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ANALYSIS OF MULTIMEDIA MESSAGE DESIGN ON THE KHAN ACADEMY KIDS PLATFORM BASED ON MAYER'S MULTIMEDIA PRINCIPLES

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Abstract

The development of digital learning media has encouraged the use of multimedia platforms in early childhood learning. Khan Academy Kids is a digital learning platform that offers a variety of interactive activities. This study aims to analyze the application of Mayer's multimedia principles on the Khan Academy Kids platform and their relationship to cognitive load theory in supporting children's learning. The study used a descriptive qualitative approach using observation and literature review techniques. The results show that Khan Academy Kids has implemented most multimedia principles, and can help reduce cognitive load.

Keywords: *Multimedia Learning; Mayer's Principle; Cognitive Load; Khan Academy Kids; Early Childhood.*

INTRODUCTION

The development of information and communication technology is currently bringing changes in the world of education, including the use of digital learning media. Multimedia-based learning platforms are increasingly being used because they provide a more interactive and engaging learning experience through a combination of text, images, audio, animation, and interactive activities (Amallia et al., 2025; Rahmat et al., 2023). The use of multimedia design is becoming increasingly used in learning, including early childhood learning (Chu et al., 2024; Swider-Cios et al., 2023). One digital learning platform designed specifically for early childhood is Khan Academy Kids. This platform provides various learning activities such as reading, basic mathematics, learning videos, educational games, and creative activities (Curiel, 2023).

According to Mayer, multimedia learning can help children understand information more effectively than learning that only uses text or verbal language (Mayer, 2009). The Cognitive Theory of Multimedia Learning explains that humans process information through two main channels: visual and verbal, with limited working memory capacity. This theory is also supported by the Dual Coding Theory, which states that visual and verbal information are processed through different cognitive systems, thus helping to improve children's understanding (Clark & Paivio, 1991; Sadoski & Paivio, 2013). Therefore, multimedia design must be designed appropriately to be able to assist the understanding process without causing excessive cognitive load (Paas et al., 2010; Sweller, 2023). The use of an appropriate combination of visuals, audio, and animation can increase children's attention and involvement in the learning process (Fiorella & Mayer, 2021).

Several studies also state that gamification and interactivity elements in digital learning media can increase children's engagement and motivation to learn (Dichev & Dicheva, 2017). The use of rewards, direct feedback, and game-based activities can create a more enjoyable and active learning experience for children. However, it is also necessary to pay attention to the principles of multimedia in its use during the learning process. There are 12 principles of multimedia according to Mayer, coherence, signaling, redundancy, spatial contiguity, temporal contiguity, segmenting, pre-training, and modality, multimedia, personalization, voice, and image (Mayer, 2009). These principles serve to reduce external cognitive load, manage essential processing, and encourage children's generative processing (Sweller et al., 2011; Kirschner et al., 2018). Previous research also analyzed the application of multimedia principles to various digital learning media (Anggraini et al., 2026; Rahayu et al., 2024; Putri & Lestari, 2025).

By paying attention to and applying these principles in the multimedia used, it can make it easier for children to receive and understand the material effectively. Furthermore, user interface design and media interactivity also play a role in enhancing children's learning experiences through digital media (Davis et al., 2025). Based on this, this study aims to analyze the application of multimedia principles on the Khan Academy Kids platform, as well as its relationship to cognitive load theory, in supporting message delivery to early childhood.

METHODS

This study uses a qualitative descriptive approach to analyze the design of multimedia messages on the Khan Academy Kids platform. The qualitative descriptive approach is used because the study focuses on the observation and analysis of multimedia elements and their suitability to the learning characteristics of early childhood (Hurst, 2023). The object of research in this article is the Khan Academy Kids platform, a digital learning platform for early childhood. The analysis was conducted on several features and learning activities available on the platform, such as visual design, audio, animation, interactivity, gamification, and user interface simplicity. The analysis refers to the principles of Cognitive Theory of Multimedia Learning (Mayer, 2009) and learning design theory (Smith & Ragan, 2005).

