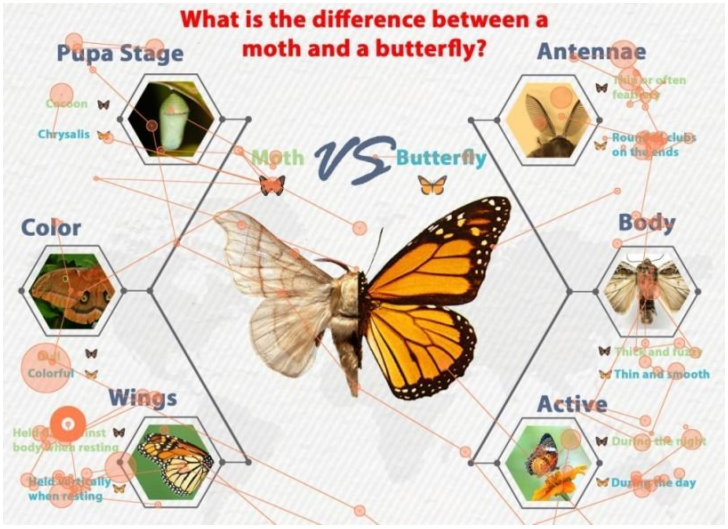
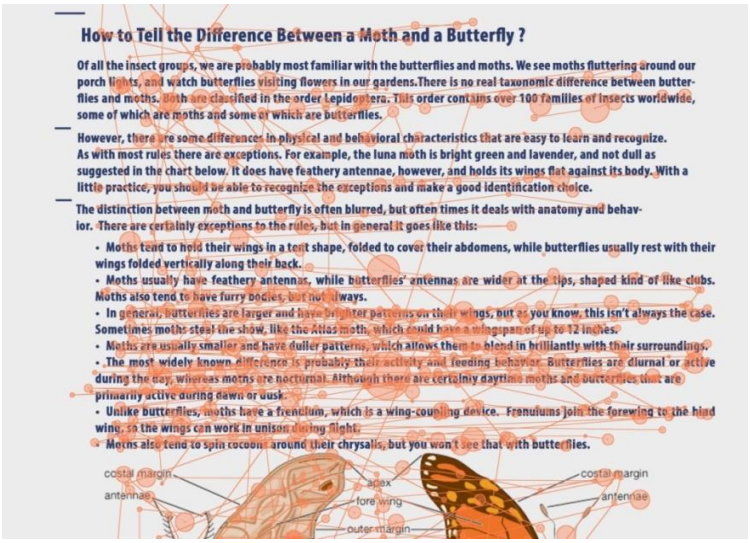


Figure 10: Infographic from participant 3 (P3)



How to Tell the Difference Between a Moth and a Butterfly ?

Of all the insect groups, we are probably most familiar with the butterflies and moths. We see moths fluttering around our porch lights, and watch butterflies visiting flowers in our gardens.There is no real taxonomic difference between butterflies and moths. Both are classified in the order Lepidoptera. This order contains over 100 families of insects worldwide, some of which are moths and some of which are butterflies.

However, there are some differences in physical and behavioral characteristics that are easy to learn and recognize. As with most rules there are exceptions. For example, the luna moth is bright green and lavender, and not dull as suggested in the chart below. It does have feathery antennae, however, and holds its wings flat against its body. With a little practice, you should be able to recognize the exceptions and make a good identification choice.

The distinction between moth and butterfly is often blurred, but often times it deals with anatomy and behavior. There are certainly exceptions to the rules, but in general it goes like this:

- Moths tend to hold their wings in a tent shape, folded to cover their abdomens, while butterflies usually rest with their wings folded vertically along their back.
- Moths usually have feathery antennas, while butterflies' antennas are wider at the tips, shaped kind of like clubs. Moths also tend to have furry bodies, but not always.
- In general, butterflies are larger and have brighter patterns on their wings, but as you know, this isn't always the case. Sometimes moths steal the show, like the Atlas moth, which could have a wingspan of up to 12 inches.
- Moths are usually smaller and have duller patterns, which allows them to blend in brilliantly with their surroundings.
- The most widely known difference is probably their activity and feeding behavior. Butterflies are diurnal or active during the day, whereas moths are nocturnal. Although there are certainly daytime moths and butterflies that are primarily active during dawn or dusk.
- Unlike butterflies, moths have a frenulum, which is a wing-coupling device. Frenulums join the forewing to the hind wing, so the wings can work in unison during flight.
- Moths also tend to spin cocoons around their chrysalis, but you won't see that with butterflies.