Data collection techniques were carried out through direct observation of the platform and literature review. Observations were conducted by exploring various learning features available on the Khan Academy Kids platform. A literature review was also conducted to obtain a theoretical basis and references related to multimedia learning, message design, digital learning media, and the characteristics of early childhood. Data analysis was conducted descriptively by identifying multimedia elements contained in the platform and then linking them to the Cognitive Theory of Multimedia and Cognitive Load Theory. The analysis focused on the use of visuals, audio, animation, interactivity, gamification, and the effectiveness of message design in supporting the digital learning process.

RESULTS

Results of Mayer's Principle Analysis

Coherence Principle

The principle of coherence in Khan Academy Kids is applied to several features/activities within it, one of which is shown in Figure 1 below.

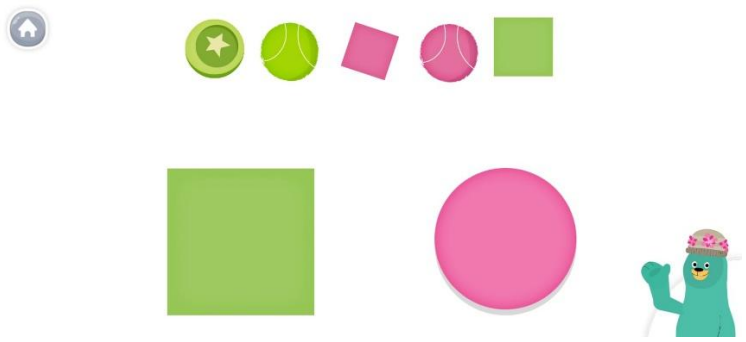

Figure 1. The Principle of Coherence

The principle of coherence is applied by using elements that are relevant to the material being taught, without any excess elements. Figure 1 shows the use of squares and circles when explaining plane figures.

Signaling Principles

The signaling principle in Khan Academy Kids is applied to several features/materials in it, one of which is as shown in Figure 2 below.

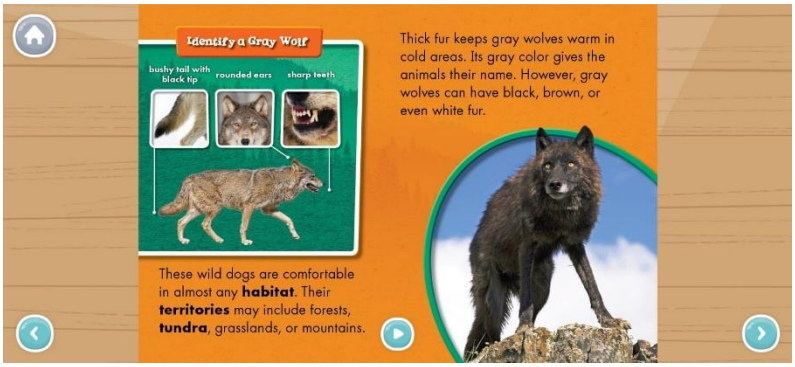

Figure 2. Signaling Principles

The principle of signaling is applied by bolding text deemed important. As seen in Figure 2, the words "habitat," "territories," and "tundra" are bolder than the rest of the text, indicating that they are important and should be highlighted.

Redundancy Principle

The principle of redundancy in Khan Academy Kids is applied to several features/activities in it, one of which is as shown in Figure 3 below.

Figure 3. Redundancy Principle

The principle of redundancy is applied in explaining material without repeating the same information in the elements used. As in Figure 3, where the character explains parts of the book with audio narration, then the book image beside it complements the explanation. When the character explains a section of the book, the illustrator points to that section, and the illustrator's writing on the side supports the explanation without repeating what has already been explained.

Spatial Contiguity Principle

The principle of spatial contiguity in Khan Academy Kids is applied to several features/activities within it, one of which is shown in Figure 4 below.

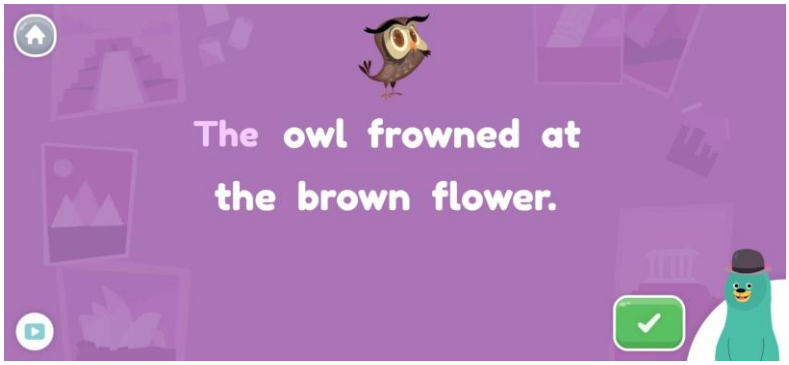

Figure 4. Spatial Contiguity Principle

The principle of spatial continuity is applied by placing text close to the image. As in Figure 4 where the writing is placed under the image of an owl.

Principle of Temporal Contiguity

The principle of temporal contiguity in Khan Academy Kids is applied to several features/activities within it, one of which is shown in Figure 5 below.

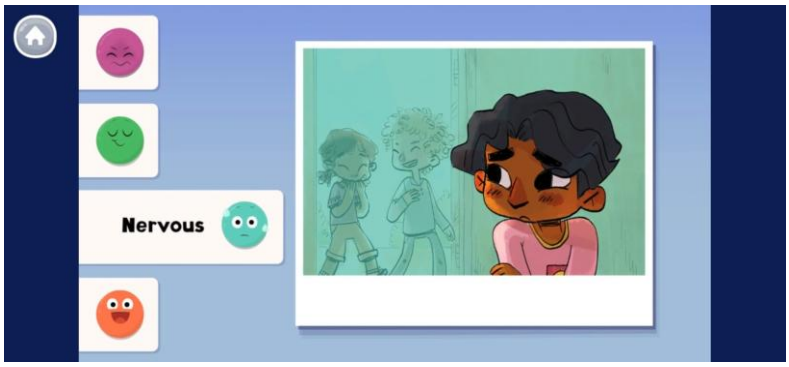

Figure 5. Principle of Temporal Contiguity

The principle of temporal contiguity is applied by simultaneously displaying text and narration. In Figure 5, when the audio mentions "nervous" it is immediately followed by the appearance of text and the expression "nervous".

Segmenting Principles

The segmenting principle in Khan Academy Kids is applied to several learning materials, one of which is shown in Figure 6 below.

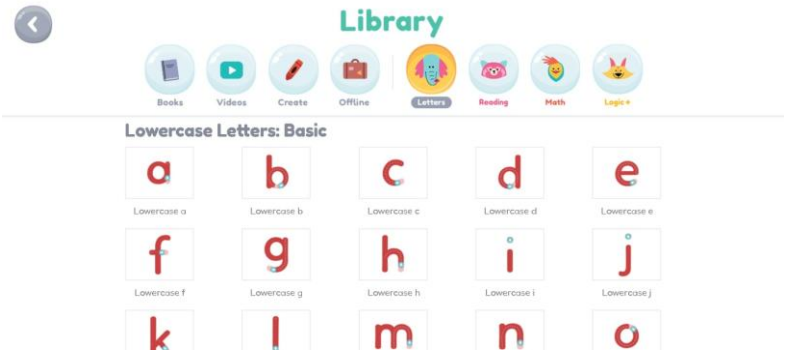

Figure 6. Segmenting Principles

Principle is applied by dividing the material into smaller parts. As in Figure 6, the alphabet material is divided into individual letters, not all letters are studied at once.