Figure 11: Text from participant 4 (P4)

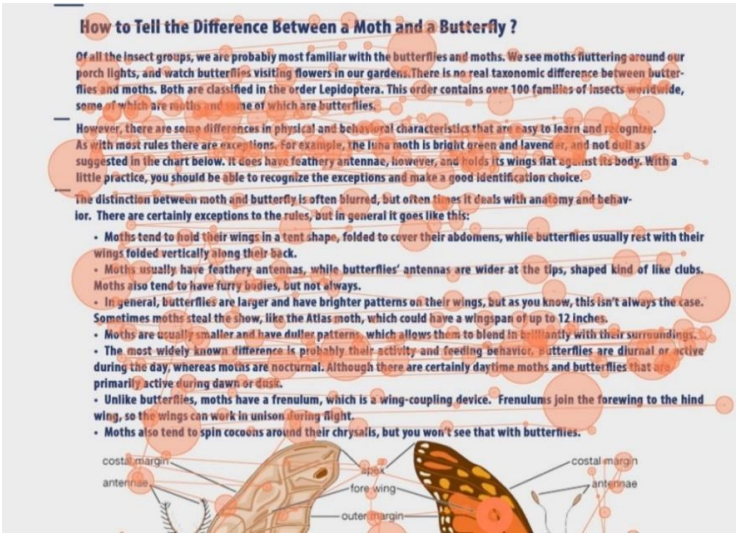


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Figure 12: Text from participant 5 (P5)

Eye-tracking analysis serves as one of the core methods in this study to examine how participants visually interact with the materials. The scan path visualizations, which track the movement of the eyes, reveal distinct differences between engagement with infographics and text-based information. Specifically, participants' scan paths while viewing the infographic appear more streamlined and steady, suggesting greater cognitive ease and lower levels of mental drift.

As observed in Figure 10, Participant 3 (P3) demonstrated a direct and organized viewing pattern, engaging first with the section on moths before moving on to butterflies. This visual behaviour aligns with P3's explanation:

> *"Information is divided into two groups to be easily understood and it has a picture that explains the characteristic that are easy to remember."*
>
> *(P3)*

In contrast, the scan paths for Participants 4 (P4) and 5 (P5), shown in Figures 11 and 12 respectively, display irregular and repetitive eye movements when interacting with the text-based version. The scan paths are noticeably scattered, indicating multiple re-reading attempts and longer fixation durations — particularly in areas dense with abstract terms. This pattern suggests that the text format requires more cognitive effort to decode, increasing the likelihood of distraction and mind wandering.

> *"Mind wander occurs when I read using text and infographic. But more often happens when reading through texts. Through infographic, mind wander occurs due to external factors. For example, when I see a butterfly image, I imagine a situation where the butterfly image is about to relate to my real-life situation. In other words, the past butterfly-related experience reappeared as you see the butterfly's image. While reading the text, the use of certain terms made me think for a moment to understand the meaning of the word. Mind wander will happen when I'm trying to understand the term and such a thing happens almost three to four times."*
>
> ***(P4)***

P4's reflection suggests that although both forms can trigger mind wandering, text materials were more often the source of internal distraction due to their reliance on abstract descriptions. This contrasts with the infographic format, which integrates visual cues and colour, enabling quicker comprehension and reducing the need for re-reading. Similarly, Participant 5 (P5), who shared the same academic background as P3, noted:

> *"In the form of texts, it is difficult to understand because the text only describes information about butterfly information. Compared to infographic, it is easier to understand the information because there are helpful images explaining certain terms about butterflies."*
>
> *(P5)*

From these observations, it is clear that the graphic elements in the infographic — such as shapes and colours — help capture and sustain attention. As confirmed by the eye-tracking data and user reflections, all three participants (P3, P4, and P5) demonstrated stronger focus and faster recall when interacting with the infographic, compared to the more cognitively demanding text material.