Modality Principle

The modality principle in Khan Academy Kids is applied to several features/activities within it, one of which is shown in Figure 7 below.

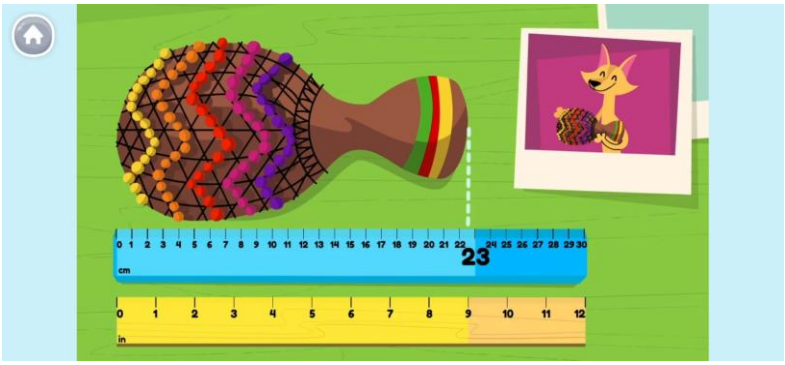

Figure 7. Modality Principle

The modality principle is applied by using oral narrative accompanied by images to explain concepts. Figure 7 explains the concept of measuring the length of an object using an oral narrative on how to measure length, accompanied by visual images of maracas and a ruler in inches and centimeters to visualize the explanation.

Multimedia Principles

The multimedia principles in Khan Academy Kids are applied to various features/activities within it, one of which is shown in Figure 8 below.

Figure 8. Multimedia Principles

Multimedia principles are applied by combining several elements simultaneously. For example, Figure 8 combines the text "Water," an image of water, and the sound of the character pronouncing the word "water."

Personalization Principle

The principle of personalization in Khan Academy Kids is applied to narratives and texts, one of which is shown in Figure 9 below.

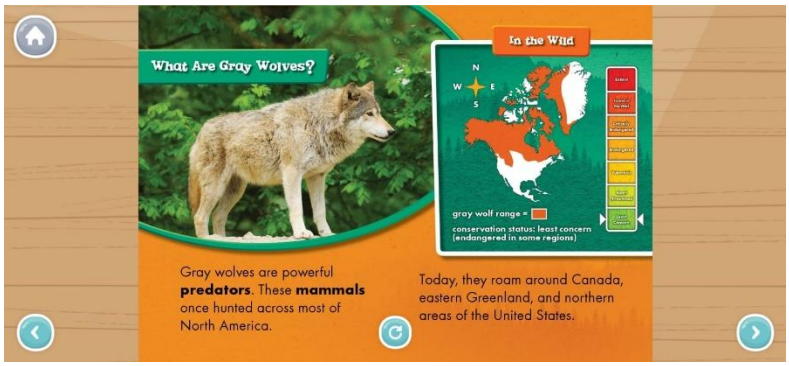

Figure 9. Personalization Principles

The principle of personalization is applied through the use of everyday language, both in text and audio. Figure 9 uses familiar, relaxed sentences like "What are gray wolves?".

Image Principle

The image principle in Khan Academy Kids is applied to various features in it, one of which is as seen in Figure 10 below.

Figure 10. Image Principle

The image principle is applied with natural gestures to explain the material. As in Figure 10, the fox character gestures by raising his hand toward a bird to indicate its position.

Other Analysis Results

User Interface (UI) Design

Khan Academy Kids uses a simple interface design, as seen in Figure 11 below.

Figure 11. UI Khan Academy Kids

As seen in Figure 11, Khan Academy Kids uses a visual display with bright colors and cartoon illustrations. Furthermore, there are not many buttons, and the icons/buttons are kept small enough to remain clearly visible. The layout also appears simple, with few distracting elements.