Participant	TEXT	INFOGRAPHIC
P3	2	5
	INFOGRAPHIC	TEXT
P4	8	4
P5	4	2

Table 2: *The result of test on* participant *P3, P4, and P5 through infographic and text.*

Although P4 displayed an unusual pattern by scoring higher in the text version compared to the infographic, this may be attributed to individual differences in learning styles or content familiarity. Furthermore, P4 herself noted that the use of technical terms in the text caused her to spend additional time discerning meaning, resulting in potential mind wandering during reading.

Overall, these results reinforce the qualitative findings: infographics are effective in reducing cognitive load and supporting comprehension in most cases, especially when visual aids are present and information is chunked.

From the findings above, the researcher concludes that mind wandering is more likely to occur when reading text-only content. In contrast, infographics are more effective in sustaining attention and reducing mental drift during information processing. An exception to this overall pattern was Participant 6 (P6), the only participant who indicated that both formats — text and infographic — were equally useful, depending on the context and purpose. As noted by P6:

> *"In my opinion, the infographic is helpful in facilitating understanding, especially in educational settings for children. From another point of view, text is also helpful. However, I tend to refer to the infographic first before the text."*
>
> *(P6)*

P6 further explained that while infographic visuals help in capturing attention, they may not always provide enough depth when used alone. Conversely, reading text without visual support can make it difficult to imagine or contextualize certain types of information. According to P6, interpretation that relies solely on pictures can often be incomplete or inaccurate, highlighting the need for both visuals and text in effective information delivery.

These observations highlight an important implication: while infographics are effective in supporting attention and reducing cognitive strain, they function best when accompanied by concise text. Without textual support, visual information may risk oversimplification or misinterpretation, leading to incomplete knowledge transfer.

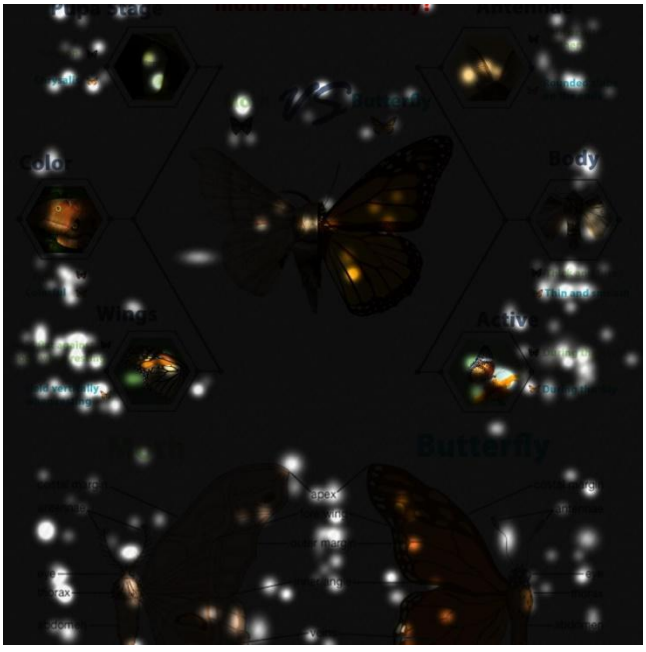


Figure 13: Infographic from participant *6 (P6)*

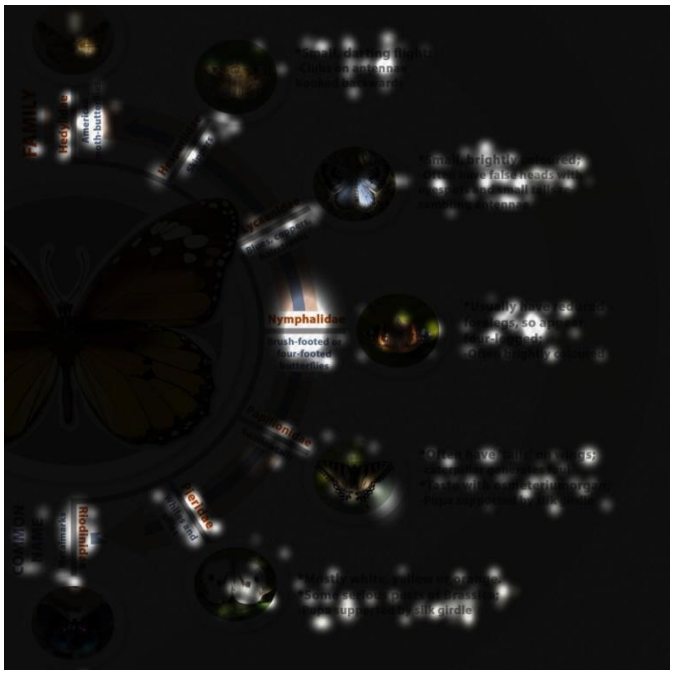


Figure 14: Infographic from Participant 6 (P6)