Gamification

Khan Academy Kids implements gamification in it, as seen in Figure 12 below.

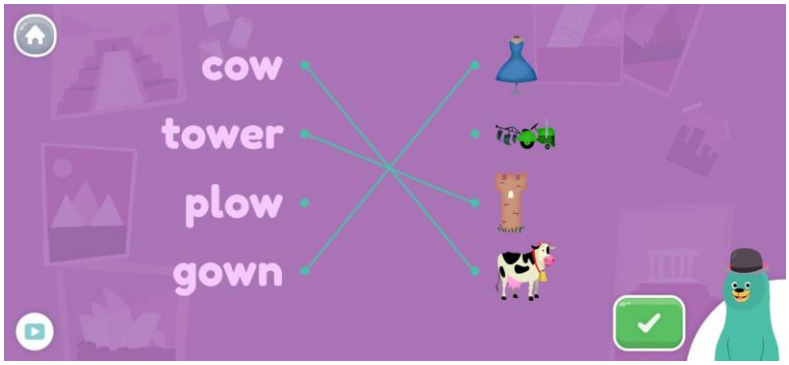

Figure 12. Gamification

As seen in Figure 12, Khan Academy Kids implements gamification by providing various activities such as tapping, matching, and drag-and-drop. It also provides immediate feedback and rewards after children complete activities.

DISCUSSION

Discussion of Mayer's Principle Analysis

Coherence Principle

The principle of coherence explains that children will more easily understand information when the material is presented without irrelevant elements (Mayer, 2009). In the Khan Academy Kids platform, this principle has been implemented by presenting elements such as audio, images, and text that are relevant to the material. This will make it easier for children to absorb information. As explained (Swider-Cios et al., 2023), eliminating irrelevant elements will help the working memory avoid wasted information processing, so that the working memory can focus on processing important information (Paas et al., 2010; Sweller, 2023)

Signaling Principles

The principle of signaling emphasizes the importance of using highlights in message design to highlight information deemed important (Mayer, 2009). This highlighting can take the form of different colors, boldface, lines, symbols, boxes, or arrows to direct children's attention to the highlighted section. Khan Academy Kids applies this principle by bolding text deemed important, allowing children to immediately focus on the essential parts. This highlighting helps eliminate cognitive load, as the brain can immediately identify the most crucial parts without solving visual puzzles (Kirschner et al., 2018).

Redundancy Principle

The principle of redundancy explains that learning media does not need to present the same information in the elements used (Mayer, 2009). Because there is repetition that occurs in each element, such as displaying the exact same text as the narrative, it will be difficult for children to absorb information. In Khan Academy Kids, interrelated elements are used, such as narration explaining parts of the book supported by visuals of the book with the title and other parts usually found on the book cover. This is done to avoid repetition, where visuals are used to support the

narrative so that information can be more easily absorbed by children. Because through this intervention, working memory can integrate information more efficiently without information processing congestion on one sensory channel (Sweller et al., 2011).

Spatial Contiguity Principle

The principle of spatial contiguity explains that children will understand material more easily when related text and images are placed close together (Mayer, 2009). Khan Academy Kids also applies this principle by presenting text and images close together. Placing text and images close together helps children understand information more easily because they can connect the information they receive directly (Clark & Paivio, 1991). If visual elements are placed far from the text, it will result in a split-attention effect, forcing children to expend mental energy searching for and matching connections between the text and images.

Principle of Temporal Contiguity

The principle of temporal contiguity explains that children learn more effectively when narrative (audio) and related visuals are presented simultaneously (Mayer, 2009). For example, in Khan Academy Kids, when explaining material, visuals in the form of images and text are displayed simultaneously. When information is presented simultaneously, children can directly connect what they hear and see, making it easier for them to process the information and build understanding of the material (Sadoski & Paivio, 2013).