The eye-tracking results from Figures 13 and 14, which display focus maps, further illustrate the engagement patterns of Participant 6 (P6). The maps reveal that P6 exhibited a higher concentration of fixations on text-based elements of the infographic rather than the accompanying images. In these focus maps, black areas represent portions of the infographic that received little or no visual attention, whereas non-black regions indicate areas where the participant's gaze was primarily concentrated.In her reflection, P6 stated:

> *"Infographic caught my attention in understanding the information about butterflies. But it should be helped with the text because I prefer facts. If it is based solely on imagination, I may think of another."*
>
> *(P6)*

P6's preference for factual content aligns with her focus map, which indicates a higher level of visual attention directed towards text. This behaviour suggests that, for participants who prioritise data-driven or factual information, text support within an infographic remains essential to achieving comprehension. The test results further affirm this observation, as P6 scored higher on the infographic-based comprehension task compared to the text-only version.

Participant	TEXT	INFOGRAPHIC
P6	3	6

Table 3: *Show the result of Participant 6 through text and infographic.*

Table 3 displays the performance of Participant 6 (P6) when comparing text-based and infographic-based materials. The results indicate that P6 retained information more effectively when presented through an infographic rather than text alone.According to P6:

> *"If the information presented on informative topics is likely to be more understandable, such as a non-smoking topic and about this road is more effective and easier to understand than the topic is*

delivered through text only. For this rather difficult butterfly topic I prefer infographic in information delivery methods."

(P6)

P6 clarified that the effectiveness of an infographic depends largely on the nature of the content. While she acknowledged that text does help in certain contexts, she emphasized that infographics are her preferred method for conveying information, especially when dealing with complex or technical topics—such as the butterfly example used in this study.

This shows that infographics can serve as a powerful communication tool, particularly for topics that are difficult to understand through text alone. However, P6 also highlighted that the decision to use text or visual formats depends on the intended purpose and audience.

"It depends on the information you want to convey, but for understanding a complicated topic like butterfly characteristics, I prefer infographic."

(P6)

In summary, the responses and performance of P6 reinforce the broader findings of the study which show that while text can be useful for conveying detailed information, infographics provide a more effective medium for increasing attention and reducing mind wandering when dealing with complex subjects.

What is the pattern of an infographic to gain learners' attention?

To answer this question, participants were divided into Group A and Group B as and given Set I and Set II respectively (refer Table 4).

Participant	GROUP	INFOGRAPHIC
P2	A	Set II
P7		
P3		
P1		
P6		
P8	B	Set I
P4		
P10		
P5		
P9		

Table 4: *Show participant divided into Group A and Group B*

Two groups have been divided to provide different infographic. Group A will have set infographic set II and group B will get set I infographic. Each set has one diagram and one sequence. The use of sequences and diagrams in the infographic is to know the pattern of an infographic to learners' attention. In this section, the researcher uses a scan path and gridded area of interest to indicate the direction of eye focus and the area of focus for each participant . Figure 15 shows the result from group A of two participants by using scan path.

Figure 15: Two examples of results that represent group A P5 and P4 by using scan path.

The whole data for group A shows the almost identical results where the scan path shows the focus of the eye more towards the same colour. In addition, the scan path also shows the eye movement indicating the focus applies to the image used. Therefore, two sample results are used to represent the other five participants for group A. Figure 16 shows the using of the same results of group A but through a gridded area of interest.

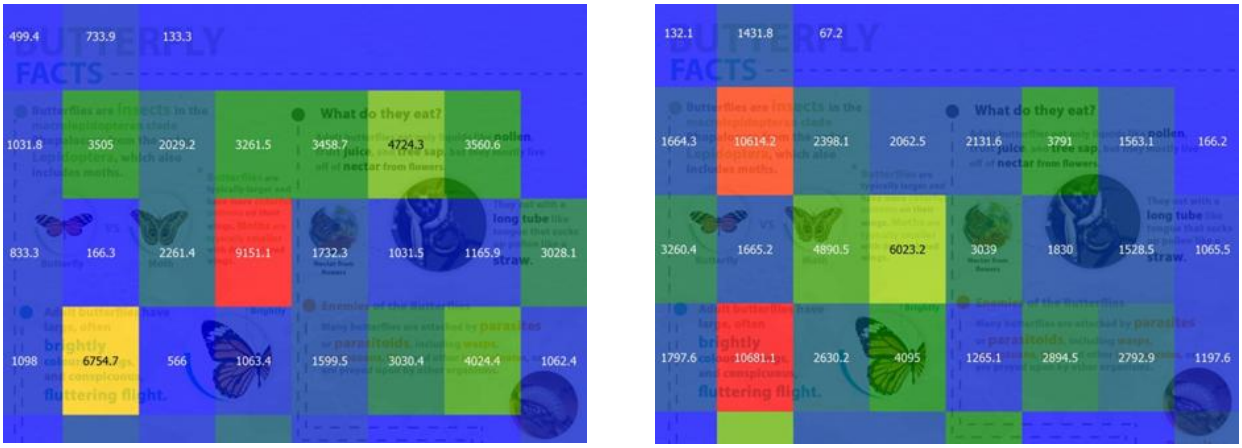
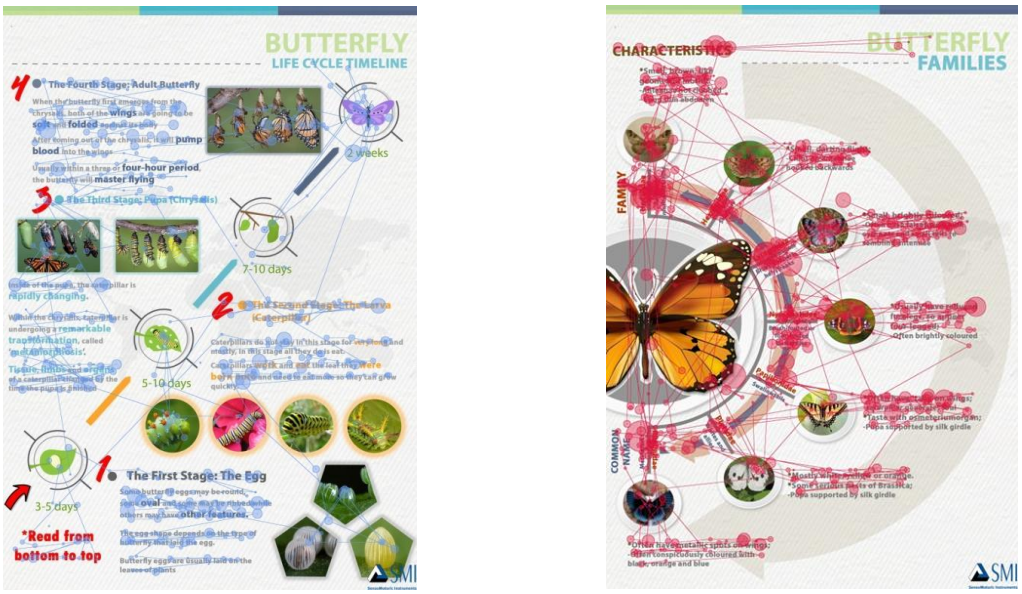


Figure 16: Two examples of results that represent group A P4 and P6 by using a gridded area of interest.