Segmenting Principles

The principle of segmentation explains that children will more easily understand learning when material is presented in several small sections (Mayer, 2009). For example, Khan Academy Kids divides material into alphabetical sections. This is done to facilitate learning by allowing children to adjust to their own pace. Providing breaks between segments is an intervention that gives working memory time to consolidate information before moving on to the next concept, effectively preventing the buildup of intrinsic load (Sweller, 2023).

Modality Principle

The modality principle explains that children will more easily understand material when information is presented in the form of images accompanied by sound, compared to images accompanied by text (Mayer, 2009). Khan Academy Kids also applies this principle by presenting images accompanied by audio narration. This relates to the view that humans process information through two main channels: visual and auditory. Through this intervention, the processing load is distributed proportionally to the visual channel for processing images and the auditory channel for processing verbal explanations. This approach is effective in optimizing available working memory capacity, allowing essential processing to occur optimally without creating congestion in one sensory channel (Clark & Paivio, 1991).

Multimedia Principles

The multimedia principle explains that children learn better through a combination of words and images than through words alone (Mayer, 2009). Khan Academy Kids applies this principle, presenting information not only with text but also with images. This is done to facilitate children's reception and processing of information. The child's cognitive system is forced to provide information in verbal and visual cognitive representations simultaneously. This process will encourage children to form functional relationships between the two representations to achieve comprehensive understanding (Clark & Paivio, 1991).

Personalization Principle

The principle of personalization explains that children tend to learn more effectively when the language used in learning media is communicative and resembles everyday conversation (Mayer, 2009). Khan Academy Kids also applies this principle by using communicative, everyday language in both the narration (audio) and text. This is done to create a more engaging and interactive learning environment. The use of familiar and easy-to-understand language can improve children's understanding of the message (Li et al., 2025).

Image Principle

The image principle explains that the presence of teacher images in learning media does not always increase children's understanding (Mayer, 2009). Under certain conditions, these images can actually distract children and increase their cognitive load. It's best to display relevant images and natural gestures so children can effectively absorb and interpret the information (Li et al., 2025). Khan Academy Kids also applies this principle, where images of teachers are omitted and replaced with animated characters that can provide gestures appropriate to the context being studied. For example, a raised hand gesture indicates a position above, a thumbs-up gesture indicates appreciation, and so on.

Other Analysis Discussion

User Interface (UI) Design

User Interface (UI) design significantly impacts a child's comfort and their ability to receive messages/information. The User Interface (UI) used in Khan Academy Kids features a simple design. It features brightly colored visuals, a limited number of distracting elements, and clear icons. This design facilitates student learning and minimizes cognitive load (Amallia et al., 2025). This user interface design is closely related to Cognitive Load Theory, which states that excessive elements unrelated to the message/material can trigger cognitive load (Swider-Cios et al., 2023). This is because children will be busy processing unnecessary information, resulting in suboptimal information reception.

Gamification

Khan Academy Kids also incorporates gamification elements. It features numerous interactive activities that engage children. Furthermore, Khan Academy

Kids offers rewards and immediate feedback after completing an activity. This gamification element facilitates children's learning and creates a more active and enjoyable learning experience (Dichev & Dicheva, 2017). Furthermore, gamification is tailored to the characteristics of children aged 2-8, where learning is facilitated through play (Curiel, 2023).

CONCLUSION

Based on the analysis results on the Khan Academy Kids platform, it can be concluded that this platform applies Mayer's multimedia principles. These principles are applied to create learning media that are not only interesting but also the information in it can be well received by children. Although not all Mayer principles are applied, the principles that are applied are in accordance with the goals and target users of the platform. In addition to Mayer's multimedia principles, this platform also applies gamification elements and a simple user interface to create active and fun learning, and minimize cognitive load on children. Overall, this platform can be said to be effective in supporting the learning process for early childhood, because it is able to combine multimedia with various interactive activities, and create an active and fun learning experience.

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