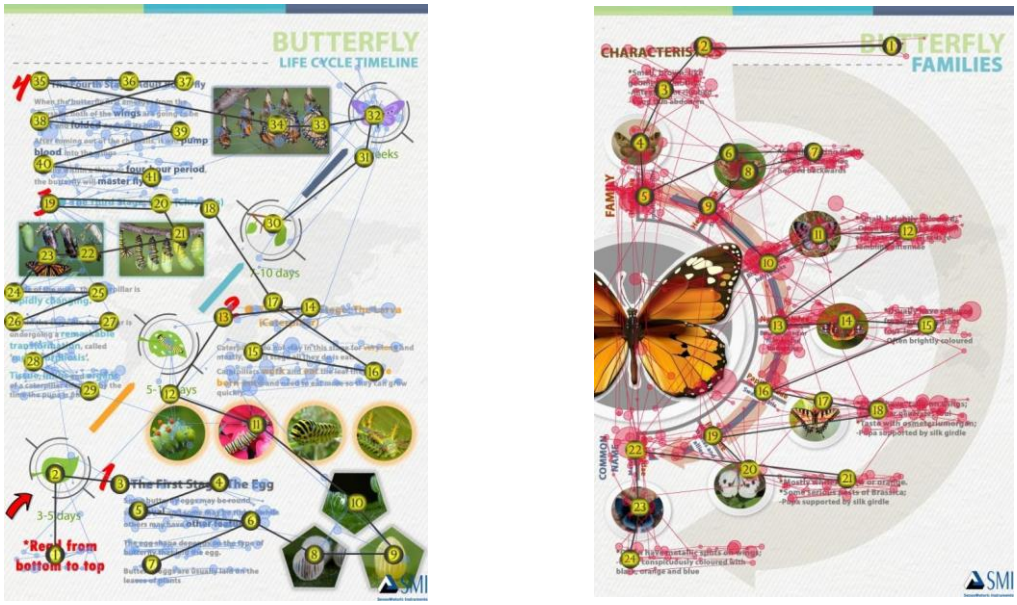
Figure 16 illustrates the heatmap result obtained through the eye-tracking analysis. The colours on the grids represent the Areas of Interest (AOIs), where warmer tones (such as red and orange) indicate higher levels of visual attention. In the left image, the reddest areas correspond to the highest attention, with a reading value of 9151.1. These hotspots are primarily located around the coloured text elements. This is followed by a yellowish grid area, registering a value of 6754.7, also positioned over highlighted words — suggesting that colour plays a role in drawing learners' focus.

Meanwhile, in the right image, the highest recorded value (10681.1) also appears over coloured text, followed closely by a secondary hotspot (10614.2), located in an adjacent coloured region. These patterns indicate that users' attention tends to cluster around text elements that are visually emphasised through colour. Figure 17 presents the accompanying scan path analysis for the same infographic, which further reveals that the sequencing elements — such as timelines and labelled stages — successfully guide learners' eye movement in a structured manner from beginning to end.



SI SII

Figure 17: The reading pattern by using sequential characteristics through result P4 from group B and result P7 from group A.



SII SI

Figure 18: The reading pattern by using sequent characteristics through result P4 and P7.

Figure 18 presents the pattern of learners' attention across infographic elements, based on scan path analysis. The results indicate that attention was guided by the sequential design of the infographic, which influenced the direction and order of eye movement. Sequence I represents the reading pattern of Participant P4, while Sequence II illustrates the pattern of Participant P7. These participants were chosen as representative examples of Group B and Group A, respectively, due to the similarity of their visual behaviour within each group.

In Sequence I, the scan path from P7 shows that the reading began at the lower section of the infographic. This was due to the presence of a visual cue — an instruction or arrow — indicating that the reading should start at the bottom, even though the conventional reading pattern is from left to right and top to bottom.

Conversely, Sequence II for P2 reflects a more traditional reading pattern: the participant began reading from the title at the top of the infographic and proceeded left to right, consistent with standard reading behaviour. Despite these differences, both scan paths shared a key similarity — eye fixation was strongly anchored on textual elements first, followed by intermittent glances toward the accompanying images. These patterns suggest that learners primarily depend on text to obtain information, and only refer to images when additional clarification is needed or when encountering unfamiliar terms. The images, therefore, function as supplementary sources of information that enhance understanding when text alone is insufficient.

In conclusion, the reading pattern of infographics is strongly influenced by the presence of visual cues such as arrows or layout structure. While textual content serves as the primary focus for comprehension, visuals play a significant supporting role by reinforcing and clarifying the meaning of the text. This combination of sequential guidance, text emphasis, and strategic imagery supports learner engagement and reduces cognitive strain during content processing.

The use an infographic can reduce mind wander

As expected, using infographic can reduce the effect of exhilarating the mind. Nine out of ten participants in their interviews have stated that infographic can reduce the effect of mind wander in delivering information. With the advantages of infographic that stated in previous chapter, focus was given more on information through the infographic. The use of chunking and highlighting information can give a person more focus on the information presented because each person's brain differs in terms of his ability and ability.

When using too much text will affect the brain's burden to remember the information presented. According to Kalyuga & Singh, (2024), when too many elements are presented simultaneously, the working memory becomes overloaded, reducing the efficiency of information processing. Thus, working memory is considered as the memory system having the role of holding and manipulating information. Hence, the use of excessive texts will affect the weak memory thus reducing the attention.

Long and complex texts can impose excessive cognitive load, limiting working memory capacity and comprehension efficiency (Cowan, 2023; Kalyuga & Singh, 2024). Working memory is associated with consciousness and it relates to the way people direct their own attention to think or to process information. The primary limitation of working memory lies in its restricted capacity, now estimated at approximately four elements rather than the seven proposed in earlier studies (Cowan, 2023; Sweller, van Merriënboer, & Paas, 2023). In reading comprehension, working memory capacity is limited; therefore, the inclusion of unnecessary or irrelevant information can overload cognitive processing and hinder learning (Sweller, van Merriënboer, & Paas, 2023; Kalyuga & Singh, 2024).

With the classification of infographic information, it will help the reader to remain focused on the information presented. Focus is a difficult thing to give even when one is aware that the focus is not fully. Conati and Kardan (2023) found that learners often overlook system-generated hints, highlighting persistent challenges in capturing attention and promoting effective hint utilization in intelligent tutoring environments. Transient attention is a short-term response to a stimulus that temporarily attracts or distracts attention.

According to Roda & Nouri, (2023), they state that the healthiest teens and adults cannot concentrate on one thing for more than 20 minutes at a time, although they may choose repeatedly to focus on things

the same. The ability to renew attention allows people to pay attention to things that last more than a few minutes, such as long films.

According to Mark & Wang, (2024), the long-cited claim that human attention lasts only eight seconds, showing instead that sustained attention typically ranges between 10 and 20 minutes, while micro-attention in digital contexts may fluctuate every few seconds. Selective sustained attention, also known as focused attention, is the level of attention that produces the consistent results on a task over time. The widely cited claim that the human attention span lasts only eight seconds has been challenged by recent empirical studies, which show that sustained attention typically lasts between 10 and 20 minutes, while digital multitasking can fragment focus into shorter intervals (Mark & Wang, 2024). Therefore, good information is delivered as quickly as possible so the reader can easily understand the information presented.

According to *P6*, when the information was clear in the process of its accomplishment, this will make the reader understandable. Understanding will help maintain one's focus on what was read. Furthermore, P6 added, infographics gave an understanding of the terms used plus the use of images reinforcing the picture of the fact that was presented in the poster. According to Kalyuga & Singh, (2024), the cognitive load theory confirms that the split-attention effect occurs when learners must divide their attention between multiple related information sources, increasing cognitive load and reducing comprehension efficiency. According to Park & Brünken (2023), multimedia learning confirms that verbal and visual representations are processed and held simultaneously in working memory, allowing learners to build integrated mental models that enhance comprehension.

Therefore, from the proof through eye tracking and interviews sessions it can be concluded that the use of an infographic can reduce the mind wander. Besides that, the theories that support the previous study reinforce existing evidence.

The pattern of an infographic to learners' attention

As with the findings found in the previous chapter, there are not many factors that cause the reading pattern of infographics. Infographic does not put certain reading requirements in understanding the topic presented. The same thing happens in terms of reading. According to Mangen & Schilhab (2024), In reading, there are no fixed or universal rules governing how meaning is constructed, each reader interprets text differently based on context and medium . This encourages deep text exploration during interpretation. According to Rayner & Schotter (2024), studies confirm that typical visual scanning patterns occur from top to bottom and left to right, reflecting natural reading directions and perceptual habits. If from a reading point of the text there is no concrete law, the infographic also has no readable way of reading. But there are some factors that make the pattern that causes the way that infographic is produced.

The use of colours in infographic writing can attract readers in forming a particular reading pattern in the process of receiving information. As the result is shown in the previous chapter, focusing points is more focused on the different words. According to Machin & Polzer (2023), Contemporary semiotic research continues to view language as a symbolic system governed by socially shared rules through which meaning and reality are constructed. With this statement, the researcher can state that the coloured word carries meaning to the person who obtained the information from the word. With the use of colour against the words that are important in the sentence will make the information presented more powerful to be remembered.

The use of coloured words can also reduce the burden of information while improving the way it is organized and displayed so that people can process it more efficiently. According to Park & Kim (2024), The use of varied colours and visual techniques effectively draws attention and supports clearer communication of graphical and textual information. According to Liu & Henderson (2024), Humans identify visual targets significantly faster in highlighted or color-enhanced displays than in neutral or

colorless ones, due to increased visual salience and attentional focus. From the results in the previous chapter, the word colour is more focused than the words in colourless. With the use of colour to the metal, it has also indirectly produced an infographic reading pattern.

Eyes will repeat the reading of the word because the words that convey colour bring meaning to the person deriving information from that word. Hence, an infographic reading pattern has been attributed to the use of colour word factors in conveying information. According to Park & Kim (2024), the use of coloured text can convey additional semantic and emotional information to readers, influencing both comprehension and affective responses.

In addition, other factors that may affect the infographic reading pattern are the use of images. Picture is another medium for communicating and other means of delivering information. According to Jewitt & Bezemer (2024), Messages take diverse forms depending on the medium used, as each medium shapes meaning through its unique expressive resources. The use of images or images will help reinforce the information presented through the text. This indirectly creates an infographic reading pattern. Results from eye tracking and interview sessions found in the previous chapter show that infographic reading patterns are influenced by images and picture. The participant will see the image as helpful to give more understanding to the information read.

Images and pictures are referred to when the use of the term is not understood. Eye movements will knock out a reading pattern on infographic whether the images are directed to help increase understanding of the elusive terms. In other words, the infographic reading pattern will be alternating in between the image and the text. These conflicts with the theory delivered by Thomas where normal readings in field scanners are usually from top to bottom or left to right. Therefore, the second factor affecting the infrared reading pattern is the use of images and picture in communicating information about the butterfly.

Moreover, the infographic reading pattern may also be influenced by the cue usage factor in the process of conveying information. The delivery of information without the use of cue against texts will directly affect the burden on the brain. According to Moreno & Mayer (2024), The integration of multiple representations fosters better retention and learning transfer by engaging both visual and verbal processing systems. This will indirectly reduce the burden on the brain to remember the information presented.

According to de Jong & Kirschner, (2023), cognitive load theory emphasizes that limited cognitive processing capacity directly affects the ability to apply acquired knowledge and skills to new contexts, underscoring the importance of optimizing instructional design. With the help of cue in the information material produced, this will help the reader to retrieve information while reducing the burden on the brain. The infographic reading pattern will be affected if any such information has a cue. When there is a cue like arrows, readers will follow the direction of the arrows pointed out to facilitate the process of understanding the information presented. This will form a reading pattern for the infographic itself.

The use of cues such as colours, arrows, and font size also shapes how viewers process information in an infographic. Human visual attention is often automatically guided toward elements with greater contrast or visual salience. As explained by Theeuwes (2023), features such as colour, shape, and size can automatically capture attention through bottom-up perceptual processes, without conscious effort. Similarly, Belopolsky (2022) emphasises that the visual system prioritises objects that stand out in a display, reinforcing the idea that cues play a vital role in directing focus. Therefore, the inclusion of clear visual cues in infographic design can help guide readers' attention to specific elements, improving understanding and memory retention.

The conclusion can be made by the researcher in the process of knowing the pattern of an infographic to learners' attention from the topic of butterfly is in terms of colour usage in writing, image usage and

picture in conveying information and using cue in the process of communicate information. With these three factors, the pattern of student attention will shape the reading pattern of their infographic.

Conclusion

The design of infographics relies on organizing complex information into visually accessible formats that enhance understanding and engagement. As noted by He et al. (2024), the interaction between text, visual cues, and layout significantly influences attention and information recall. In this study, the use of structured visuals, colour cues, and chunked content was shown to reduce cognitive overload and limit mind wandering when presenting complex topics. This supports the view that effective infographic design is rooted in cognitive and educational principles, not just aesthetics. By aligning visual structures with how learners process information, designers can facilitate deeper comprehension. Moving forward, integrating insights from learning science and attention theories will be essential in further improving the instructional value of infographics (Traboco, 2022).

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